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GROWTH OF CRITICAL THINKING ABILITY IN MIDDLE-SCHOOL STUDENTS: OVERVIEW OF DISCOVERY LEARNING MODEL

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ABSTRACT

This study aims to elucidate the impact of the Discovery Learning model on the critical thinking skills of junior high school students in the eighth grade. This investigation employs a quantitative approach, specifically a quasi-experiment. We conducted this investigation in class 8 of Public Middle School 2 Candi Sidoarjo, utilizing both an experimental and a control group. The results of the data analysis and discussion indicate that teacher activities in social studies learning meet the criteria for both the experimental group and the control class and that student activities in improving students' critical thinking skills in the experimental group are better than the control class. Additionally, at a significance level of 5% (0.05), we observe a significant influence or difference in student responses, with a p-value of 0.000. Therefore, we can conclude that the Discovery Learning learning model significantly influences students' critical thinking skills about the geographical conditions of the ASEAN countries through the atlas, compared to conventional models.

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1. INTRODUCTION

Education is inextricably linked to technology. For instance, teachers instruct students to research the subject matter during class sessions to enhance their cognitive abilities and tackle the challenges they face (Wu et al., 2013). Today's digital era expects teachers to effectively manage, design, or master the class, which includes developing a learning strategy relevant to the material and learning objectives and utilizing information technology (Asad et al., 2021; Biletska et al., 2021; Zimmer & Matthews, 2022). This approach aims to foster increased student engagement in their learning process. According to Permendikbud No. 81 (2013), the ability to communicate, think critically, and be creative are essential skills for students to possess to effectively compete in the future (Formi & Yulhendri, 2021). Preliminary research conducted at Public Middle School 2 Candi Sidoarjo on the capacity of students to think critically when studying social studies in the material geographic conditions of ASEAN countries

through atlases, according to my eighth-grade social studies instructors, is still less active. We also conducted a preliminary study on a random sample of eighth-grade students to evaluate their interest in the material and the teacher's method of instruction.

Under the guidance of a teacher, students use Discovery Learning to solve problems intensively. The tutor in Discovery Learning instructs students to respond to or resolve a problem. Discovery learning is a learning model that necessitates instructors to identify additional novel concepts to establish a state in which students can actively seek and acquire knowledge (Ozdem-Yilmaz & Bilican, 2020; Yerimadesi et al., 2023). Discovery learning is a critical element of contemporary constructivist methodologies that have a rich history in innovation education. Discovery learning focuses on students' learning success through active engagement with concepts and principles (Darmaji et al., 2022). Teachers encourage students to undertake experiments and engage in experiences that allow them to independently discover principles.

As stated by Marisya & Sukma (2020), the Discovery Learning model is a teaching method that regulates teaching in a manner that allows children to acquire knowledge that they have not yet acquired through notification, partially or wholly discovered themselves. Ozdem-Yilmaz & Bilican (2021); Palinussa et al. (2023) implements the following stages in the discovery learning process: 1) stimulus or stimulation, 2) identification of problems, 3) data acquisition, 4) data processing, 5) verification, and 6) concluding.

The capacity to consider rationally and reflectively by beliefs is known as critical thinking (Elder & Paul, 2020; Southworth, 2022; Ellerton, 2023). We use critical thinking to respond to a thought or theorem that we embrace. Bean & Melzer (2021); Leão & Ferreira (2022) define critical reasoning as critical thinking is an intellectual process that involves the development of concepts, application, analysis, synthesizing, and/or evaluation of a variety of information derived from observations, experiences, and reflections. The outcomes of this process are then used as a foundation for action.

Additionally, Allen et al. (2004); Rubenfeld & Scheffer (2006) assert that seventeen dimensions can demonstrate critical thinking activities, including: 1) analyzing, 2) applying standards, 3) discriminating, 4) seeking information, 5) making logical arguments, 6) predicting, 7) transforming knowledge, 8) confidence, 9) contextual perspective, 10) flexibility, 11) creativity, 12) curiosity, 13) intelligence honesty, 14) intuition, 15) open-mindedness, 16) persevering, and 17) reflection.

We must resolve the issues mentioned earlier to enhance or develop students' critical thinking and skills. One approach to resolving this issue, among others, is to identify appropriate learning techniques that promote the development of students' critical thinking skills, specifically through the implementation of Discovery Learning. When given an assignment, this model can provide students with the flexibility and freedom to explore and develop their ideas, facilitating the expression of ideas and enhancing comprehension (Druckman & Ebner, 2018; Salem, 2019; Pramesti et al., 2022).

The goal of this study is to investigate the impact of the Discovery Learning model on the critical thinking abilities of students in Public Middle School 2 Candi Sidoarjo

concerning ASEAN countries' geographical conditions. This is based on the descriptions mentioned earlier.

2. METHOD

This investigation employs a quasi-experimental design (pretest-posttest). The study population consisted of 8th grade students at Public Middle School 2 Candi Sidoarjo. The research sample consisted of 67 individuals from classes VIII-A and VIII-B, chosen from a population sample of 8. Class VIII-F, the experimental class that Discovery Learning teaches, is composed of 33 students. There are 33 students in Class VIII-A, the control class that follows conventional learning. This investigation employed critical thinking skills test sheets (TKBK) and observation sheets as data collection instruments. Ten questions in the TKBK test instrument focused on the geographic conditions. During the lesson, both the teacher and the students use the observation document to monitor their activities. A team of experts, including two lecturers and one Social Studies teacher, validated the TKBK test instrument and observation document before conducting the research. In medium and high categories, they declared the TKBK test instrument valid. We also administer TKBK description test items to students to assess the instrument's reliability and validity. We test these items independently of the research subject. You can use the product-moment correlation formula, as shown below, to assess an item's validity (Humphreys et al., 2019).

$$r_{xy} = \frac{n\sum_{i=1}^{n} x_{ij}y_i - \left(\sum_{i=1}^{n} x_{ij}\sum_{i=1}^{n} y_i\right)}{\sqrt{\left\{n\sum_{i=1}^{n} x_{ij}^2 - \left(\sum_{i=1}^{n} x_{ij}\right)^2\right\}.\left\{n\sum_{i=1}^{n} y_i^2 - \left(\sum_{i=1}^{n} y_i\right)^2\right\}}}$$

Furthermore, we categorize and match the calculation results with the formula below to determine the level of improvement in the pretest (TKBK) and posttest (TKBK) results, followed by an interpretation. Next, we use the Alpha-Cronbach test item (Warrens, 2015; Vaske et al., 2017) to calculate the reliability coefficient.

$$r_{11} = \left(\frac{n}{n-1}\right)\left(1 - \frac{\sum_{i=1}^{n}\sigma_i^2}{\sigma_t^2}\right)$$

3. RESULTS AND DISCUSSION

Results

We used the non-parametric Mann-Whitney U test in data analysis to compare the pretest results of TKBK. As a result of the comparison, the TKBK pretest scores of the experimental and control groups did not show any significant differences. We compared the TKBK post-test scores of the experimental and control groups using independent t-tests, which offer parametric testing propositions. Table 1 presents the results of the Mann-Whitney U test for the TKBK pretest scores.

Table 1. Mann-Whitney-U test results of TKBK pretest scores

Test	Group	N	Average	Total	U	P
TKBK	Experimental	33	65.35	2156.55	488.4	0.305
	Control	33	50.55	1668.15		

The hypothesis criteria are as follows: if Tcount > Ttable, we accept hypothesis (H0), and if Tcount > Ttable, we reject hypothesis (H1). The research hypothesis is as follows:

H0: The use of the Discovery Learning learning model at Public Middle School 2 Candi Sidoarjo has no effect on students' critical thinking skills in the material geographic conditions of ASEAN countries.

H1: Public Middle School 2 utilizes the Discovery Learning learning model. Candi Sidoarjo's atlas influences students' critical thinking skills in studying ASEAN countries' geographical conditions.

TKBK

We administer the TKBK test to both courses to evaluate students' critical thinking abilities at the start of the learning implementation process. We administer a test to gauge the improvement in students' critical thinking skills after implementing discovery learning. We administered different learning treatments to the control and experimental classes. The TKBK results, as illustrated in Table 2, indicate that the designed learning significantly enhances students' critical thinking abilities in terms of pretest and posttest scores.

Table 2. Results of TKBK scores

Test	Class	Number of Subject	Highest Score	Lowest Score
Pretest	Experiment	33	45	35
	Control	33	40	30
Post-Test	Experiment	33	80	60
	Control	33	65	40

Table 3 indicates that the student's critical thinking ability was superior when comparing the experimental and control grades to the average attained by students using discovery learning. Next, we conduct the initial analysis to ascertain the normal distribution and homogeneity of the data from the two groups. We then implement the hypothesis test to demonstrate the T value, which we determined from the pretest and posttest data. According to the statistical results, the T count is 15,363, and the T table (N-2) is 1,695. Given that Tcount exceeds T table, we can deduce that the student's critical thinking skills surpass those of their conventional learning counterparts in the control grade, thereby accepting (H1) and rejecting (H0). The posttest values of the students provide evidence of this. Students who meet the criteria for classical completion are demonstrated. In classical education, students achieve more than 70% of their learning completeness.

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Table 3. N-Gain results of TKBK post-test

N-Gain	Criteria
(<g>) ≥ 0,70	80,75%
0,30 ≤ (<g>) < 0,70	19,25%

For students in the experimental grade, the average N-Gain value is 80.75 percent greater than or equal to 0.07. It is possible to assert that the control grade is 67% greater than or equal to 0.3.

Observations

The Discovery Learning model's stages, along with descriptive presentations, guide the implementation of this learning process. The teacher initially presents students with a confusing situation, then instructs them to refrain from making generalizations, thereby fostering a desire for self-exploration. In addition, the teacher can initiate the activity by posing questions, promoting book reading, and engaging in other learning activities that foster problem-solving skills.

Following the stimulation phase, the teacher allows students to pinpoint numerous agendas pertinent to the topic, then selects one and formulates it into a hypothesis. Next, they formulate it into questions or hypotheses, which are essentially statements that serve as temporary answers to the questions posed. This process allows students to identify and scrutinize the problems they face, thereby cultivating a habit of problem-solving.

Furthermore, in the exploration phase, the teacher allows students to gather as much information as is relevant to prove whether or not the hypothesis holds. During this phase, students actively search for connections to the current problem, unintentionally linking it to their existing knowledge. Students are in the process of analyzing and interpreting the data and information they've gathered from interviews, observations, and other sources.

Moreover, during the proof stage, students meticulously scrutinize the hypothesis, comparing it to alternative findings, to establish its connection to the data processing outcomes. And the last stage is a generalization. In the activity, the teacher guides students to make a conclusion based on the findings obtained during learning.

Discussion

Through personal experience, discovery learning seeks truth. Students can use it to solve problems and identify concepts (Ozdem-Yilmaz & Bilican, 2020). The implementation of discovery learning models correlates with students' engagement. According to Abrahamson & Kapur (2018); Almulla (2023), the discovery learning paradigm has the potential to enhance students' intellectual capacity, thereby fostering new aspirations for success. Additionally, students will acquire the ability to organize and resolve issues, as well as to identify solutions to their issues. Teachers must take into account the presence of a variety of advantages and disadvantages when implementing the discovery learning model. Therefore, the implementation must align with the unique characteristics of the students.

Teachers teach students to think critically by observing tangible objects, enabling them to identify an object's principles and concepts (Brookfield, 2011). At this stage, the teacher can encourage students to think critically by posing queries that prompt them to do so. Activities go through an information processing stage that aligns with the syntax of discovery learning. Students discuss the results of their experiments with their peers. In discussions, students can exercise critical thinking skills by expressing their opinions and exchanging ideas (Foo, 2021; Bean & Melzer, 2021). Therefore, the teacher's responsibility at this juncture is to encourage students to participate in the discussion. In the control class, the teacher distributes papers for literature studies, which serve as data collection activities instead of actual objects. The reading activity in the handout can positively impact students' critical thinking skills. Students can cultivate critical thinking skills through printed teaching materials and discussion (Brookfield, 2011; Lu, 2021). By reviewing the handout, students acquire material that can serve as a basis for the analysis of an idea.

Based on research results, for students in the experimental grade, the average N-Gain value is 80.75 percent greater than or equal to 0.07. It is possible to assert that the control grade is 67% greater than or equal to 0.3. Furthermore, during the data processing phase, students communicate their ideas or opinions to their peers, which can subsequently facilitate their comprehension of a concept. The discussion offers an occasion for all students to articulate their thoughts (Brookfield & Preskill, 2012). Students subsequently analyze the collected data, leading to the conclusion stage. The discovery model employs an inductive reasoning approach, which entails students formulating conclusions through experiments and observations (Lawson, 2010; Brookfield, 2011). The students subsequently present the results of the group discussion. Constraints during discussion activities arise when active students exclusively dominate the activities or when students who listen to presentations do not respond. The presenter and participants may not interact, making learning monotonous. In this instance, the instructor encourages students to engage in physical activity.

Some students were aggressively dominating the discussion activities, while others were less active in conveying their ideas. To prevent the discussion from having a minimal number of participants, the teacher must ensure that students actively participate in the activities (Sormunen et al., 2020). The teacher concludes the group and inquires about the challenges encountered by the students. As a result, the teacher poses questions that may generate ideas from all members of the group. The teacher encourages students to engage in discussion activities, which encourages them to actively investigate concepts and issues (Tsai et al., 2020). Discussion activities simultaneously develop and train students' cognitive, affective, and psychomotor abilities. At this juncture, students can refine their social awareness and collaboration skills. Discussions or interactions among students can enhance critical thinking and collaboration abilities (Satriani et al., 2022; Thornhill-Miller et al., 2023). This model facilitates effective learning through its activities. Discovering learning models can substantiate the efficacy of learning (Kumar et al., 2015; Chase & Abrahamson, 2018).

4. CONCLUSION

We summarize this investigation's findings at Middle School 2 Candi Sidoarjo as follows: The experimental grade demonstrated a substantial improvement in students' critical thinking abilities in the application of discovery learning, surpassing that of the control grade. The teacher effectively executes observations and activities, while the students actively engage in social studies through discovery learning. The N-gain of 80.75 percent of pupils was greater than or equal to 0.7, as indicated by the results of their critical thinking tests. Consequently, it is feasible to assert that discovery learning is more effective than learning in the control grade. Therefore, we can infer that, in contrast to conventional models, the Discovery Learning learning model significantly enhances students' critical thinking skills when studying the geographical conditions of ASEAN countries through the atlas.

As a suggestion, the results of this research can support and contribute to learning, especially in social studies. In addition, teachers can utilize discovery learning to enhance students' critical thinking skills.

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