INSPIRE 2024
International Symposium on Global Education, Psychology, and Cultural Synergy

RESEARCH ARTICLE

APPLICATION OF THE GUIDED INQUIRY LEARNING MODEL TO IMPROVE STUDENTS' CRITICAL THINKING SKILLS IN NATURAL SCIENCE SUBJECTS

Nur Efendi [1], Dinda Tia Tinara [1], Sabrina Oktavia Irawati [1], Nabila Indana Zulfa[1]
*Corresponding Author Email: tinaradinda@gmail.com

[1]* Science Education Study Program, University of Muhammadiyah Sidoarjo, Sidoarjo, Indonesia

ABSTRACT

This research aims to improve students' critical thinking skills through the application of guided inquiry learning. This research is Classroom Action Research which was carried out in two cycles. Each cycle consists of four stages: planning, acting, observing, and reflecting. The research subjects were class VII ECP students at SMP Muhammadiyah 1 Sidoarjo for the 2024/2025 academic year, totaling 34 students and consisting of 18 men and 16 women. The data collection techniques used in this research were essays, tests, observations and interviews, with data validation using triangulation techniques. The essay test used in this research contains six aspects of critical thinking skills: interpretation, analysis, evaluation, inference, explanation, and self-regulation. Data were analyzed using qualitative descriptive techniques. The spiral model is used for research procedures. The research results show that every aspect of critical thinking ability increases in two guided inquiry cycles of learning implementation. Interpretation increased 30.30%; analysis 36.36%; evaluation 41.67%; inference 31.82%; explanation 37.88%; and self-regulation 24.25%. Based on the results of data analysis, it can be concluded that the implementation of guided inquiry learning is able to increase the critical thinking abilities of class VII ECP students at Muhammadiyah 1 SIdoarjo Middle School for the 2024/2025 academic year.

Keywords: *Classroom Action Research, Guided Inquiry, Critical Learning*

INTRODUCTION

In order to support effective learning activities, of course, for the young generation in the world of Education, the ability to think critically is very necessary. However, to make this happen, educators must of course use various approaches or learning models that are suitable so that students can understand the material easily and be able to apply it. As for the learning model, there is an effective model to improve students' critical skills, namely the guided inquiry learning model (Dewi et al., 2020, p. 1066). This guided inquiry includes a directed and organized learning model through external and internal unit-based educational plans and an in-depth understanding of the theme (Adi, 2020, p. 10). So it can be said that students will have meaning in implementing learning in their lives.

In addition to critical thinking, scientific attitudes are included in the educational character that must be possessed by students. This scientific attitude describes open-mindedness, curiosity, and an optimistic approach to failure as values of scientific training (Parwati et al., 2020, p. 50). Regarding the guided inquiry learning model, Kunandar explained that the model is a process in which learners actively interact with concepts and principles, while teachers play a role in encouraging them to gain experience through experimental activities. Through this experience, students can find concepts that come from the results of the experiment (Sari et al., 2019, p. 32).

Meanwhile, according to Gulo, as quoted in Nurdin and Adriantoni, inquiry is a learning method that involves students optimally in exerting all their abilities to search and research systematically, critically, logically, and analytically. In this way, students can formulate their own findings independently and confidently.

Furthermore, according to Kitot, Ahmad, and Seman, the effective application of the inquiry learning model can improve students' critical thinking skills compared to traditional learning methods that focus on the role of teachers (Kitot et al., 2010, p. 268). Through guided inquiry, students become accustomed to solving problems with hands-on activities that involve practical skills, critical thinking, and social interaction, especially in science subjects. Science itself is a science that plays an important role in life because it is the basis for the development of technology that opens up opportunities to nurture students' curiosity naturally, solve problems faced so that they can stimulate students to think critically which can later be used to answer the challenges of the times (Julimah et al., 2020, p. 54). This is reinforced by the results of research from Samatowa that science learning should provide space for students to grow their curiosity naturally and can encourage them to hone their questioning skills, find answers based on evidence, and develop a scientific mindset (Julimah et al., 2020, p. 56).

Based on the research, it can be concluded that the science learning process that involves direct experience for students will certainly help foster critical thinking skills, work, scientific attitudes, and the ability to communicate knowledge as an important part of life skills. Therefore, the researcher is interested in exploring more deeply through a study entitled "Application of the Guided Inquiry Model to Improve Critical Thinking Skills in Natural Science Subjects." Meanwhile, to find out the level of students' critical power, the author will carry out a pre-action critical thinking ability test which is carried out by providing descriptive questions in accordance with the critical thinking aspect of Facione.

According to Facione, (Facione, 2011, p. 10) Critical thinking involves six main aspects, namely: 1) Interpretation, the ability to understand the meaning of various experiences, data, or procedures, 2) Analysis, the ability to recognize the purpose and relationship between statements, concepts, or representations, 3) Evaluation, the ability to assess the credibility and logical strength of a statement or argument, 4) Inference, the ability to identify elements to formulate conclusions or hypotheses, 5) Explanation, the ability to communicate the results of reasoning with clear based on certain evidence and criteria and 6) Self-Regulation, Awareness to monitor the process of self-thinking with the aim of criticizing, confirming, or improving the assessment results that have been achieved. From these aspects, the test results showed that students in grade VII ECP SMP Muhammadiyah 1 Sidoarjo were classified as less critical with the achievement of each aspect, namely: interpretation 40.15%; analysis 34.85%; inference 47.73%; evaluation 25.00%; explanation 30.30%; and self-regulation 42.42%.

Based on initial observations, it also found several findings of obstacles experienced by students, namely: (1) student participation in giving arguments is still low, (2) at the stage of deduction or drawing conclusions to phenomena, students still experience difficulties in interpreting the events presented, (3) at the induction stage, many students are less able to analyze the data, which makes it difficult for them to make conclusions, (4) at the evaluation stage, Students are quite capable of conducting evaluations based on facts and theories, and (5) students have not been able to provide solutions to problems, so they are less effective in making decisions and applying alternative solutions according to the theories obtained. From the obstacles found, efforts are needed to improve the critical thinking skills of grade VII students at SMP Muhammadiyah 1 Sidoarjo. Meanwhile, one of the effective ways that can be applied is through the use of a guided inquiry learning model.

METHOD

The research method uses classroom action (PTK) research. The research procedure uses a spiral model which includes four stages in each cycle, namely: planning, implementation, observation,

and reflection. This stage will continue to repeat in a continuous cycle until the desired target is successfully achieved (H.B et al., 2012, p. 37). Meanwhile, the subjects of this study are students of grade VII ECP 1 SMP Muhammadiyah 1 Sidoarjo for the 2024/2025 academic year with a total of 34 students consisting of 18 males and 16 females. In addition, the object of this research is a guided inquiry learning model and critical thinking skills which are carried out in two cycles, namely cycle I and cycle II. Meanwhile, the focus of this science subject is related to substance material and its changes, because this material still tends to be passive in learning and teacher interaction with students is relatively minimal.

Research data on students' critical thinking skills were collected through test techniques, observations, and interviews. To ensure the validity of the data, this study uses triangulation techniques. The analysis was carried out using a qualitative descriptive method. The research instruments included a multiple-choice test of 20 questions and a description consisting of 5 questions and a total of 25 questions, each of which reflected every aspect of critical thinking skills according to Facione. The calculation of the achievement of each aspect of critical thinking ability is carried out with a predetermined formula as follows (Pasani et al., 2018, p. 10).

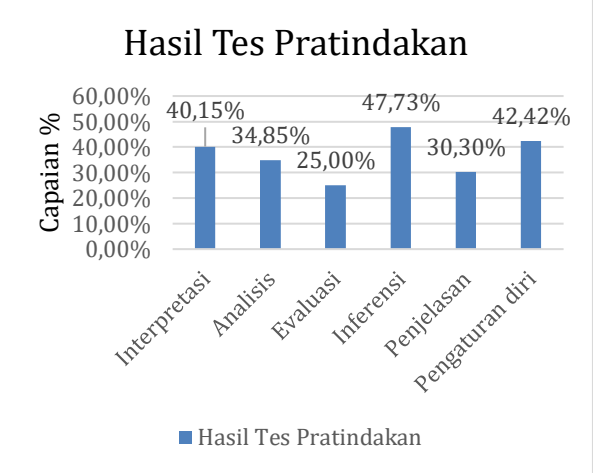
$$\text{Capaian (\%)} = \frac{\sum \text{Skor}}{\sum \text{Skor Maksimal}} \times 100\%$$

According to Sahfriana, Subchan and Suratno (2015) group the level of critical thinking ability of students as follows: 0-20% are not critical; 21%-40% less critical; 41%-60% is quite critical; 61%-80% critical; and 81%-100% very critical. The purpose of this research is to improve students' critical thinking skills up to the "critical" category. Therefore, the action cycle will be stopped if each aspect of critical thinking skills reaches an improvement of at least 61%.

RESULTS

This research was conducted at SMP 1 Muhammadiyah Sidoarjo. SMP Muhammadiyah 1 Sidoarjo, located in Sidoarjo District, is an Islamic-based junior high school under the auspices of the Muhammadiyah Islamic Organization. This school is located on Jl. K.H. Saman Hudi No.81, Jasem, Bulusidokare, Sidoarjo Regency, East Java. Carrying the vision of "Islamic, Smart, and Accomplished," SMP Muhammadiyah 1 Sidoarjo is committed to creating an environment that supports the development of students' character and discipline (Baqy et al., 2021, p. 10). One of the efforts is to design the interior of the school to support character formation. Meanwhile, good arrangement is expected to encourage discipline and strengthen the school's identity as an educational institution based on Islamic values.

After observation, it can be seen that students are still lacking in critical terms and the learning methods used are too monotonous that focus on teachers so that students are less active. So that the researcher conducted a pre-action test of the guided inquiry learning model to produce the following data:



DISCUSSION

Matter of Substances and Their Changes

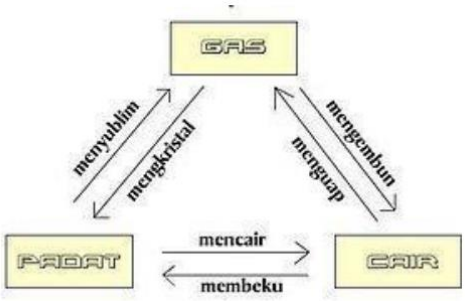
1. Forms of Substances and Particles
   A substance is something that has mass and occupies a room. There are three types of substances, namely solids, liquids, and gases (Wandini et al., 2022, p. 2014). The properties of solid substances have a fixed shape and volume, independent of their place. The property of a liquid substance is that its volume is fixed, but the shape changes according to its place. The nature of a gas is that its shape and volume change according to its place. The properties of the particles of the substance are as follows.

   a. Properties of Solid Matter Particles
      1) The shape and volume are fixed, independent of their place.
      2) The arrangement of the particles is regular.
      3) The distance between the particles is close.
      4) The force of attraction between particles is very strong.
      5) Non-free particle motion

   b. Properties of Liquid Substance Particles
      1) The shape changes according to the place, but the volume is fixed.
      2) The arrangement of the particles is irregular.
      3) The distance between the particles is somewhat farther.
      4) The attraction between particles is weak.
      5) The motion of the particles is free, but still in their group bonds

   c. Gaseous Properties
      1) The shape and volume change in place.
      2) The arrangement of the particles is very irregular.
      3) The distance between the particles is very far apart.
      4) The force of attraction between particles is very weak.
      5) Particle motion is very free

2. Changes in the Form of Substances



A change in the form of a substance is a thermodynamic change from one phase of an object to another state of the form of a substance (Cholil, 2015, p. 28). Changes in the form of this substance can occur due to the event of heat release and absorption. A change in the shape of a substance occurs when a certain point is reached by the atom/compound of the substance which is usually quantified in temperature figures. For example, the liquid to become solid must reach its freezing point and the liquid to gas must reach its boiling point.

Types of Deformation

a. Freezing and Thawing
Freezing and thawing are inversely proportional existential changes. Freezing is the change in the form of a substance from water to solid. Meanwhile, melting is the change in the form of a substance from solid to liquid. Freezing events are caused by a decrease in temperature or heat release.
Meanwhile, melting events are caused by an increase in temperature or the addition of heat. A liquid substance will freeze if its temperature is continuously lowered or cooled to its freezing point. Meanwhile, a solid substance will melt if its temperature is lowered or heated to its melting point.

b. Condensing and Evaporating
Condensation is a change in the form of a substance from gaseous to liquid. This event is known as condensation. Condensation is also interpreted as water points related to steam. In this process, condensation occurs because the gas releases heat energy (heat) so that it turns into a liquid.
Evaporation is a form of change of form that occurs in a liquid object into a gaseous substance. Yawning is a change in form that requires heat or heating. These changes do not only occur in liquids, but can also occur in the human body.

c. Crystallizing and Sublimating
Summing is a form of changing the form of a solid object into a gaseous object without going through a liquid process. In the process of sublimation, heat or heat energy is required.
According to the Great Dictionary of the Indonesian Language (KBBI), sublim comes from the word sublim which means to change a solid substance into steam. Crystallization is the change in the form of an object from the gaseous phase to solid. The crystallization event is the opposite of the sublimation event.

3. Mixed Separation
Mixed separation is a process applied in science Chemistry. This separation aims to take impurity substances to be separated from the mixture and take beneficial substances from the mixture (Cahyono et al., 2018, p. 67). Basically, the constituent substances in a mixture can be separated based on the physical properties of their constituents, including particle size, form, boiling point, melting point, solubility, magnetic properties, and others. The following are some methods in separating the mixture, including:

a. Filtration
Filtration is one of the simplest separation methods, the filtration method is the separation of mixtures used to separate liquids and insoluble solids based on the difference in particle size of the substances that are mixed (Prastyo et al., 2018, p. 23). An example of the use of the filtration method in daily life is when making coffee, if seen during the coffee making process, the brewing water in the coffee making will pass through the paper but the coffee grounds will be left on the paper. So this is one of the applications of the filtration method that aims to ensure that when drinking coffee there are no coffee grounds left behind and disturbing.

b. Centrifugation

The centrifugation method is the process of separating matter according to its size and density by utilizing centripetal force. This centrifugation separation method separates substances that are finer in size and less in the amount of mixture.
The centrifugation method is widely used to separate white blood cells from blood plasma. Solids are red blood cells and white blood cells that will collect at the bottom of the test tube, while blood plasma is a liquid at the top. The application of this centrifugation method of separation of substances is widely used in the medical field.

c. Distillation (distillation)
The method of separating mixtures by distillation is the separation of mixtures by distillation is used to separate a liquid substance that mixes, so that when evaporating each substance will be separated.
The method of separating mixtures by distillation (distillation) is widely used in daily life or for industrial activities. An example of the use of the distillation method in industrial activities is used in the petroleum refining process which consists of various petroleum components with different boiling points.

d. Chromatography

Chromatography is a process of separating mixtures using the principle of one phase at rest and the other phase moving (Rizalina et al., 2018, p. 225). The method of separation by means of crasatomography is widely used in various lives.

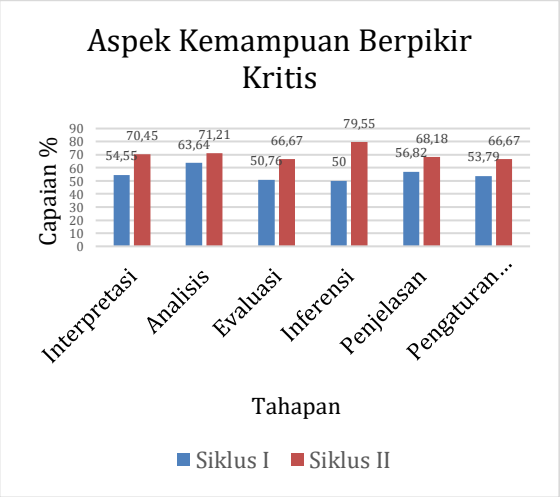
Separation of mixtures by chromatography is generally used to identify a different substance in a mixture. Chramatography is a method of separation of mixtures that is circulated at the difference in propagation speed between particles mixed in a stationary medium when flowing through a moving medium. An example of the use of chromatography methods is to separate various dyes and urine tests for someone suspected of using illegal drugs or using doping.

Other examples can be seen in the process of identifying the content of certain substances in a food ingredient, identifying agricultural products contaminated by pesticides and many more of their application in daily life.

e. Sublimation
Separation of mixtures by the sublimation method, namely the method of separating mixtures by sublimation is based on a mixture of substances that have one substance that can subliminate (change of solid form to gaseous form). An example of separation of mixtures by sublimation is a mixture of iodine and salt that can be separated by sublimation.

Guided Inquiry Learning to Improve Critical Thinking Skills

The results of actions in the form of achievements in each aspect of critical thinking skills can be seen in the Figure



Achievement Chart of Each Aspect of Critical Thinking Skills in Each Cycle

Interpretation Aspects

The interpretation aspect is specifically trained through observation and investigation stages. In the observation stage, students observe the phenomena displayed. In Cycle I, students are given a picture of the particle system of solid, liquid and gaseous bodies, then they are asked to observe and express their opinions on how to distinguish the properties of the three particle bodies.

Furthermore, in the investigation stage, students observe further using video graphs. In Cycle II, for example, students observe a graph of the types of shape changes and reveal that there is an influence of temperature and energy. This shows their ability to understand and interpret the information obtained from the graph.

In Cycle I with the stages of the guided inquiry model, the achievement of interpretation has not met the target, which according to the interview is caused by the assumption that the material is poorly understood by some students, thus reducing their interest in observing and asking more in-depth questions. However, in Cycle II through the stages of the guided inquiry model, students are more comfortable with the type and shape of the material, which makes it easier for them to build understanding. Finally, the interpretation aspect has increased by 30.30% from Pre-Action to Cycle II.

Analytical Aspects

The analysis aspect in students is mainly honed through the data analysis stage involving group discussion activities. In this discussion, students in small groups work together to look for a relationship between the data that has been collected and the relevant theory. In Cycle I, the analysis aspect has reached the research target, which is 63.64%. Based on the interviews, students stated that group discussions through a guided inquiry model about the filtration process were very helpful for them in analyzing problems, especially when they had difficulty in providing reasons or relating observations to theory.

Discussions in small groups provide significant benefits for students, especially in improving their ability to present strong arguments and develop arguments. Small groups, consisting of four to six students, allow them to learn the material more deeply, encourage closer interaction between members, and provide opportunities for each student to express their opinions more freely so that in the second cycle it reaches 71.21%.

Evaluation Aspects

The evaluation aspect is mainly honed at the stage of data analysis and argumentation. For example, in Cycle I through a guided inquiry model, after observing the centrifugation and filtration processes, students question whether there is a difference in the screening process. They verified the truth by reading references and discussing the stages of centrifugation and filtration and the usefulness of the two separations. Evaluation occurs when students consider, accept, or reject their peers' opinions by checking their validity.

Improvement in the evaluation aspect was seen in each cycle, although in Cycle I the research target had not been achieved. From the results of the interviews, it is known that some students have difficulty evaluating the correctness of an opinion due to a lack of understanding of scientific terms and related theories. They tend to judge based on personal experience without a theoretical basis.

In the next cycle, students are directed to utilize learning resources, such as books, to verify opinions, which makes their arguments stronger. They are also accustomed to discussing and judging from various perspectives, enriching critical understanding. More intensive discussions in Cycle II helped improve evaluation capabilities, resulting in an increase in achievement from Pre-Action to Cycle II by 41.67%.

Inference Aspect

Inference is an integral part of the scientific process, which can be taught through inquiry learning, including the activities of formulating hypotheses, designing investigations, and drawing conclusions. The ability to make inferences is also developed by giving students the opportunity to draw conclusions based on the material they have learned and the results of the investigations they have conducted. This conclusion was drawn by considering the results of the investigation and theoretical references through group discussions. Inference is not just about inferring, but it also involves making the right decisions based on factual information. In the investigation design

stage, inference is trained when students determine an accurate investigation strategy to obtain the information needed, such as through image or video observation in studying the chromatography process.

In Cycle I, students' inference ability has not reached the target. Observations show that students are still hesitant and tend to state hypotheses in unison. After the interview, some students expressed difficulty in drawing conclusions from scientific texts because they were not familiar with the language used. In Cycle II, students are further guided to draw conclusions by highlighting important information in a text, so that their inference skills can be improved. With continuous inquiry learning, students become accustomed to doing scientific activities, improving their inference skills significantly with an increase in achievement from Pre-Action to Cycle II by 31.82%.

Explanation Aspect

The achievement of the explanation aspect increased by 37.88% from Pre-Action to Cycle II. This aspect is mainly trained through data analysis and argumentative discussion. The explanation process begins with observations by students on the guided inquiry model. At the data analysis stage, they were asked to explain the results obtained from the investigation activities, accompanied by logical reasons and supporting theories. In Cycle I, students explain the concept of types of shape changes. The increase in achievement in the explanatory aspect occurred in each cycle, but the research target was only achieved in Cycle II. Based on the interviews, students stated that they had no difficulty in providing descriptions or definitions, but lacked reading relevant theories, so the reasons given were often less in-depth. Observations during discussions in Cycle I show that students tend to give opinions based on their experiences or observations, which leads to less than optimal explanations.

Self-Regulation Aspects

The implementation of inquiry learning from the observation to argumentation stage trains students to regulate themselves, because this learning provides opportunities for them to actively participate in the learning process. This approach makes students more independent and responsible for their learning process. Students learn by observing and interacting in groups. Discussion activities at the data analysis stage allow them to check the correctness of each other's statements, which indirectly helps to improve their understanding of concepts.

Self-regulation develops more effectively when students have a positive attitude towards learning. Although this aspect increases in each action cycle, the target is only achieved in Cycle II. Observations showed that some learners lacked focus during the data analysis stage, as seen from off-topic talks and still completed worksheets while others presented the results.

Self-regulation in learning is the awareness to monitor thoughts, behaviors, and emotions in order to achieve learning goals. Students need to control their attention and get rid of distractions, as well as manage their time to complete tasks effectively. Teachers also play a role in providing guidance at each stage, so that students' learning skills and habits are increasing.

Students' critical thinking skills also showed improvement in each action cycle, driven by improving the quality of learning. Teachers gradually improve the method through reflection and re-planning in each cycle, so that the achievement in critical thinking is getting better in each aspect.

CONCLUSION

The application of the guided inquiry learning model is able to improve critical thinking skills in grade VII students of Muhammadiyah 1 Junior High School Sidoarjo for the 2024/2025 academic year. The percentage improvement in each aspect of critical thinking showed the following results: interpretation increased by 30.30%; analysis 36.36%; evaluation 41.67%; conclusion 31.82%; explanation 37.88%; and self-regulation 24.25%.

ACKNOWLEDGEMENT

Thank You delivered to all the party that has describe support and contribution in implementation of research this . Thank you delivered on party Junior High School Muhammadiyah 1 Sidoarjo yes has give permission as well as chance in do research in class VII ECP. Students who have participated actively in study This , which allows us to obtain valuable data related to interests and activities they in science learning . The research team and mentors who have give input valuable during the ongoing research process , as well as those that have help in data analysis and compilation article . The campus of Muhammadiyah University of Sidoarjo which has provide facilities and funds needed to implement study this well . At the same time , all parties who do not can mention One by one , will but Which has give support moral And material so that study This can completed well .

DECLARATION OF POTENTIAL CONFLICT OF INTEREST

Dinda Tia Tinara does note work for, consult, ownshares in, or receive funding from any company or organization that would benefit from this manuscript, and has disclosed no Affiliations others than those noted above.

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