



TEACHER'S CHALLENGES IN APPLYING A SCIENTIFIC APPROACH TO MATHEMATICS IN ELEMENTARY SCHOOL

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ABSTRACT

Mathematics involves analyzing problems, identifying patterns, and applying logical reasoning to arrive at solutions. Similar to this is a scientific method that promotes systematic and logical investigation of and resolution of scientific issues through experimentation, data analysis, and inference. Unfortunately, the implementation of a scientific approach by mathematics teachers is not easy. This study aimed to describe the teacher's challenges in applying a scientific approach to mathematics at SDIT Nurul Fikri Makassar. The research method used was qualitative research with descriptive methods. The data collection technique used was direct communication techniques through observation, interviews, and documentation, with data collection tools in the form of observation guides and interview guides. The results of the study showed that there are challenges for SDIT Nurul Fikri Makassar teachers in applying a scientific approach to mathematics. These difficulties come in the form of the need for extensive training, the readiness of students, the requirement for originality and innovation, time and resource constraints, as well as the need for supporting media.

Keywords: Mathematics; teacher challenges; elementary school

1. INTRODUCTION

The implementation of the 2013 curriculum places a strong emphasis on a scientific approach that revolves around learner-centered learning. According to the Regulation of the Minister of Education and Culture Number 65 of 2013, which pertains to Process Standards, the standard learning process in the 2013 Curriculum adopts a scientific, integrated, and thematic approach. The scientific approach serves as a bridge

for fostering the development of students' attitudes, skills, and knowledge. By enhancing the integration of attitudes, skills, and knowledge, the aim is to cultivate students who are productive, effective, innovative, and creative and possess strong character traits (Mulyasa, 2015).

Learning with these characteristics encompasses more than just the processes of exploration and confirmation; it also involves observing, asking questions, reasoning, and experimentation. In essence, this type of learning is synonymous with applying the scientific method. The learning approach that incorporates the stages of the scientific method is known as the scientific approach (Hosnan, 2014).

In the scientific approach, the learning process is carefully designed to encourage students' active construction of concepts, laws, and principles. This is achieved through a series of steps, including observing a problem, formulating problems, proposing hypotheses, collecting data using various techniques, analyzing the data, and drawing conclusions. Finally, students are expected to communicate their findings regarding the concepts, laws, or principles they have discovered (Daryanto, 2014).

Implementing the 2013 Curriculum necessitates a paradigm shift in how students learn, emphasizing training them to observe, ask questions, collect data, analyze, and effectively communicate their learning outcomes. This shift, known as the scientific approach, is crucial for developing students' ability to learn independently and think creatively (Sani, 2014). Drawing on Dyer's theory, the scientific approach to learning encompasses key components such as asking questions, conducting experiments, making associations and reasoning, as well as communicating findings (Sani, 2014). Additionally, another viewpoint explains that a scientific approach is an approach that enables students to recognize and understand various subjects using scientific principles. Students engage their senses and intellect to experience the knowledge acquisition process directly, empowering them to tackle and solve problems effectively (Fadlillah, 2014).

According to Barringer (in Abidin, 2014), scientific process learning entails systematic and critical thinking to solve complex problems that do not possess readily apparent solutions. This type of learning engages students in activities like brainstorming, creative thinking, research, and conceptualization of knowledge (Abidin, 2014).

Building upon the aforementioned understanding, the scientific learning model is developed based on the concept of scientific research. This means that the learning process should incorporate a series of research activities conducted by students to construct knowledge. This aligns with Weinbaum's viewpoint (in Pahrudin and Pratiwi,

2019), which asserts that learning is a process of deriving meaning from new information within a conceptual framework. Understanding factual information within a conceptual framework allows students to retrieve, organize, and retain the acquired knowledge. Conversely, when factual information is learned without a clear conceptual framework, it is often forgotten quickly.

The implementation of the scientific approach to learning comprises three stages: introduction, core activities, and closing. The introduction stage aims to enhance students' comprehension of the material's purpose and significance, igniting their curiosity. Curiosity is the key to the subsequent core activity stage, representing the most substantial part of the scientific approach. In the Lesson Implementation Plan (RPP), teachers design systematic learning activities based on scientific steps. Teachers guide students to construct concepts, knowledge, understanding, and skills through activities involving observation, questioning, critical thinking, experimentation, and communication. These steps need not be followed in a strict sequence and can be adapted to suit the subject matter being studied.

Applying a scientific approach to learning has several advantages, including 1) The focus of learning is more directed toward students so that they are more active in the learning process. 2) The learning steps are arranged systematically so that it is easier for the teacher to organize the implementation of learning. 3) Provide opportunities for teachers to develop their creativity and encourage students to interact with various learning resources actively. 4) Learning steps involve science process skills in constructing concepts, laws, and principles. 5) The learning process involves cognitive activity that stimulates higher-order thinking skills. 6) Building positive student character (Rhosalia, 2017).

In mathematics, students often face multiple complexities, including abstract concepts, mathematical notations and symbols, complex problem-solving, concept connections, and deductive reasoning. Abstract mathematical concepts and special notations can make understanding difficult for students. In addition, solving complex problems, building relationships between concepts, and using deductive reasoning can also be challenges in learning mathematics.

To overcome this complexity, teachers can provide learning that supports an in-depth understanding of concepts by using concrete examples and real-life situations. Involving students actively in problem-solving and building relationships between mathematical concepts is also very important. Teachers need to provide support and direct instruction so students can overcome the complexities of learning mathematics. The scientific approach and learning mathematics provide invaluable benefits in developing students' critical thinking skills, problem-solving skills, logic, and positive

character. Both of these approaches have a positive impact on learning and student life as a whole. The application of a scientific approach has been carried out at SDIT Nurul Fikri Makassar. Several subject teachers have applied this scientific approach several times, including in learning mathematics. Unfortunately, this approach is sometimes adopted by the math teacher at the school and sometimes not. Some challenges are the reasons why this approach is not implemented sustainably. They state that implementing a scientific approach requires effort and challenge. In another statement, it is said that the benefits of this scientific approach are enormous because it involves students actively in the learning process, develops critical thinking skills, and forms positive character. Unfortunately, the challenges of its application also make teachers think about using it. This study aims to describe the teacher's challenges in applying a scientific approach to mathematics at SDIT Nurul Fikri Makassar.

2. METHODS

This study employed a qualitative descriptive research design. Qualitative research is descriptive in nature and aims to provide an accurate depiction of the phenomena being studied. According to Miles and Huberman (1992: 73), a systematic method is necessary for analysis, which proves invaluable during the data collection process, particularly in qualitative research. The chosen method facilitates the collection of information through handwritten or dictated field notes, as well as audio recordings of events in the field. Strauss and Corbin (2007: 1) posit that qualitative research does not rely on statistical procedures or calculations for obtaining findings. While data can be quantified and presented numerically, the analysis itself is qualitative, involving the examination of non-mathematical data. This research procedure yields findings derived from various data sources, including interviews, observations, documents or archives, and tests (Nugrahani, 2014: 9).

Sugiyono (2017) defines qualitative research as an approach grounded in the philosophy of postpositivism. It is employed to investigate natural objects, where the researcher serves as the key instrument, data sampling is purposeful and empirical, data collection techniques involve triangulation, data analysis is inductive or qualitative, and the results emphasize meaning rather than generalization.

The purpose of this research was to identify the challenges faced by mathematics teachers in implementing a scientific approach at SDIT Nurul Fikri Makassar. The participants in this study consisted of three mathematics teachers at SDIT Nurul Fikri Makassar. The data collection methods employed documentation and interviews.

Interviews: Direct interviews were conducted with the research participants to obtain valid data. As Moleong (2018) suggests, an interview is a purposeful conversation between the interviewer who poses questions and the interviewee who answers.

Documentation: The documentation method is employed as a data collection technique in social research methodology. Documents can take various forms such as written records, photographs, or significant works produced by individuals. Document analysis serves as a complement to observation and interviews in qualitative research. It involves extracting information from essential records obtained from institutions, organizations, or individuals (Hamidi, 2002). Qualitative methods are utilized to obtain in-depth data rich in meaning (Sugiono, 2017). The data analysis process consists of several steps, as follows

1. Data reduction: After data was collected from observations, interviews, and documentation, the researcher analyzed the data to identify important and relevant variables.
2. Presentation of data: Once the data was summarized, it was presented in a qualitative form, using narrative text and concise descriptions. This structured information allowed for concluding.
3. Conclusion and verification: Based on the reduced and presented data, the researcher formulated preliminary conclusions, which could have been subject to change if substantial supporting evidence had been discovered during subsequent data collection phases. The conclusions were continually verified throughout the research process, ultimately leading to the conclusion.

3. RESULTS AND DISCUSSION

Based on the results of interviews conducted from April 2023 to May 2023, exposure to research data was obtained according to the research objectives, namely the challenges of mathematics teachers in applying a scientific approach at SDIT Nurul Fikri Makassar.

The teacher's understanding of the scientific approach is important because it can help improve the quality of learning and prepare students to become lifelong learners who have high-order thinking skills and can face challenges in an increasingly complex society. Likewise the mathematics teacher's understanding of the scientific approach at SDIT Nurul Fikri Makassar.

"I understand the scientific approach. Even so, it is necessary to refresh yourself regarding this scientific approach. The scientific approach is very important for explaining certain concepts, such as weight, by comparing objects with a certain

weight. In measuring objects, it is very important to direct students to make direct observations followed by an analysis of experimental results and discussion" (Interview with NN, a math teacher at SDIT Nurul Fikri Makassar, 2023).

"The advantage of the scientific approach lies in the ability to understand students more easily because students are directly confronted with objects related to the mathematical concepts being studied. Even though I already understand the scientific approach, I think we must continue to receive training on the application of the scientific approach in learning" (Interview with DN, a math teacher at SDIT Nurul Fikri Makassar, 2023).

"I understand the scientific approach. I use a scientific approach because this approach is practically compatible with contextual learning in mathematics" (Interview with HS, a math teacher at SDIT Nurul Fikri Makassar, 2023).

Thus, all teachers are known to have understood, been able to explain, and applied a scientific approach to their lesson plans. The collected lesson plan analysis results show the implementation of a scientific approach following the syntax of the cooperative learning model used. Mathematics teachers at SDIT Nurul Fikri Makassar have implemented a scientific approach because it is very important in explaining concepts in learning mathematics.

There are several steps in the scientific approach. At each of these steps, it becomes a challenge for mathematics teachers at SDIT Nurul Fikri Makassar.

1) Observing. The first activity in the scientific approach is the observation and learning step. Observing mathematical objects can be grouped into two types of activities, each of which has different characteristics, namely: a) observing phenomena in the environment of everyday life related to certain mathematical objects, and b) observing abstract mathematical objects. The observing method is also very useful for satisfying students' curiosity, so the learning process has high significance. The observation method is very useful for satisfying the curiosity of students. So that the learning process has high meaning (Hosnan, 2014: 41). In the observing activity, the teacher opens wide and varied opportunities for students to make observations through activities such as seeing, listening, reading, and observing. In this activity, the math teacher at SDIT, Nurul Fikri Makassar, often faces obstacles in the form of student readiness.

"I often provide stimulation to students as an initial preparation for learning activities. I ask them to observe phenomena through readings and videos related

to stories from everyday life regarding the concepts to be taught. Students seem difficult to understand, and this is very time-consuming to direct them to make observations" (Interview with NN, a math teacher at SDIT Nurul Fikri Makassar, 2023).

"When we (teachers) are ready to teach with a scientific approach, students are not ready. They sometimes do not pay attention to what we explain. And this, of course, affects the next steps." (Interview with HS, a math teacher at SDIT Nurul Fikri Makassar, 2023).

"Student readiness is indeed a challenge because students are not homogeneous. So some students may need attention during this initial process" (Interview with DN, a math teacher at SDIT Nurul Fikri Makassar, 2023).

- 2) Questioning. In observing activities, the teacher allows students to ask questions about what has been seen, listened to, read, or heard. In this activity, the teacher has guided students to be able to ask questions about the results of observations of concrete objects concerning facts, concepts, procedures, or other, more abstract things (Hosnan, 2014: 49). Regarding this stage, it is known that students also have difficulty asking questions as expected by the teacher.

"It takes time to explore questions from students. Only a few students are active. This stage can be influenced by the previous stage" (Interview with HS, a math teacher at SDIT Nurul Fikri Makassar, 2023).

"Students still need the teacher's help to ask questions. Even though there were some students who were able to make questions independently" (Interview with DN, a math teacher at SDIT Nurul Fikri Makassar, 2023).

"The number of questions asked must always be adjusted. We must pay attention to the questions that are following the learning objectives. This is where we can judge that the questions that arise come from the curiosity of students." (Interview with EK, a math teacher at SDIT Nurul Fikri Makassar, 2023)

- 3) Associating. In general, reasoning is the process of thinking logically and systematically about observable facts to obtain conclusions in the form of knowledge (Hosnan, 2014: 68). In learning mathematics, the reasoning process often involves steps such as analyzing information, processing data, and presenting the results of reasoning. By using inductive or deductive reasoning, we can reach better conclusions when understanding mathematical concepts.

"To support associating in learning, I can use strategies such as giving assignments related to real life, using concrete examples, group discussions, and collaborative projects that involve problem-solving. By facilitating the associating process effectively, teachers can help students build stronger connections between math concepts and improve their overall understanding. Of course, this can be done well if time supports it" (Interview with HS, a math teacher at SDIT Nurul Fikri Makassar, 2023).

"In a supportive environment, students can practice their skills in making the right associations between mathematical concepts, developing creativity. Students' limitations in making associations sometimes hinder this process." (Interview with EK, a math teacher at SDIT Nurul Fikri Makassar, 2023).

"By facilitating the process of associating effectively, teachers can help students build stronger connections between math concepts and improve their overall understanding. This has been done; indeed, it takes time for students to build concepts" (Interview with DN, a math teacher at SDIT Nurul Fikri Makassar, 2023).

- 4) Experimenting. Based on the results of the reasoning obtained in the previous stage, namely in the form of temporary conjectures or conjectures until a conclusion is obtained, it is necessary to carry out "trying" activities.

"Through this trying activity, students solve math problems, which is the main goal of learning mathematics. The teacher plays an important role in facilitating this experimental activity so that students can develop their abilities without hindrance. At this stage, it needs media coverage. Teachers must be creative in making media and in how the media is used in experiments. Making certain media takes time and innovation. Need support from various parties. This can be in the form of training because making media is a challenge for us when we are going to apply a scientific approach" (Interview with HS, a math teacher at SDIT Nurul Fikri Makassar, 2023).

"At this stage, it is an opportunity for students to try and apply their knowledge and skills. It is hoped that students can face math problems more confidently and develop problem-solving skills. Unfortunately, the teacher has to take time to think about it, make appropriate media, and this has to be in conjunction with other activities" (Interview with EK, a math teacher at SDIT Nurul Fikri Makassar, 2023).

"Math experiments involving observation and measurement often require special equipment. Teachers may face challenges in acquiring the necessary equipment and resources to carry out experiments effectively. They need to find alternatives or make creative use of available resources to facilitate students' experimental experiences. For this reason, sometimes teachers have to prepare funds"

independently" (Interview with DN, a math teacher at SDIT Nurul Fikri Makassar, 2023).

- 5) Communicating. In the scientific approach, teachers are expected to provide opportunities for students to communicate what they have learned. At this stage, students are expected to be able to communicate the results of the work that has been compiled together in groups and the conclusions that have been reached together. In observing the implementation of learning mathematics with a scientific approach, SDIT Nurul Fikri Makassar students made presentations regarding the results of their group work. Some forms of communication are done in writing. These forms of communication are carried out because of the diverse communication abilities of students.

"Sometimes, limited time in the learning schedule can hinder students' opportunities to communicate effectively. Teachers need to plan activities that allow students to discuss, collaborate, and present their thoughts to classmates. It is sometimes difficult to provide sufficient time for students to communicate and provide constructive feedback" (Interview with HS, a math teacher at SDIT Nurul Fikri Makassar, 2023).

"Some students may feel insecure when communicating about mathematics in front of the class or discussion groups. This sometimes makes learning take longer" (Interview with EK, a math teacher at SDIT Nurul Fikri Makassar, 2023).

"Some students face difficulties in communicating their thoughts and understanding of mathematical concepts orally or in writing. I need to provide guidance and exercises for students to develop their math communication skills. Of course, this requires time and support not only in class but also in the students' everyday environment" (Interview with DN, a math teacher at SDIT Nurul Fikri Makassar, 2023).

4. CONCLUSION

In conclusion, while the mathematics teachers at SDIT Nurul Fikri Makassar have demonstrated a commendable understanding and application of the scientific approach, there is a continuous need for their professional growth through updated training. Overcoming the challenges associated with implementing the scientific approach will require addressing student readiness, promoting originality and innovation, optimizing limited resources and time, and utilizing suitable supporting media. By addressing these challenges, mathematics teachers can further enhance their teaching effectiveness and facilitate optimal student learning outcomes.

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