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Writing in Learning Mathematics and Problem Posing Approach

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Abstract

Solving math problems through writing not only deepens their understanding of mathematics but also strengthens their communication skills about mathematics and learning vocabulary in mathematics lessons, because writing means they can explain what they have done and why the strategy works. Mathematics learning should provide space and opportunities for children to ask questions, by formulating their own questions from given mathematical situations or related to material in mathematics. This can be accommodated by learning using the Problem Posing approach. This research aims to discuss the relationship between writing in mathematics and the problem posing approach. This type of research is qualitative descriptive research with a literature study method. Data was collected through related journals for study. The research results show that learning activities must be able to develop various students' mathematical abilities. Based on the explanation given, one alternative learning strategy that can develop students' mathematical abilities is the Writing in Learning Mathematics strategy and learning by problem posing.

Keywords: Writing, Learning Mathematics, Problem Posing

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Introduction

One of the competencies that a teacher must have is pedagogical competence. Pedagogical competency is a teacher's ability to manage student learning in the classroom. Gagne (Ratna Wilis Dahar, 2006: 2) defines learning as a process in which an organization changes its behavior as a result of experience in a better direction. Thus, teachers must plan the learning process in the classroom well, so that students can learn and become better.

However, teaching mathematics well is a complex endeavor and there is no easy recipe (NCTM, 2000: 17). This may be because the mathematical content is abstract and complex so that students have difficulty understanding mathematics easily. For this reason, learning must be designed in such a way that students are helped to more easily understand the mathematics material provided by the teacher in class.

One of the mathematical abilities that must be developed through mathematics learning is students' mathematical communication skills. NCTM (2000: 60) states that communication skills are students' ability to express ideas and the results of their mathematical thinking both orally and in writing using mathematical representations and connecting them. Communication skills are very important, in mathematical communication skills are needed by students to be able to reason and solve mathematical problems well. One form of mathematical communication is the ability to write. Students must master how to explain reasons and write down mathematical ideas when they are going to and are carrying out the process of reasoning and solving mathematical problems, whether working manually or using technology to work on mathematical problems. NCTM in Standard Principles for School Mathematics (NCTM, 2000: 61) states that writing activities in mathematics learning help students combine the results of their thinking because it is necessary to reflect on the results of their work and clarify what has been the result of their thinking about the mathematical ideas developed in learning, so it is hoped that this writing activity will really help students to read again and record the results of their thoughts. So, writing activities in mathematics learning are very important.

Apart from that, learning mathematics focuses on training how to think and reason, develop creative activities, develop the ability to solve problems, and communicate ideas. In general, some of the students' weaknesses include: understanding the problem and planning a solution. Understanding the problem is demonstrated by knowing what is known and what is asked. Planning a solution is demonstrated by creatively organizing existing information or data by using certain strategies to find a solution to the problem. To solve problems, students can form mathematical models, make diagrams, etc. In this case, creative thinking skills are needed which include the ability to understand problem information, solve problems with a variety of answers, solve problems with various strategies, and solve problems with new methods. This ability can be developed if students are able to ask and develop their own questions regarding mathematical problems. For this reason, learning is needed to develop and provide opportunities for students to be active in posing problems. One lesson that can be used by teachers is problem posing learning.

Research Methodology

This research is qualitative research using the literature study method. The literature used is in the form of journal articles (both national and international) collected from the Google Scholar, Science Direct, DOAJ, ISDJ Neo, Jstore and IJERN databases. The number of articles used was 10 journal articles. The article selection technique uses a purposive sampling technique based on criteria related to writing in learning mathematics and problem posing approaches. The next stage is an analysis to see the relationship between the two.

Result and Discussion

Writing Strategies in Learning Mathematics

NCTM in Principles and Standards for School Mathematics (2000:20) states that the learning principle is that students must learn mathematics with understanding, actively building new knowledge from experience and previous knowledge. Then, Bransford, Brown and Cooking (NCTM, 2000: 20) stated that students who memorize facts or procedures without understanding are often unsure when and how to use the facts or procedures they know, and that knowledge is often fragmented or easily lost. Through writing, students try to express the results of their thoughts, so that the writing can be used to be read again as a reminder, and can be used by students and teachers to assess the location of errors and correct them.

The Nuffield Mathematics (Dewi, 2009) states three rules in learning, namely: I hear and I forget, I see and I remember, I do and I understand. From these three rules, it can be seen that writing means students are trying to reflect on what they are doing, they are involved in the process of forming an understanding of the material being studied so that students will easily understand the subject matter of the material being studied. Ali (2009) states that by writing, students' thoughts that are still raw and unorganized will be more fully coordinated, so that writing can be seen as a learning strategy.

Writing is an important component of communication in the classroom. NCTM in Standard Principles for School Mathematics (NCTM, 2000: 61) states that writing activities in mathematics learning help students combine the results of their thinking because it is necessary to reflect on the results of their work and clarify what has been the result of their thinking about the mathematical ideas developed in learning, so it is hoped that this writing activity will really help students to read again and record the results of their thoughts. Writing is also a way for humans to communicate, express and reflect one's thoughts, ideas and knowledge to others. Writing is a process of thinking hard that is poured onto paper. Writing activities in mathematics are one of the activities that can improve students' reasoning and solving mathematical problems. Because by writing, students can express ideas and communicate what they understand about the mathematics they have studied. From this writing activity, teachers can easily find out what students understand and what they do not understand. Because from the writing made by students, the teacher can read the sequence of students' thoughts in solving the

problem given and what the student knows about the problem, as well as how the student should solve it.

According to Sipka (Ali, 2009) there are several forms of writing assignments that can be applied in mathematics learning, in general writing can be categorized as follows:

a. Informal Writing, for example: in-class writing (focus writing, free writing); math autobiographies; and letters.

b. Formal writing, for example: proofs, summaries of journal articles, research papers, and lecture notes.

Bernadatte Russek (1998) states that to start a dialogue between teachers and students, writing activities can be carried out by asking students at the beginning of learning to write down what they know and feel about the mathematical material to be studied, then asking students to reflect on the results of their work and the results of reading it during the learning process in the form of writing assignments. Russek (1998) gives an example of a writing assignment as follows:

a. Write a letter to a classmate who could not attend class today so that she/he will understand what we did and learn as much as you did. Be as complete as possible.

b. Reflect on your participation in class today and then complete the following statement. Select one of your choice.
I learned that I ...
I was surprised that I ...
I discovered that I ...
I was pleased that I ...

c. Reflect on where you are in the course and complete the following statements. Select two.
Now I understand
I still do not understand
I can help myself by doing
You can help me by

d. Write a letter of advice to a student who is going to take this class next year.

e. Explain to a high school senior why it is important or not important to do mathematics.

f. Design two mathematical bumper stickers, one funny and one serious.

Then Russek (1998) presented examples of student writing as follows:

Part a : Dear Classmate,

*Today was not a good day to miss because we went over Scientific Notation. Scientific notation is a system used that makes very big #'s and very small #'s easyer (sic) to see and write. For example, 72,000,000 = 7.2 x 107, because if you did (this) out you would get 72,000,000. It's just nicer. Make sure you get to class next time. Part c : Now I understand the problems that involve charts. At first I had trouble with the coin, stamp, and Integer problems. After reading the corresponding text, which I read slowly and thoroughly to make sure I absorbed every bit of info., I began the homework. I breezed right through it. I find it much easier to do all the reading before I start the work. When I do these problems containing fractions, **I** still don't understand how to make them whole numbers You can help me by doing more math problems w/ fractions.*

Ali (2009) stated that writing assignments can be carried out at any stage of learning activities, at the beginning of learning, during the learning process, and at the end of learning. From several of these explanations, writing is a mathematics learning strategy where students are given the opportunity to express ideas, ideas, knowledge, results of thoughts, and processes experienced as well as difficulties experienced during the mathematics learning process on certain material which is made into written form based on Writing assignments given by the teacher use their own words. Writing assignments are a form of discussion between students and students, students and teachers and especially as a form of reflection on their understanding of the subject matter in class. However, to get good writing and avoid conceptual errors, it is necessary to provide guidance from the teacher as a model in the classroom. The teacher must be able to provide corrections or evaluations of students' writing, thus the teacher himself must be able to master good writing skills.

Benefits of Writing in Mathematics Learning

Several explanations regarding the benefits of writing in learning mathematics include Russek (1998) stating that writing is very valuable as an assessment tool, writing is used to assess attitudes and self-confidence in mathematical abilities and the ability to express mathematical ideas clearly. Apart from that, to open communication between students and teachers. Miller et al (Ali, 2009) stated that the results of their research indicated that children's ability to express their ideas in writing can help their understanding. Apart from that, Possamentier (Ali, 2009) in his research revealed that children who wrote down the concepts they had just learned had much more precise memories than students who did not learn that way.

Burns (Kelly McCormick, 2010) revealed that by writing students can confirm, organize, review and clarify the results of their thoughts, so that they can be used to solve problems. Furthermore, McIntosh and Draper (Kelly McCormick, 2010) state that writing is not only useful for organizing information and procedures, but for learning about our thinking processes. Kelly McCormick (2010) also suggests that explaining their solutions to mathematical problems through writing not only deepens their understanding of mathematics but also strengthens their communication skills about mathematics and learning vocabulary in mathematics lessons, because writing means they can explain what they have done and why the strategy works.

From these several explanations, it can be concluded that writing activities and mathematics learning can provide benefits for students and teachers as follows:

a. For student

1) By rewriting the learning they have experienced, it makes it easier for students to understand the material, because the writing uses their own language, and students can find out what they have understood and what they have not understood.
2) Writing can be used as memory for students, and students do not easily forget the material taught by the teacher.

3) Develop students' language and writing skills, learn to criticize their own and their friends' writing.
4) Improve students' mathematical communication skills verbally and non-verbally, by mastering communication skills students can reason and solve problems
5) Increase student creativity, and train students to write concepts and procedures sequentially.
6) Increase student self-confidence.

b. For Teachers

1) Easy to diagnose student difficulties and plan solutions.
2) Providing information for teachers where to start learning
3) Able to obtain information on difficulties experienced by individual students
4) As evaluation material for the next learning activity.

Problem Posing Approach

The curiosity that exists in everyone encourages someone to ask questions. The ability to ask questions is an indicator of the ability to think creatively, and asking questions is a mental activity that is very important in stimulating children's thinking abilities. (Ali, 2009: 2). For this reason, mathematics learning should provide space and opportunities for children to ask questions, by formulating their own questions from the given mathematical situation or related to the material in mathematics. Through this process, it is hoped that children's thinking abilities can develop much better in learning mathematics. An appropriate strategy for developing children's ability to ask questions is to use the problem posing learning strategy in mathematics learning.

Understanding Problem Posing

Problem Posing comes from English which consists of two words, namely problem problem/problem and posing from to pose = pose / form. Ellerton (Ali, 2008: 4) defines problem posing as the creation of questions by students that they can think about without any restrictions regarding the content or context. Silver (Lin, 2004) defines problem posing as creating new questions based on questions that have been given or reformulating questions from existing questions. Silver (Wardani, 2008: 35) states that posing a problem has three meanings, namely:

a. Formulate simple problems or formulate existing problems with several changes to make them simpler and more understandable in solving difficult problems. This meaning is one of the steps in creating a problem solving plan.

b. Formulate problems related to the requirements of problems that have been solved to find other alternative solutions. This second meaning is related to the review steps in the problem solving stage.

c. Formulate the problem of the given situation.

Suryosubroto (2009: 203) states that problem posing is a form of learning that can motivate students to think critically as well as dialogically, creatively and interactively by posing problems expressed in the form of questions. Problem posing learning is expected to

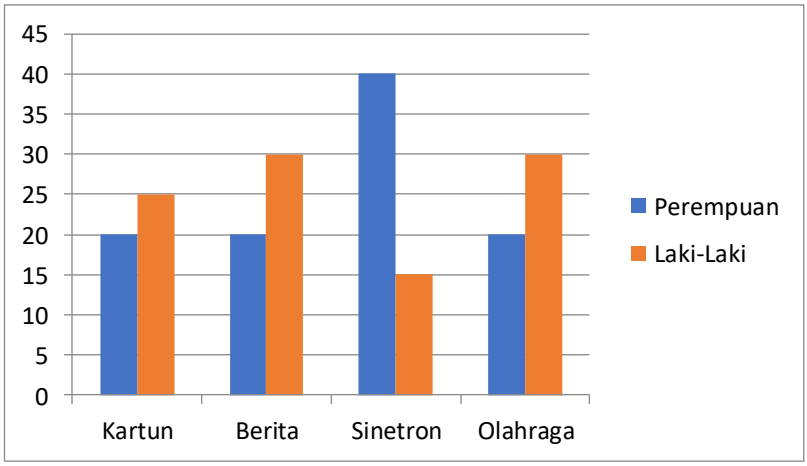
provoke students to discover knowledge that is not the result of accident but through their efforts to look for connections in the information they learn.

Silver and Cai (Ali, 2008: 4) classify three cognitive activities in making questions as follows:

a. Pre-solution posing, namely creating questions based on the situation or information provided.

Example

The following diagram shows the favorite TV shows of all Smart Scholar Middle School students.



Based on the diagram above, create 3 different questions related to the topic of fractions.

Some questions that students might prepare are as follows.

1) What percentage of students like cartoons?

2) What is the ratio of the number of students who like news and sports?

3) Write down a fraction that shows the number of students who like soap operas compared to the total number of students.

Within-solution posing, namely the creation or formulation of the problem being solved. The creation of such questions is intended as a simplification of the questions being solved. Thus, creating such questions will support the solution of the original questions.

Example

Know the following questions.

The area of Pak Ade's circular fish pond is 154 m2. Mr. Ade will make a fence around the pool made of wood. The distance between wood to make a fence is 4m. How much wood is needed?

Based on the situation above, create 2 questions that can support solving the problem in this situation.

Some questions that students might prepare are as follows.

1) What is the radius of the pool?

2) What is the circumference of Mr Ade's pool?

Post-Solution Posing. This strategy is also known as the "find a more challenging problem" strategy. Students modify or revise the objectives or conditions of questions that have been completed to produce new, more challenging questions. Making such questions refers to the "what-if-not...?" strategy. or "what happens if ...". Several techniques that can be used to create questions with this strategy are as follows.

1) Change the information or data in the original question
2) Add information or data to the original question
3) Change the data values given, but still maintain the original condition or situation of the problem.
4) Change the situation or conditions of the original question, but still maintain the data or information in the original question.

Example

The area of a rectangle 2 m long and 4 m wide is 8 m.

The questions that can be prepared are as follows.

1) What if the width is not 2 m but 3 m? How wide is it?
2) What happens if you change the length and width twice each? Will the area also become twice the original area?
3) What if we double the length and reduce the width by half? Will the area remain constant?
4) Determine the length and width of a rectangle whose area is equal to twice the area of the original rectangle.

Apart from the cognitive domain, problem posing can also develop the affective domain, including self-confidence and respect for other people. From these explanations, it can be concluded that problem posing is a lesson in class where students are given the opportunity to ask their own questions about the topic or material provided. When asking questions, of course children are also able to answer and complete these questions. Problem posing can be done by submitting new questions based on a given topic, and formulating questions from situations that have been given or modifying existing questions.

Steps to Learning Problem Posing

The steps for learning problem posing according to Lyn D. (1998) are as follows:

1) Students formulate problems, both individually and in small groups.
2) Students write solutions to the problems they create and submit the problem and solution sheets they wrote to the teacher.
3) The teacher distributes the problems created by students to other groups. The teacher provides sheets for criticism and answer sheets.
4) Students try to solve the problems they get and write them on the criticism sheet and answer sheet. Then it is collected back to the teacher and the teacher hands it over to the group of students who formulate the problem for correction.
5) Students present their work in front of the class, for discussion and correction.

Specifically, the Problem Posing learning guidelines for teachers based on this presentation are:

a. The teacher prepares activity plans and learning materials in the form of several different mathematical problem situations, in the form of written information, manipulative objects, pictures or others.
b. The teacher directs students to ask or formulate questions.
c. Next, the teacher trains students to formulate and pose mathematical problems, problems or questions based on the given situation.
d. Teachers can offer open-ended math problems, problems or questions.
e. The teacher facilitates discussion or dialogue between the teacher and students regarding the subject matter by rotating students to act as teachers.

Advantages and Disadvantages of Learning with Problem Posing

The advantages of learning by problem posing are as follows:

a. Learning problem posing improves students' analytical skills, because problem posing is not just formulating problems but involves students in how students discuss the results of their formulation, criticize one another, and filter problems from the results of joint discussions (Lyn D, 1998).
b. Improving students' understanding and awareness or caution in the structure of mathematical problems so that they can differentiate between good and bad problems.
c. Improving students' mathematical problem solving abilities while enriching and strengthening basic concepts.
d. Encourage students to think creatively, with variety and flexibility.
e. Increase students' self-confidence in solving mathematics problems and in solving mathematical problems.
f. Improving students' writing skills in mathematics.

The disadvantages of problem posing learning activities are:

a. The learning process takes a long time, so it is possible that the learning objectives are not fully conveyed.
b. It takes quite a long time for students to adapt to learning by problem posing.

Conclusion

In connection with the teacher's pedagogical competence, namely the teacher's ability to manage the class, in teaching mathematics teachers must always improvise themselves using various strategies to make learning mathematics in the classroom more enjoyable. Besides being fun for students, learning activities must be able to develop various mathematical abilities that students must have. Based on the explanation given, one alternative learning strategy that can develop students' mathematical abilities is the writing strategy Writing in Learning Mathematics and learning by problem posing.

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