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The Effect of Geographical Inquiry Learning Using SETS Approach to Complex Problem-Solving Abilities on Environmental Conservation Material

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Abstract

This study aims to determine the effect of the geographical inquiry learning model with the SETS approach on complex problem-solving abilities. The hypothesis in this study consists of H0 (There is no difference in the effect of the geographical inquiry learning model with the SETS approach on the students' CPS abilities) and H1 (There is a difference in the effect of the geographical inquiry learning model with the SETS approach on the students' CPS abilities). The research used quasi-experimental research with a pre-posttest control group design and Independent Sample T-Test from the results of the N-Gain Score as data analysis. The population in this study was the Class XI Social Sciences in high school level in the odd semester of the 2021/2022 academic year at MAN Kota Batu, Indonesia, using a purposive sampling technique. The research subjects consisted of 70 students (35 students in the experimental group and 35 in the control group). The research was carried out in the study of Geography, with the subject matter of Environmental Impact Analysis. The results of the Sig (2-tailed) showed a score of 0.000 < 0.05. The experimental class had an average score of 85.06 for CPS abilities, higher than the control class's 71.2. According to the findings, the geographical inquiry learning model with the SETS approach greatly impacts CPS abilities. This research proves that the geographical inquiry learning model with the SETS approach positively affects complex problem-solving abilities following the 21st-century learning objectives.

Keywords: Geographical inquiry learning, SETS approach, complex problem-solving abilities, environmental conservation materials

Introduction

The development of the world in the 21st-century influences aspects of learning, including geography. Partnership for 21st Century Learning (P21) has developed a learning design in the 21st century that constrain students to own 4C skills (Communication, Collaboration, Critical Thinking and Problem Solving, Creativity and Innovation) (Trilling & Fadel, 2009). In the context of 21st-century geography learning, learning activities are directed at the practice of thinking geographically, geographical research, and problem-solving (Hadi, 2020; Rutherford, 2015). Learning activities are more directed to student-centered learning.

Learning Geography in the 21st century aims to improve Geography skills, including knowledge, skills, and attitudes. Teachers must create effective learning for students (Putra et al., 2021). One of the efforts that one can make is to apply an appropriate learning model. Determining the use of learning models in the classroom is the main factor in achieving learning objectives (Sun et al., 2018). An effective learning model is geographical inquiry learning.

Geographical inquiry learning is a learning model designed to teach geographical thinking skills. This learning model relates to physical and social geosphere phenomena (Handoyo et al., 2017) with five stages of activities, including asking, collecting, visualizing, creating, and acting (Cassandra, 2017). Geography literacy creates active and informative students about problems in the surrounding environment (Maddox et al., 2018). Students are directed to examine the surrounding problems in-depth to answer their curiosity.

The geographical inquiry learning model is still relatively new and has not been studied much. The primary purpose of this learning model is to focus students on studying geosphere phenomena through spatial thinking processes (Carroll, 2018). This learning model can stimulate students to relate complex components and understand the relationships in the surrounding environment (Chang & Kidman, 2018).

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However, this model has weaknesses in its application; among others, it requires careful preparation from the teacher because its implementation requires much time (Davies et al., 2020). The complexity of thinking activities at each stage also makes students less understand the boundaries of the thinking process, especially when formulating geographic questions and analyzing the data obtained. In addition, an appropriate learning design is also needed due to differences in student learning habits (Casinader & Kidman, 2018; Utami et al., 2021). This learning model has drawbacks, but the researchers covered the shortcomings with the SETS approach.

SETS is a learning approach that combines science, environment, technology, and society. The SETS approach presents contextual learning material (Riwu et al., 2018) and is related to the community's life around students, so it is easy to understand its interrelationships (Hastuti et al., 2020). SETS in learning Geography can help students understand complex geosphere phenomena (Zahra et al., 2019). This approach aims to equip students with scientific knowledge, technology, and the environment to take appropriate decisions and actions regarding problems in society (Khasanah, 2015). In addition, this approach has the advantage of allowing students to have comprehensive reasoning and thinking abilities when they are faced with a problem to solve (Hastuti et al., 2020). SETS in geography learning can be combined with the geographical inquiry learning model to achieve the desired learning objectives.

The geographical inquiry learning model is new in learning geography using the SETS approach. The geographical inquiry learning model and the SETS approach are linked by implementing numerous syntaxes in the geographical inquiry learning model that employs the SETS approach, especially the asking and creating phases. The learning model can condition students to think geographically (Kuisma, 2018) and discuss based on the elements of SETS (Zahra et al., 2019). This process will make it easier for students to analyze various studies in learning Geography directed (Azkiyah, 2020), especially the characteristics of Geography material that require complex studies.

Geography, especially natural resource management about environmental conservation, requires a complex study. Studies on natural resource management as meeting human needs are broad (McKinley et al., 2017). An in-depth study is needed in studying this material because it is directly related to phenomena and aspects of environmental sustainability (Ladawan et al., 2017). Especially in the 21st century development period, environmental issues related to natural resources are discussed globally (Martine & Alves, 2015). Various efforts to utilize natural resources that are carried out often do not use the principles of sustainable development, giving rise to various complex environmental problems (Satmaidi, 2017). Explicitly requires students to have complex problem-solving (CPS) abilities. However, most students in learning activities only listen to the teacher's explanation, so students' CPS abilities are less developed (Mulyono & Wekke, 2018).

CPS is the ability to solve complex problems in real life. CPS describes the whole thinking process in overcoming a complex problem (Greiff & Fischer, 2013). One of the skills required for 21st-century geography study is CPS (Kunze et al., 2018). Characteristics of learning Geography, which raises many contextual problems in the environment around students (Hindriyanto et al., 2019; Yli-Panula et al., 2020); thus, students need to have qualified CPS abilities. CPS is part of the 21st-century skills that students must possess, but it is rarely implemented as a goal in learning activities (Greiff et al., 2013), including in geography learning (Weiss, 2017). In addition, students' CPS abilities are also still low due to a lack of opportunities to improve and develop problem-solving skills (Asfar et al., 2021). Therefore, we need a learning process to stimulate students to have CPS abilities.

The geographical inquiry learning model with the SETS approach can be an innovation in learning activities. Through these learning activities, students understand the material theoretically and are also directed to solve problems based on the elements contained in SETS with the stages of thinking geographically. In addition, students are also directed to solve problems in the surrounding environment, which makes learning more meaningful. Thus, this study aims to determine the effect of the geographical inquiry learning model with the SETS approach on CPS ability.

Method

Research Design

This study is a Research quasi-experiment with a pre-posttest control group design. The research design is presented in Table 1.

The experimental class will learn using a geographical inquiry learning model with the SETS approach, while the control class will use an inquiry learning model. Each class group was given a pre-test before receiving treatment and a post-test.

Geographical inquiry learning model (independent variable) with SETS approach and complex problem-solving skills (choice variable). In comparison, the control variables consist of students' initial abilities, subject matter, teachers, allocation of learning time, grade level and data collection instruments. Control variables can help control research but

Table 1: Research Design

	Pre-test	*Treatment*	*Post-test*
Experiment Class (E)	O1	X	O2
Control Class (C)	O1	-	O2

Source: (Sugiyono, 2017)

cannot control external variables (foreign variables) that affect the experiment. Implementation of a pre-test to measure the initial ability of research subjects can make the subject sensitive to the research focus, affecting the results of the study (Carlson & Wu, 2012). In controlling the influence of confounding variables, we make different questions between the pre-test and post-test, but the goals achieved are the same.

Participants

The study was conducted at MAN Kota Batu, Indonesia, with Class XI Social Sciences in the odd semester of the 2021/2022 academic year. MAN stands for Madrasah Aliyah Negeri. MAN is a formal education at the high school level in Indonesia with a religious basis. Natural resource management materials with analysis studies on environmental impacts is a material that is taught in the Geography curriculum of senior high schools in Indonesia. The selection of groups used a purposive sampling on the class with an average geography learning outcome equivalent to four Class XI Social Studies. Of the four classes, XI Social Sciences 1 and XI Social Sciences 3 have the same average learning outcomes, specifically 77.9 and 77.6. The results obtained are class XI Social Sciences 3 (n = 35) as the experimental class and class XI Social Sciences 1 (n = 35) as the control class.

Research Implementation Procedure

The research implementation in the experimental class used the syntax of the geographical inquiry learning model (Cassandra, 2017) combined with the SETS approach (See table 2). The control class uses the inquiry learning syntax (Wilson & Murdoch, 2004).

Data Collection Tools

This study used an instrument in the form of essay questions to gather data in line with the CPS ability indicator, which relates to the CPS indicator from Funke & Frensch (2017), as shown in Table 3.

The essay items given are six questions in the pre-test and seven questions in the post-test. The determination of the Score given to each item is adjusted to the level of thinking ability which is measured based on the cognitive level of Bloom's taxonomy with a total score of 100.

The test instrument was tested for validity and reliability with SPSS for windows. This test is important to determine whether the instrument used is appropriate (Rogers & Révész, 2019). The test instrument is given to students who have received natural resource management materials, namely Class XII students of School Science at MAN Batu City for the 2021/2022 academic year. Instrument validation was obtained from the results of the Pearson product-moment correlation with a significance (Sig 0.05). The results of instrument validation with n = 40 (0.003), the instrument is interpreted as valid. Then, the reliability test (alpha Cronbach), the result is 0.6 (0.714) the instrument is declared reliable.

Data Analysis

The procedures applied not only on the experimental group(s) but also on the control group(s) should be explained.

Tabel 2: Experimental Class Student Activities

Syntax	*Learning Approaches*	*Student Activities*
Ask	SETS	Develop skills in compiling geographic questions that focus on one particular problem/topic obtained from observations/literacy on the environment and social behavior of the surrounding community.
Collect	Scientific	It is collecting data to answer geographic questions that have been compiled by utilizing various sources of information both digitally and non-digitally.
Visualize	Scientific	Organize the data that has been collected by visualizing it in the form of tables, graphs, pictures, videos, and maps.
Create	SETS	Investigate answers to geographic questions that have been compiled based on information collected by taking into account the interrelationships that occur between science, environment, technology, and society to solve problems appropriately.
Act	Scientific	Share the results of the investigation that has been made and share it into action. This stage guides students to explore each stage carried out from beginning to end.

Table 3: Complex Problem Solving Ability Indicator

Indicator	*Description*
Experience	Ability to find problem issues based on experience and data/information search results
Cognitive Variables	Ability to describe complex issues
Noncognitive Variables	Ability to take real action in the problem-solving process
Problem Structure	Ability to solve problems sequentially
Problem Context	Ability to understand the intricacies of the problem
Environmental Factors	Ability to solve problems by correlating environmental factors

Source: (Funke & Frensch, 2017)

Data analysis used normality test, homogeneity test, and hypothesis testing through the SPSS program. Normality test (Kolmogorov-Smirnov) with a significance level of 0.05. Homogeneity test (Levene) for the variance equation with a significance level of 0.05. While the hypothesis test (T-test) of the gain score. The N-Gain Score is used to determine the difference in the increase (effectiveness) of the learning model implemented in the learning process in the classroom. Decision-making was based on the category of N-Gain effectiveness interpretation can be seen in Table 4.

The t-test was used to compare whether there was a difference (significant) in effect between the experimental class and the control class. If the data are not normally distributed and homogeneous (Mann Whitney). The hypotheses in this study are:

H_0: There is no difference in the effect of the geographical inquiry learning model with the SETS approach on the CPS abilities of the experimental class and control class students.

H_1: There is a difference in the effect of the geographical inquiry learning model with the SETS approach on the CPS abilities of the experimental class and control class students.

The decision-making criteria of the t-test with a significance level of 5% (2-tailed) (Sig. 0.05) and the average value of the experimental class > control class, then H_0 is rejected. Meanwhile, if the value of Sig. > 0.05 and the average value of the experimental class < control class, then H_0 is accepted.

Findings

Table 5 shows the difference between the experimental and control classes' post-test results, with the experimental class's post-test average value being higher than the control classes.

Assumption Test

A normality test was conducted to determine the data were normally distributed or not. Table 6 shows the results of the data normality test.

Table 4: Category Interpretation of N-Gain Effectiveness.

Percentage (%)	Interpretation
<40	Ineffective
40 – 55	Less effective
56 – 75	Effective enough
>76	Effective

Source: (Hekke, 1999)

Based on the output above, the significance value of the Kolmogorov-Smirnov test in the experimental and control classes is > 0.05. The research data were normally distributed. Meanwhile, the data homogeneity test results can be seen in Table 7.

Table 7 shows the significance value (Sig.) Based on the mean of 0.274 > 0.05, it can be concluded that the data variance is the same (homogeneous).

Hypothesis Testing

Hypothesis testing is carried out to answer whether H^0 is accepted or rejected. On each indicator of CPS ability, the average value of the pretest-posttest from the experimental and control classes was first tested for the N-Gain Score. The results were then analyzed using the independent sample t-test, seen in Table 8.

The significance value for all indicators is < 0.05, and the overall results of the N-Gain Score of the experimental and control classes have a significance value of 0.000 < 0.05, with the experimental class's effectiveness of the learning model being better than the control classes. It can be interpreted that the Geographical Inquiry Learning model with the SETS approach has a significant effect on CPS abilities (H_0 is rejected).

Discussion

The implementation of relevant learning models influences the achievement of learning objectives. Geographical inquiry learning is a model that directs students to apply geography skills through investigation. Geographical inquiry is part of inquiry learning (Kuisma, 2018). When combined with inquiry-based learning, approaches in the discipline of geography will provide a more effective geography learning process (Casinader & Kidman, 2018). Investigation-based learning follows the characteristics of geography, which is that studying a phenomenon is always based on a spatial,

Table 5: Descriptive Analysis of the Average Value of the Experimental Class and Control Class

	N	*Min*	*Max*	*Mean*	*Std. Deviation*
Pre-test Experiment Class	35	45	81	60.20	10.781
Post-test Experiment Class	35	71	100	85.06	7.757
Pre-test Control Class	35	42	74	60.17	7.980
Post-test Control Class	35	56	95	71.20	9.560

Table 6: Normality test

		Kolmogorof Smirnov			*Saphiro-Wilk*		
	Class	*Statistic*	*df*	*Sig.*	*Statistic*	*df*	*Sig.*
CPS	Experiment class	0.098	35	0.200*	0.961	35	0.253
	Control class	0.115	35	0.200*	0.977	35	0.670

environmental, and complex regional approach (Neighbour, 1992; Rosyida et al., 2019). The differences can be seen from the syntax of each model in Table 9. Integrating them into inquiry-based learning will make learning more meaningful (Casinader & Kidman, 2018).

Table 9 shows the stages of the geographical inquiry learning model, and the inquiry learning is the same. The significant difference lies in the first and third syntax of the geographical inquiry learning model. In the inquiry learning model, the activities of formulating problems are generally carried out based on students' knowledge. Meanwhile, in the geographical inquiry learning model, problem formulation activities are carried out by emphasizing geographical thinking. Geographic thinking is the ability to study, ponder, conclude, and apply ideas to a problem topic in a way that is specific to geographic problems (Metoyer & Bednarz, 2017). In addition, in the third stage of the geographical inquiry learning model, students were asked to visualize data that this stage did not contain in the syntax of the inquiry learning model.

The good and the bad of the CPS ability also depend on students' understanding of the taught material. Geography material, especially environmental problems, requires a complex understanding of concepts to solve them (Dia et al., 2021; Putra, Sumarmi, Fajrilia, et al., 2021). A learning model that emphasizes the process of inquiry based on a spatial perspective can guide students in understanding and solving environmental problems. According to the learning model, the determination of material will affect the results obtained (Andrini, 2016).

Learning activities using a geographical inquiry learning model with the SETS approach positively affect students' CPS abilities, as evidenced by the results of hypothesis testing (T-Test). Table 5 shows the value of Sig. of 0.000 < 0.05, it can be concluded that H_0 is rejected and H_1 is accepted, which means that the geographical inquiry learning model with the SETS approach affects the ability of CPS. Testing the hypothesis on each indicator of CPS ability statistically also showed significant results > 0.05. The interpretation of the results can be seen in the relevance of the stages of geographical inquiry learning and indicators of CPS abilities because each stage emphasizes students' reasoning abilities in the learning process (Cassandra, 2017).

Using the SETS approach, the geographical inquiry learning model can help students have good CPS skills. In its application, students collaborate to investigate environmental problems using natural resources with sustainable principles through

Table 7: Homogeneity Test

		Lavene's Statistic	*df1*	*df2*	*Sig.*
CPS	Based on mean	1.215	1	68	.274
	Based on median	1.201	1	68	.277
	Based on median and with adjusted df	1.201	1	63.974	.277
	Based on trimmed mean	1.192	1	68	.279

Table 8: Independent Sample T-test Result of N-Gain Score Indicator of CPS Ability

		N-gain Score (%)				
Indicator	*Ideal Score*	*Experiment Class*	*Classification*	*Control Class*	*Classification*	*Sig.*
Experience	5	93.18	Effective	30.43	Ineffective	0.000
Cognitive variables	25	48.17	Less effective	11.51	Ineffective	0.008
Noncognitive variables	15	64.28	Effective enough	26.72	Ineffective	0.006
Problem structure	20	87.96	Effective	47.05	Less effective	0.005
Problem context	20	84.66	Effective	52.36	Effective enough	0.018
Environmental Factors	15	60.86	Effective enough	29.03	Ineffective	0.024
	100	59.47	Effective enough	25.93	Ineffective	0.000

Table 9: Comparison of Syntax Inquiry Learning Models (Wilson & Murdoch, 2004) and Geographical Inquiry Learning (Cassandra, 2017)

Inquiry Learning	*Geographical Inquiry Learning*
Orientation (turning in)	Composing geography questions (ask)
Formulating the problem (finding out)	Collecting data (collect)
Collecting data (sorting out)	Visualizing (visualize)
Analyzing data (going further)	Creating (create)
Formulating conclusions and taking action (make a conclusion and taking action)	Taking action (act)

a series of scientific investigations (Irawan et al., 2021). A collaborative process can increase students' skills in solving real-life problems (Samson, 2015). Stages of student learning activities begin with asking. This activity directs students to develop skills in compiling geographic questions based on a SETS approach covering science, environment, and society. Students and groups prepare geographical questions focusing on specific issues obtained from observations of the environment (environment) and the social behavior of the surrounding community (society). Topics studied by students include land-use change, damage to springs, and development project plans in the use of natural resources for tourism development.

The asking activity above encourages students to find environmental issues following one of the indicators of CPS ability, namely experience. This is evident from the T-test results showing a significant effect of the experience indicator with the sig value of 0.000. Activities at the asking stage can stimulate students to find problems based on the experience they have gained. The ability of students to formulate or formulate geography questions in learning will indirectly increase their ability to examine problems in the surrounding environment (Casinader & Kidman, 2018).

The stages of student learning activities are continued with collecting activities. Students collect data to answer geography questions by utilizing various sources of information, both digitally (searching online articles/journals, news, data/maps from relevant agencies such as land use maps, and google earth to study the landscape of the area being studied) and non-digital (observation of the environment and community social activities related to the topic of the problem). This activity aims to train CPS skills, especially in the problem context's fifth indicator. By collecting data, students will be able to explicitly understand the intricacies of the content of the problem based on the series of information that has been obtained (Tayeb, 2017). 0.018 > 0.05 is a significant result for the problem context indicator.

The third stage of learning activities is visualizing. Students organize the data that has been collected in the form of tables, graphs, pictures, and maps to make it easier for students to comprehend the environmental issues being studied. This activity aims to clarify students' understanding of the environmental problems raised to understand the problems in a more structured manner. Organizing ideas in visual form can train students to manage the information they already have (Wardika et al., 2017). The problem structure, which has a substantial influence of 0.005, is followed by the CPS capability indicator. The students' data organizing is carried out in tables, graphs, and maps.

After that, the learning activities go on to the fourth stage, creating. Students and groups analyze the data obtained to answer geography questions based on the information collected to solve problems correctly. In the data synthesis process, the SETS approach is used to direct students to link the reciprocal relationship between scientific knowledge they have (science), technological developments, and aspects of the environment (environment) and the social life of the surrounding community (society) so that they can take appropriate decisions and actions regarding the environmental problems being studied (Khasanah, 2015). This activity explicitly stimulates students' CPS abilities on indicators of cognitive variables and environmental factors that get Sig. of 0.008 and 0.024 <0.05. Data analysis activities can assist students in determining the best solution strategy for a problem, allowing them to choose and develop problem-solving skills (Karatas & Baki, 2013; Mahanal et al., 2019).

The last stage of learning activities is acting. Students and groups present the results of the investigations carried out while reflecting on various problem-solving efforts. In this activity, students can train their CPS skills on indicators of noncognitive variables that get Sig. of 0.006 < 0.05. Reflection activities aim to deepen and dig up information to strengthen the existing problem-solving efforts (Miller & Maellaro, 2016) to obtain the most appropriate problem-solving efforts.

The stages of activities in the geographical inquiry learning model using the SETS approach positively influence students' CPS abilities. The stage assumed to be the most influential is the create stage. This stage can implicitly train all indicators on CPS ability. Because, at this stage, it is a core activity where students synthesize data to obtain appropriate problem-solving efforts (Utami et al., 2021). So that students will tend to use all their CPS abilities in order to obtain maximum results. The indicator of CPS ability which is assumed to have the most significant influence is the experience indicator. Experience is the initial indicator used in students' CPS abilities, so students should master this indicator to have CPS abilities.

Table 8 shows that the N-Gain Score of the experimental class has a percentage of 59.47% and the control class of 25.93%. It can be interpreted that the geographical inquiry learning model with the SETS approach has better effectiveness on CPS abilities than the Inquiry learning model. This is also supported by previous research, which examined the geographical inquiry learning model.

The geographical inquiry learning model positively affects critical thinking and problem-solving skills with Sig. 0.017 and 0.006 < 0.05 (Utami et al., 2021). This learning model is effective in supporting the geography learning process (Utami et al., 2021); students are directed to study the surrounding environmental problems related to natural resource management by focusing on their geographic capabilities (Irawan et al., 2021) and examining them by linking elements contained in SETS (Eliyanti et al., 2019). The geographical inquiry learning model requires students to explore, analyze, and take action based on things found directly or due to

literacy (Casinader & Kidman, 2018b; Kuisma, 2018). Thus, students' complex problem-solving abilities can be built.

Conclusion

The results significantly affected the geographical inquiry learning model with the SETS approach on students' complex problem-solving abilities. The significance value on the T-test is 0.000 < 0.05, so it can be interpreted that H_0 is rejected and H_1 is accepted. The N-gain score test also shows that the geographical inquiry learning model with the SETS approach has better effectiveness than the inquiry learning model, with 59.47% in the experimental class and 25.93% in the control class. The geographical inquiry learning model emphasizes the process of inquiry with a spatial perspective that can help students understand environmental problems. Integrating SETS in the geographical inquiry learning model can make it easier for students to carry out complex thinking processes in the investigation process

Suggestion

The author recommends the geographical inquiry learning model with the SETS approach applied in geography learning. However, its application will produce optimal output if carried out for a long time and is continuous.

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Limitation

This study found several obstacles, including those related to the research's minimal time. The time limitation in this research is because the researcher has to adjust to the semester program that has been prepared at the research location. This is one of the obstacles considering that applying the geographical inquiry learning model has the disadvantage of requiring much time while students are faced with learning activities with scientific thinking processes. So that by integrating the SETS approach into the geographical inquiry learning model can be a solution to overcome these weaknesses because students' thinking processes become more focused. The second obstacle is the Covid-19 pandemic which has resulted in the implementation of Limited Face-to-face Learning so that the implementation of learning must be carried out semi-online. It causes the learning process to not run optimally because of limitations for researchers to control learning for students with online learning. The third obstacle is that the CPS ability test is conducted online using Google Form. Using it can have an impact on students not understanding the questions. To minimize it, the researcher facilitates students to ask questions outside of class hours by utilizing digital platforms such as WhatsApp and google meet.

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