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Effectiveness of Problem Based Instruction (PBI) VS Expository Model: A Comparative Study of Junior High School Students' SPLDV Problem Solving Ability

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ABSTRACT

Objective: *This study analyzes the comparison of the effectiveness of the Problem Based Instruction (PBI) model and the Expository model in improving mathematical problem solving skills. The fundamental problem in learning mathematics often lies in the low skills of students in solving problems. The PBI approach is based on active learning through real problems, while the Expository model emphasizes the direct delivery of information by the teacher.* ***Method:*** *This study used a comparison experimental design between two treatment groups. The instrument used was a test of mathematical problem solving skills in the form of descriptions.* ***Result:*** *The analysis showed that there was a significant difference in mathematics problem solving ability between the group of students taught with PBI and the group taught with the Expository model. Specifically, the group using PBI showed a higher average problem solving ability than the Expository group.* ***Novelty:*** *This finding indicates that the Problem Based Instruction model is potentially more effective in developing mathematical problem solving skills.*

INTRODUCTION

Mathematics is the foundation of the development of modern technology and science, and plays an important role in honing the ability to think logically and systematically [1], [2], [3], [4], [5]. One of the main objectives of learning mathematics is to develop problem solving skills [2], [3]. This ability is not only relevant for solving academic problems, but also for facing challenges in everyday life, NCTM. However, the reality on the ground shows that students' mathematical problem solving skills in Indonesia are still relatively low. Data from international studies such as PISA (Program for International Students Assessment) and TIMSS (Trends in International Mathematics and Science Study) consistently place Indonesia at the bottom of the rankings, Ulum & Afriansyah. One of the contributing factors is the teacher-centered learning model, where students tend to be passive recipients of information [6]. The expository learning model, which relies on lectures and direct delivery of material, is often less effective in developing higher order thinking skills such as problem solving [7], [8], [9].

As an alternative, the Problem Based Instruction (PBI) model offers a student-centered approach. PBI is a learning model that uses real-world problems as a context for students to learn about critical thinking and problem-solving skills, as well as to acquire essential knowledge and concepts from the subject matter, Arends in Trianto. In the PBI model, students are encouraged to actively identify problems, gather information, develop strategies, and present solutions.

Based on this description, this study aims to empirically test whether there are significant differences in mathematics problem solving skills between students taught with the Problem Based Instruction (PBI) model and students taught with the expository learning model on the material of the System of Linear Equations of Two Variables (SPLDV).

RESEARCH METHOD

Research Design

This research uses a quantitative approach with a quasi-experimental method [10]. The design used was The Nonequivalent Posttest-Only Control Group Design, which is described as follows:

Table 1. Quantitative experimental design.

Group	Treatment	Post-test
Experiment	x_1 (PBI Model)	T_1
Control	x_2 (Expository Model)	T_2

Population and Sample

The population in this study were all VIII grade students in one junior high school. Sampling was conducted using Simple Random Sampling technique from the population. One class was selected as an experimental group that received PBI model treatment, and another class as a control group that received expository learning model treatment.

Research Variables

Independent Variable: Learning model, which consists of Problem Based Instruction (PBI) Model and Expository Model.

Dependent Variable: Students' math problem solving ability on SPLDV material.

Instruments and Data Collection Techniques

Data on mathematical problem solving ability was collected using a test instrument in the form of a 4-point description question that had been validated. Before use, the instrument was tested for validity and reliability. The validity test used Pearson's Product Moment correlation and the reliability test used Cronbach's Alpha. The test results showed that all items were valid and the instrument was reliable (r = 0.668).

Data Analysis Technique

Data analysis was conducted using inferential statistics after the prerequisite test was met.

1. Prerequisite Test: Includes normality test of data distribution using Liliefors Test and homogeneity test of variance using F Test.

2. Hypothesis Test: Using t-test for independent samples (independent sample t-test) at a significance level of α=0.05 to determine the difference in mean scores between the experimental and control groups.

RESULTS AND DISCUSSION

Result

After the treatment was given to both groups, a post-test was conducted to measure students' problem solving ability. The results of the data analysis are presented as follows:

1. **Descriptive Statistics:** The data showed that the experimental group (PBI model) had an average score ($\underline{X}$) of 31.22 with a standard deviation (s) of 9.11. Meanwhile, the control group (expository model) had an average score ($\underline{X}$) of 26.00 with a standard deviation (s) of 8.11.

Table 2. Descriptive statistical summary.

Group	Average	Standard Deviation	Highest Score
Experiment (PBI)	31,22	9,11	44
Kontriol	26,00	8,11	40

2. Prerequisite Test Results: The results of the normality test showed that the data of both groups were normally distributed ($L_{Hitung} < L_{Tabel}$). The homogeneity test results show that both groups have homogeneous variances ($F_{Hitung} = 1{,}263 < L_{Tabel} = 1{,}85$)
3. Hypothesis Test Results: Based on the t-test calculation, the value $T_{Hitung} = 2.417$ was obtained. With a significance level of $\alpha = 0.05$ and degrees of freedom (dk) = 59, the value $T_{Tabel} = 1.689$ is obtained. Because $T_{Hitung} > T_{Tabel}$, the null hypothesis (H_0) is rejected. This shows that there is a significant difference between students' math problem solving skills in the experimental group and the control group.

Discussion

The results showed that the Problem Based Instruction (PBI) learning model was significantly more effective in improving students' mathematical problem solving skills compared to the expository model. The average score of the class using PBI is higher, which indicates that the learning process in the class goes better in achieving learning objectives.

This finding is in line with the theory underlying PBI. The PBI model places students as the center of learning and encourages them to be actively involved in the discovery process. The steps in PBI, starting from orientation to the problem, organizing students to learn, guiding the investigation, to presenting the work systematically train students to go through the stages of problem solving proposed by [11], namely understanding the problem, planning a solution, implementing the plan, and re-examining.

In contrast, expository models that tend to be one-way in nature make students less trained in constructing their own knowledge [12], [13], [14], [15]. Students only receive ready-made information from the teacher, so when faced with non-routine problems that demand analysis and reasoning, they have difficulty. The advantage of PBI lies in its ability to create an authentic and challenging learning environment, which motivates students and develops critical thinking skills and learning independence.

CONCLUSION

Fundamental Finding : This study concludes that there is a significant difference in mathematics problem solving ability between students taught using the Problem Based Instruction (PBI) model and students taught using the Expository model. **Implication :** The Problem Based Instruction (PBI) model proved to be more effective in improving students' mathematical problem solving skills. **Limitation :** However, the study does not elaborate on contextual variables such as student motivation, teacher competence, or classroom environment, which might influence the effectiveness of the models. **Future Research :** These results underscore the potential of PBI as a superior approach for the development of problem solving skills in mathematics education, and future research is encouraged to explore its implementation across different educational levels, subject complexities, and diverse student populations.

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