Development of Problem Based Learning Models Assisted by Autograph to Improve Problem Solving Ability of Students in Class XI Students of Mentari Bangsa School Medan

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Abstract.This research is categorized into Research and Development research (research and development). This research includes development research using 4D model to develop Project Based Learning learning model assited by Autograph on Turunan Fungsi material and all required research instruments. This study used a limited trial to 30 students of class XI at senior high school Mentari Bangsa. The results showed that: Based on the normalized gain index, it was found that in the first trial there was an increase in the problem solving ability of students with the low criterion and in the second trial there was an increase in the score with the "medium" criterion. The increase is also seen from the acquisition of an average N-gain score of 2,50 which is in the high category.

Keywords: Model development, Problem Based Learning, Promblem Solving Ability

1 Introduction

Mathematics education is planned by teachers in various ways so that mathematics learning programs can develop and grow optimally, students can carry out their learning activities efficiently, and students can carry out their learning activities efficiently. The process of interaction between teachers and students is related to the development of thought patterns and logic in the realm of learning. According to Andriani (2015:5), to have human values, mathematics learning must begin with contextual or real-life problems that are relevant to students' direct and social lives.

In fact, Ningsih (2011:3) found that when teaching mathematics in schools, most teachers still dominate the teaching and learning process by applying behavioral theory-based learning such as direct learning models. Consistent with Ningsih, Halim (2017:2) states that teachers in general are too focused on solving problems.

During learning, teachers usually explain concepts informatively, provide sample questions, and provide exercises. During learning activities, students are very passive, they just listen and absorb explanations and work on questions while the teacher concentrates. In addition, student assessment with practice. But understanding mathematics learning is not easy. Many students do not understand the concept of a teacher. Students are taught mathematics passively and

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may even memorize formulas without understanding the meaning or utility of what they are learning. As a result, mathematics achievement in school is still relatively low.

To achieve more meaningful mathematics learning and ensure high student achievement, teachers need to be creative and innovative in developing learning activities during the teaching and learning process. Pentury (2017:2) states that education is no longer an effort to impart knowledge, but an effort to create an environmental system that teaches students in the best way to achieve educational goals. Teaching in this sense requires the right strategy to achieve the goals to be achieved and encourage teacher creativity in managing educational programs using various teaching and learning strategies.

Nani, Hamid, and Bahara (2018:49) argue that the learning model is selected and adapted to the environment that is relevant to real life. Learning models are needed so that they have a positive impact on students' skills and activities in learning (Ainin, Mulyono, Syahputra, 2020: 2). In line with this, Rahmawati and Suryanto (2018: 89) argue that a learning model consists of 5 components that affect the achievement of learning objectives.

However, the reality contradicts the existing theory. As explained by Abidin, Mohamed and Ghani (2016: 80), in carrying out learning activities, teachers use learning models that are not in accordance with the subject. The majority of teachers use the traditional model to carry out learning activities, and the learning model prioritizes the teacher as the main source of information. The teacher centered model does not pay attention to the active participation of students in the learning process. Wibowo, Budiyono, and Subanti (2014:695) suggest that the learning model used by school teachers still does not encourage students to develop thinking skills. Ainin, Mulyono, and Syahputra (2020:2) added that the use of innovative learning models has not been effectively applied in the mathematics learning process.

The development of learning models must pay attention to curriculum requirements. In other words, the learning tools that you develop must be in line with the curriculum. In addition, it is necessary to pay attention to the characteristics of students who are formed, such as the social environment, geography, culture, stage of development, initial abilities, interests, and family background, namely the characteristics of the intended person. Therefore, a learning model must be designed to carry out its functions effectively in order to achieve the expected learning objectives.

One of the educational models that can be developed is a problem-based learning model. In its application, PBL creates problems at the beginning of the educational process. The cases presented in the problem-based model are contextual cases, which are close to students' daily lives. In addition to the problems that are the starting point in this model, PBL students have the opportunity to build knowledge and communicate mathematical ideas through problem generation and problem solving activities. This has been confirmed by Arends and Kilcher (2010:328). He reports that problem-based learning has been shown to actively engage students in relevant learning experiences. Teaching that engages students actively in learning helps them to use your existing knowledge to deepen your knowledge. Furthermore, Arends & Kilcher (2010:328) argue that problem-based learning assesses learning in a way that demonstrates understanding rather than acquisition.

Therefore, it can be said that the PBL model can help students achieve the goals of mathematics education, especially mathematical problem solving skills.

2 Theoretical study

a. Problem Solving Skill

NCTM (2000:52) defines problem solving as a goal and an approach. Solving problems means solving problems, and we don't know how to solve problems before. To create solutions, students must practice what they have previously learned and practice through the process of developing new mathematical descriptions. Problem solving is not only the goal of mathematics education, but also a means to carry out the educational process (NCTM, 2000: 52).

In addition, the NCTM explains the problem solving criteria in learning mathematics in the context of problem solving. It aims to enable all students to develop new mathematical skills through problem solving, problem solving encountered in mathematics and other mathematics learning situations. Apply and adapt appropriate problem solving strategies to observe and reflect on the math problem solving process for pre-kindergarten to grade 12. Problem solving is an integral part of all mathematics learning. It consists of five criteria in its application to learning.

The following is a detailed explanation of the criteria for solving problems in mathematics education from NCTM (2000:52). In other words, in mathematics education, students can:

1. Build new mathematical knowledge through problem solving. Good problems give students the opportunity to consolidate and expand their knowledge and, when selected properly, can inspire students to study mathematics. Problem solving helps students develop special skills. The mathematical purpose of this problem is to allow students to think about the possible and control their thinking systematically without waiting for them to become proficient.

2. Unpacking problems that arise in mathematics and other contexts. Naturally, good problem solvers tend to carefully analyze the situation mathematically and propose problems based on what they observe.

3. Practicing and adapting various appropriate problem-solving strategies.

Different strategies are needed when students are faced with more environmental problems. Strategies are learned over time, applied to specific contexts, and become better, more detailed, and more flexible when used in a more environmental problem setting.

4. Observing and reflecting on the process of solving mathematical problems. Good problem solvers keep track of things and make adjustments. To make sure that students fully understand the problem, review them and adjust your strategy as you uncover the problem.

b. Problem Based Learning

Mathematics learning begins at every opportunity by introducing situational problems (contextual problems) so that students have the opportunity to formulate questions and conduct investigations so that these problems can be solved in the context of the student's knowledge building process. Problem-based learning is a structured model that helps students build knowledge and problem-solving skills and helps students acquire critical knowledge (Delisle, 1997:6). As Delisle notes (1997:8), the problems experienced in problem-based learning are contextual problems and relevant to students' daily lives, “problem-based learning deals with problems that are as close to real life situations as possible”.

The design of the PBL model refers to the 5 main components of the learning model. Hypothetically, the design of the components of the PBL Model is described as follows:

1. PBL Model Syntax

a. Open learning
b. Explaining learning objectives and motivating students (problem orientation)
c. Giving apperception (problem orientation)
d. Guiding students in forming groups, each group consisting of 4-5 students (organizing students to learn)
e. LAS distribution and explanation of work instructions (observations)
f. Guiding students to discuss problems with group members and find solutions to problems (individual/group teaching experience)
g. Making works in report format (elaboration and presentation of works)
h. Announcement of the results of group discussions (development and presentation of work) and providing reinforcements
i. Giving gifts to groups
j. Review and completion of learning materials (analysis and evaluation of the problem solving process)
k. Ask evaluation questions
l. provide follow-up care

2. Social system

The social system establishes the roles and relationships between students and teachers and the norms that govern the PBL model. In group discussions, students interact with each other. At that time, they had the opportunity to work together, defend each other's opinions, ask each other questions, respond to each other, and reach an agreement to resolve the problems they faced, to guide, direct and control the flow of discussion.

3. Principle of Reaction Management

The principle of reaction relates to how the teacher pays attention and treats students, and responds to stimuli that come from students such as questions, answers, responses and other activities.

4. Support System

To support the smooth implementation of this learning model, supporting devices are needed consisting of: Learning media materials and learning assessments equipped with an assessment/assessment rubric.

5. Instructional Impact and Accompaniment Impact

Effects of learning or teaching are learning outcomes that are directly achieved by directing students towards the expected goals. Accompanying effects are other learning outcomes produced by the learning process as a result of creating a learning environment experienced by students without direct direction from the teacher. The educational effect of this research is to improve the quality of mathematics learning. A side effect of implementing the PBL

development model is that students understand the importance of benefits in their lives, teamwork, and knowledge sharing.

Tabel 1. Autograph-Assisted Problem Based Learning Syntax

Fase	Indicator		Teacher Behavior
1.	Student orientation on problems		The teacher explains the learning objectives, explains the tools and materials needed, motivates students to be involved in problem solving activities.
2.	Organizing students to study		The teacher divides students into several groups, helps students define and organize learning tasks, and determines learning resources that can help students solve problems.
3.	Organizing students to get to know Autograph		The teacher introduces the Autograph software to students which will later be used by students to help solve the problems given and distribute the software to students.
4.	Solving mathematical problems	Understanding the problem	The teacher encourages students to collect the information provided in the problem, then guides in determining the strategic plan, and becomes a facilitator in implementing the strategy and carrying out observations to solve the problem.
		Planning strategy	
		Implementing strategy	
		Reviewing solutions	
5.	Develop and present the work		The teacher helps students in planning and preparing appropriate works such as reports, and helps them to share assignments with their friends.
6.	Analyze and evaluate the problem solving process		The teacher helps students to reflect or evaluate with the help of the Autograph on their investigations and the processes they use.

3 Research methods

Four D model is the development model used in this study to develop Problem Based Learning models with all the required instruments. The study used a limited trial of 30 samples, namely class XI at senior high school Mentari Bangsa Medan.

Mentari Bangsa school which is located at Mujahir street, Medan, North Sumatra Province is where this research is carried out. Research time is in the odd semester of the 2021/2022 academic year in October 2022.

The research subject was some 30 students in class XI Mentari Bangsa school. The reasons and considerations for choosing the subject of this study were based on considerations of Piaget's level of intellectual development theory where children aged over 11 years have entered the formal operational stage, which is the child's ability to think creatively. While the object is the problem based learning model on Turunan Fungsi material.

Fig. 1. Flowchart of developed problem based learning models is used in *Turunan Fungsi*

The developed problem based learning models is used in *Turunan Fungsi* learning if the model is valid, practical, and effective. The validity of this study was tested by introducing several experienced experts in evaluating learning model products, both learning and model design. The criteria are if the level of validity of the problem based learning assisted by Autograph and the minimum validity and level validity are , then it is "valid" (3 Va < 4).

4 Research Result

The research results are the problem based learning model for learning materials for students in Mentari Bangsa school grade XI. This research design uses the four D model. The results of the data analysis of Test I and Test II were obtained. In other words, 1) the learning model developed is valid. 2) The learning model developed is practical. 3) The learning model developed is effective.

Based on the results of testing the problem based learning model assisted by Autograph by the researcher, it has been validated with considerable validity. Due to the validity achieved, the developed model and device are suitable for use in research. In addition, the results of the validation of the Learning Implementation Plan (RPP) are 4.60, the Student Guide Book is 4.60, teachers book is 4,70, the Student Worksheet (LKPD) is 4.60. From that data, all validation values range $4 \leq V_a < 5$ with valid category.

For the practicality of the problem based developed, it has met the practicality category in terms of the results of the analysis of observations and observations of the implementation of learning activities. Test I obtained a score of 3.80 which was in the "Medium" criteria and did not reach the successful category. However, after making several revisions, the

implementation of test II obtained a score of the results of the implementation of observations and observations of learning activities that increased the score of 4.93 was in the "High" category. The conclusion was practical.

The problem based learning model by assisted by Autograph developed has met the effectiveness categories, namely: (1) 26 students or 86.67% have completed the second trial; (2) in the second trial, each item has reached the achievement of the learning objectives are achieved with criteria 75% of the maximum score for each item (3) in the second trial the students gave a positive response of 97,71%; and (4) the use of learning time does not exceed the usual learning time set by the school.

The development of this model based on the opinion of Joyce, Weil and Calhourn (2009: 48-51) there are five elements, namely: (1) syntax, (2) social system. (3) reaction principles, (4) support systems, and (5) instructional impact and accompaniment.

5 Conclusion

Based on the results of the analysis and discussion in this study, it was concluded that the devolepment of problem based learning models assisted by Autograph was declared valid, practical and effective so that it was feasible to use.

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