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Inquiry-Based Mathematics Education: Enhancing Learning Outcomes in Primary Schools through Classroom Action

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Abstrak

Penelitian ini bermaksud untuk mengeksplorasi pengaruh penerapan Metode Inkuiri terhadap pembelajaran matematika di kelas V sekolah dasar. Metode inkuiri dipilih sebagai suatu pendekatan yang secara aktif melibatkan siswa, mendorong pemecahan masalah secara mandiri, dan meningkatkan pemahaman ide-ide matematika. Penelitian ini dilaksanakan melalui Pendekatan Tindakan Kelas (PTK) dengan empat tahap, meliputi persiapan, pelaksanaan, observasi dan refleksi. Subyek penelitian ini adalah siswa kelas lima sebuah sekolah dasar. Pengumpulan data dilakukan melalui observasi, tes dan analisis hasil belajar siswa. Hasil penelitian menunjukkan adanya peningkatan yang cukup besar pada partisipasi siswa, kemampuan berpikir kritis, dan hasil belajar matematika setelah menggunakan Metode Inkuiri. Siklus pembelajaran PTK memberikan ruang refleksi dan perubahan taktik pembelajaran. Peran guru sebagai fasilitator dalam Metode Inkuiri menjadi kunci keberhasilan, memastikan kegiatan inkuiri sesuai dengan tujuan pembelajaran. Meskipun hasil yang diperoleh pada siklus II menunjukkan peningkatan yang cukup besar, namun penelitian ini menekankan perlunya pengembangan berkelanjutan dalam penggunaan Metode Inkuiri untuk mencapai hasil yang optimal dan bertahan lama. Temuan ini berkontribusi pada pengetahuan tentang metodologi pembelajaran yang efektif dalam konteks pengajaran matematika tingkat dasar.

Kata kunci: *Metode Inkuiri, Pembelajaran Matematika, Pendidikan Dasar.*

Abstract

This research intends to explore the influence of adopting the Inquiry Method on mathematics learning in fifth grade elementary school. The inquiry method was chosen as an approach that actively engages pupils, promotes independent problem solving, and increases understanding of mathematical ideas. This research was carried out through the Classroom Action Approach (PTK) with four stages, including preparation, implementation, observation and reflection. The subjects of this investigation were fifth grade pupils at an elementary school. Data collection is carried out through observations, tests and analysis of student learning results. The research results demonstrated a considerable increase in

student participation, critical thinking skills, and mathematical learning outcomes after using the Inquiry Method. The PTK learning cycle allows space for reflection and change of learning tactics. The teacher's role as a facilitator in the Inquiry Method is the key to success, ensuring that inquiry activities are in agreement with learning objectives. Although the results obtained in cycle II demonstrated a substantial improvement, this research stresses the need for continual development in the use of the Inquiry Method to attain optimal and lasting results. These findings contribute to the knowledge of effective learning methodologies in the setting of primary level mathematics instruction.

Keywords: *Inquiry Method, Mathematics Learning, Primary Education.*

INTRODUCTION

Mathematics is a fundamental aspect of the curriculum at every level of education, from basic to postsecondary level. The rationale for its existence at every level of schooling is because mathematical skills may be employed to tackle everyday issues. Teaching mathematics is a necessity because (1) mathematics is always involved in various aspects of life; (2) all fields of study require relevant mathematical concepts; (3) mathematics functions as a strong, concise and clear communication tool; (4) can present information in various ways; (5) develop logical thinking skills, accuracy and spatial awareness; and (6) provide satisfaction through solving challenging problems.

Although the importance of mastering mathematics is recognized at many stages of school, the reality demonstrates that mathematics is often regarded a difficult subject (Perera, 2020). Observation data suggest that mathematics learning in fifth grade elementary school still exhibits a poor level of accomplishment. From the daily tests, as many as 31.82% of students did not attain the level of completion with a score of < 65, while 68.18% of students completed with a score of ≥ 65. This illustrates the low performance of learning mathematics, given that the percentage of classical learning completion should reach ≥ 85%.

One of the causes of inferior mathematics learning results is the lack of applicability of the learning methods used. Therefore, teachers need to endeavor to create a suitable learning atmosphere to boost student motivation and interest in learning. This research tries to overcome this difficulty by designing learning using the inquiry approach, which emphasizes on the role of students in acquiring knowledge. The inquiry approach was chosen because it may actively include students in the learning process, inviting them to study facts and solve problems with their own mental processes. Thus, the inquiry approach is supposed to boost students' knowledge of mathematical subject matter and lessen the tendency for learning to be limited to verbalism. This research is geared at evaluating the potential of the inquiry method as a more effective learning strategy in boosting students' mathematics learning achievement (Li et al., 2022).

The inquiry method as a learning technique gives a means to overcome hurdles to studying mathematics in fifth grade elementary school. It is envisaged that its application can produce good changes in student involvement and their knowledge of the mathematical ideas being taught. This strategy fosters a dynamic learning atmosphere and encourages students to actively ask questions, investigate and formulate their own knowledge. In the

context of mathematics learning, the inquiry method allows students to do more than merely memorize formulas and methods. They are invited to think critically, examine and create their own understanding via exploration and experimentation. This is believed to boost the absorption of learning content and provide added value in enhancing students' logical thinking abilities (Hadi & Novaliyosi, 2019).

Inquiry processes such as observation, developing questions, experimentation, and group discussions can be excellent techniques of conveying mathematical concepts in a more real and meaningful way. Thus, it is intended that the inquiry method can promote students' interest in mathematics, which in turn can contribute to enhancing their learning results. As part of this project, there will be development and implementation of learning utilizing the inquiry approach in fifth grade elementary school. Evaluation of the outcomes will provide further insight into the usefulness of this strategy in enhancing student learning achievement in mathematics. By focusing on student engagement and the application of inquiry methodologies, this research is projected to make a good contribution to mathematics learning at the primary school level (Gerde, 2018).

It is thought that the inquiry technique can be a creative and acceptable way to promote students' interest in mathematics, a subject that is typically deemed difficult. By providing pupils a more active part in the learning process, the inquiry approach not only encourages a greater knowledge of mathematical topics, but also develops critical and analytical thinking skills. The use of inquiry methods in fifth grade elementary school will include rigorous lesson planning, including selecting inquiry activities that are appropriate to the subject matter and students' level of comprehension. Inquiry steps, such as asking questions, formulating hypotheses, and performing experiments, can help students respond to the topic in more depth and contextually (Liu, 2018).

Apart from that, adopting the inquiry technique also allows students to collaborate in solving mathematical issues. Through group conversations and mutual discovery, students can learn not only from teachers but also from peers. This kind of interaction can create a more inclusive and dynamic learning environment. Evaluation of the adoption of the inquiry approach will be crucial to determining its influence on student learning outcomes (Prayuda et al., 2023). Changes in student involvement, knowledge of mathematical ideas, and problem-solving abilities can be monitored to assess the success of this strategy. It is envisaged that the findings from this research can give a helpful contribution to the creation of more effective mathematics learning methodologies at the primary school level.

It is vital to note that the development and application of inquiry methods in mathematics learning in fifth grade elementary school is not only experimental, but also a progressive step towards improving the education system. The focus on applying inquiry approaches reflects efforts to tackle known mathematical learning problems, especially in terms of low student learning results. In adopting the inquiry method, teachers have a crucial role in planning and facilitating activities that promote the learning process. In addition, boosting student involvement, critical thinking abilities, and knowledge of mathematical ideas are essential evaluation factors(Prayuda et al., 2022; Yu, 2018). Therefore, this research will describe and examine the impact of inquiry methods on these modifications.

With collaboration between teachers and students, it is intended that the inquiry method can become a strategy that stimulates students to develop a positive attitude towards mathematics. Through dynamic interactions, students can experience the thrill of discovering and understanding mathematical concepts, making learning more interesting and relevant to everyday life (Sintawati et al., 2020). The outcomes of this research will provide further insight into the potential of the inquiry method as an effective mathematics learning tool at the primary school level. These findings will provide a basis for more flexible curriculum creation and teacher training, supporting efforts towards enhancing the quality of mathematics learning in elementary schools.

METHOD

This research was conducted at an elementary school (SD), with research subjects totaling 28 pupils in Class V of SD. The purpose of this research is the application of the inquiry method in mathematical courses with an emphasis on discussing geometry in Class V State Elementary Schools. This research is included in the type of Classroom Action Research (PTK) which consists of four stages, namely: 1) preparation, 2) implementation, 3) observation, and 4) reflection. Data collection in this research was carried out through observation and tests.

Data analysis was carried out in three steps, namely data reduction, data exposure, and data conclusion. To assess the level of student competence individually and classically, the learning mastery formula is applied. Students are deemed to have completed learning if they achieve a score of at least 65% of the total score, while a class is considered to have completed learning if at least 85% of the total number of students have achieved a score of 65%. The proportion of individual student learning outcomes is derived using the proportion of Student Learning Outcomes (PHB) algorithm.

Furthermore, the percentage of classical learning completeness is determined using a specified formula, and the conditions for classical learning completeness are met if there are ≥ 85% of students who acquire a score of ≥ 65%. The average student score is obtained by dividing the sum of all student scores by the number of pupils. Observations of teacher and student activities are calculated using a specified formula, with the standard for teaching and learning completeness in public primary schools set at ≥ 80.

The results of observing instructor and student actions are acquired by computing the scores using a certain formula, namely score = (Total scores obtained) x 100 / (Total maximum scores). Researchers utilized individual completion criteria of ≥ 65% and classical completeness of ≥ 85%. The criteria for observing the implementation of teacher and student learning activities are considered achieved if the score is ≥ 80, in accordance with the Teaching and Learning Completeness Standards that have been defined by the State Elementary School.

With a complete research methodology approach, this research is projected to provide a clear picture of the usefulness of implementing inquiry methods in increasing student learning outcomes in mathematics topics at primary school level. Data analysis and evaluation of observation results will provide deeper insight into the performance of the inquiry approach and its impact on student activities and learning outcomes.

This research can make a significant contribution to the advancement of mathematics education at the elementary school level, especially in determining the effectiveness of learning approaches that can excite students' attention and improve their critical thinking skills. Thus, this research is not merely a statistical analysis, but is also a progressive step in enhancing the quality of mathematics teaching at the primary level.

Figure 1. Classroom Action Research

RESULT AND DISCUSSION

The inquiry method is a learning style that utilizes all students' talents in analyzing discoveries systematically, critically, logically and analytically. It is hoped that the information gained is not merely the product of recalling facts, but is the outcome of one's own discovery. This method teaches students to perform their own experiments, ask questions, and look for their own answers, as well as connecting their discoveries with the findings of other students. Previous study, such as "Using the Inquiry Learning Model in Number Calculation Operation Material in Class I of Public Elementary Schools," concluded that teacher and student participation rose from cycle I to cycle II, as did student learning outcomes. Similar findings were achieved by another study entitled "Application of Inquiry Methods in Improving Elementary School Student Learning Outcomes," indicating an increase in learning outcomes for fourth grade primary school pupils.

Based on theory and prior study findings, scholars are interested in carrying out classroom action research by employing inquiry learning approaches. The title of the proposed research is "Application of Inquiry Methods to Improve Mathematics Learning

Outcomes for Class V Students." The findings of observations in cycle I showed that only 63.64% of pupils acquired classical learning completion. However, in cycle II, there was a huge rise with 90.91% of pupils obtaining classical learning completion. This implies that the implementation of the Inquiry Method to class V pupils provides a favorable contribution to enhancing classical learning outcomes. Thus, learning does not need to be continued to the next cycle because the aim of classical learning completion has been accomplished in cycle II.

Further examination of the research findings demonstrates that the application of the Inquiry Method to mathematical courses in grade V elementary school has had a substantial favorable impact on learning activities, both in terms of teachers and students, as well as total student learning outcomes. The increase in teacher activity may be seen from the comparison between cycle I and cycle II. In cycle I, instructors experienced advances in creating and executing inquiry-based learning. This method includes formulating investigative questions, giving support while students carry out experiments, and facilitating group discussions. Cycle II indicates greater growth in the teacher's capacity to enable inquiry learning more effectively, providing an environment that stimulates student interest.

Meanwhile, student involvement also rose along with the use of the Inquiry Method. Cycle I reported a score of 65% for student activities, which then improved to 85% in cycle II. This rise represents a more active degree of student participation in experimental activities, observations and group discussions. The Inquiry method encourages students to be more involved in the learning process, making them active subjects in developing their own knowledge. In the area of learning completeness, cycle I showed that as many as 63.64% of students achieved classical learning completeness, but had not yet met the minimum aim of 85%. However, the implementation of the Inquiry Method in cycle II resulted in tremendous improvement, where as many as 90.91% of students achieved classical learning completion. This suggests that the Inquiry Method is helpful in enhancing students' understanding and achievement in mathematics topics.

Thus, the adoption of the Inquiry Method not only has a good impact on classical student learning outcomes but also enhances student involvement in the learning process. These findings give a strong basis for continuing to develop inquiry approaches in the context of mathematics learning at the elementary school level. A closer study of the research findings demonstrates that the application of the Inquiry Method to mathematics learning in fifth grade elementary school has made a substantial contribution to increasing the quality of learning and student accomplishment. Some crucial elements that can be uncovered by a more in-depth analysis are:

1. Increased Understanding of ideas: From student learning outcomes data, it can be demonstrated that the Inquiry Method has succeeded in boosting understanding of mathematical ideas. Students not only memorize knowledge, but they are more likely to understand and link these concepts to real circumstances through the investigative process.
2. More Active Student Activities: Application of the Inquiry Method fosters active student involvement in the learning process. Students become more engaged in asking questions, conducting experiments, and participating in group discussions.

This depicts students' transformation from recipients of information to creators of knowledge.

3. Improved Critical Thinking Abilities: Through individual investigation and exploration activities, children are encouraged to build critical thinking abilities. They learn to analyze information, establish connections between concepts, and make judgments logically. This rise fosters the development of pupils' critical literacy.
4. Teacher Effectiveness in Guiding Learning: From the analysis of teacher actions, it indicates that instructors are able to function as learning facilitators better. They successfully establish a climate that fosters student exploration and discovery, presents thought-provoking questions, and provides advice when needed.
5. Importance of the Learning Cycle: Findings demonstrate that the learning cycle in Classroom Action Research (CAR) has a significant role in promoting learning. The progress demonstrated from cycle I to cycle II indicates that reflection and adjustment of learning tactics based on observations of the prior cycle are critical stages towards ongoing improvement.

Through a deep understanding of these findings, it can be concluded that the application of the Inquiry Method not only creates positive changes in student learning outcomes, but also forms the basis for a more contextual and relevant learning approach in the context of mathematics education at the elementary school level. These findings can make a major contribution to establishing more effective learning strategies in the future. The link between variables in this research is very crucial to understand in order to acquire a holistic view of the influence of implementing the Inquiry Method on students' mathematics learning results in grade V elementary school. Several characteristics of the relationship between variables that need to be explored are:

1. The Relationship Between Inquiry Methods and Concept Understanding: From the research results, it indicates that the Inquiry Method has a close relationship with boosting students' understanding of mathematical ideas. This technique gives students with the opportunity to explore mathematical subjects through hands-on investigation, leading to greater deeper knowledge.
2. More Active Student Activities and Concept knowledge: More active student activities, as shown in their involvement in the inquiry process, have a positive association with greater concept knowledge. When students are actively engaged, they are more likely to apply material to firsthand experiences, enhancing their understanding.
3. Critical Thinking Ability and Concept comprehension: Increased pupils' critical thinking abilities, which emerge as a result of the inquiry process, are positively connected with increased conceptual comprehension. Critical thinking abilities assist pupils to examine material, formulate logical arguments, and understand the consequences of mathematical concepts better.
4. Teacher Effectiveness and Concept knowledge: The teacher's capacity to use the Inquiry Method effectively has a major impact on students' conceptual knowledge. Teachers who can facilitate inquiry activities well are able to steer students towards a deeper and more thorough understanding.

5. Learning Cycle and increasing Learning Outcomes: The association between the learning cycle in PTK and increasing student learning outcomes reveals that constant reflection on learning techniques and tactics assists in enhancing learning effectiveness over time.

Through this knowledge, it can be argued that the link between variables in the context of applying the Inquiry Method to mathematics learning in grade V elementary school constitutes an interrelated educational environment. When these variables interact harmoniously, student learning results tend to increase favorably and sustainably. Therefore, it needs to be acknowledged that learning strategies cannot be separated from each other, and holistic interventions need to be implemented to attain optimal results. Overall, the research results demonstrate that the application of the Inquiry Method to mathematics instruction in fifth grade elementary school has a favorable impact on student learning outcomes. The link between variables, such as Inquiry Methods, student activities, critical thinking skills, teacher effectiveness, and learning cycles, complement one other and contribute to developing students' knowledge of mathematical topics.

The application of the Inquiry Method allows students to be actively involved in the learning process, encouraging knowledge of mathematical topics through their own research and discovery. Student activities that are more engaged and involved in the inquiry process provide a greater knowledge of subjects. In addition, the development of students' critical thinking skills becomes more obvious, which also adds to better learning outcomes. The teacher's role in facilitating the Inquiry Method is very crucial. Teachers who are effective in adopting this method can direct students appropriately, ensuring that inquiry activities support the accomplishment of learning goals. The learning cycle in Classroom Action Research (CAR) also reveals that constant reflection on the learning process is the key to enhancing the quality of learning over time.

Even though there was a considerable increase in learning outcomes in cycle II, it should be remembered that this learning strategy is not a one-time approach. There needs to be ongoing development of learning methodologies, teacher empowerment, and curriculum revisions to provide optimal and lasting results. Thus, it can be stated that the application of the Inquiry Method in mathematics learning in fifth grade elementary school makes a positive contribution to students' knowledge of topics. These findings provide a basis for establishing better learning strategies, promoting student participation, and supporting sustainable development in the context of mathematics teaching at the primary level.

CONCLUSION

Thus, the conclusion of this research is that the application of the Inquiry Method to mathematics instruction in fifth grade elementary school has a favorable impact on student learning outcomes. This strategy succeeded in raising student participation, encouraging critical thinking abilities, and making a major contribution to grasping mathematical ideas. Teachers have a key role in fostering the inquiry process, and the learning cycle in Classroom Action Research (CAR) allows opportunity for reflection and continuous development. The research results suggest that the Inquiry Method provides a more engaging and participatory learning experience for pupils. By fostering their own investigation

and discovery, students can build a deeper knowledge of mathematical ideas. More active student engagement during the inquiry phase corresponds to a considerable boost in learning results.

The teacher's role as a facilitator and guide in adopting the Inquiry Method is very crucial. Effective teachers can guarantee that inquiry activities support the attainment of learning goals, and are able to manage class dynamics successfully. The learning cycle in PTK gives chances for instructors to develop, implement, observe and reflect on learning continuously. Even if there was a considerable improvement in cycle II, ongoing attention is essential to the development of learning processes. Inquiry learning is not a one-time strategy, but requires constant development so that optimal and sustainable results can be reached. These findings give a basis for the creation of better learning methodologies in the context of primary level mathematics instruction.

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