

## The Effectiveness of Generative Learning in terms of Learning Independence of Students Problem Solving Abilities in the Pythagorean Theorem Material

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### Abstract

This study aims to describe the generative learning of quality in increasing problem solving abilities, to test the effect of learning independence on problem solving abilities, and to define problem solving abilities in terms of learning independence. This research method is mixed methods with concurrent triangulation model. The population of this research were VIII grade students of SMP Negeri 35 Semarang in 2018/2019 academic year, and samples were taken by cluster random sampling. The technique collection of data used such as a questionnaire of learning independence, a test of problem solving skills, documentation, observation, and interviews. The data analysis technique used the average similarity test, the proportion test, the average similarity test (two-sample t test), and simple linear regression. The results of this study indicate that students have good problem solving skills because of the enthusiasm in mathematics, understanding concepts, and feeling mastered the material. The study also showed that the generative learning model was declared effective, by indicators namely the problem solving ability of students reaching KKM (Minimum Mastery Criteria), the generative model produced problem solving abilities and students learning independence better than PBL (Problem Based Learning), and the problem solving abilities of students to the generative model that affected their learning independence.

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## INTRODUCTION

Education for human life is an absolute necessity that must be fulfilled throughout life. Without education, human cannot live to develop and progress. Education for the Indonesian people is currently one of the sector that must be developed. The quality of human resources will be formed and improved because education is a vehicle for realizing the ideals of the Indonesian in realizing national public welfare and educating the life. The national education functions to develop capabilities and compose the character along with dignity of a nation in the context of educating the nation life purposed in developing the student potentials in order they become an human who is devoted to God Almighty, having good morality, healthy, knowledgeable, creative, independent and becoming the color of a democratic country as well as to be responsible.

Mathematics is a subject that plays an important role in the development of science and technology. In the mathematic learning, not just learning about numbers and formulas, but more important role in human life, teaches how to think critically and solve problems in everyday lifes. The National Council of Teachers of Mathematic (NCTM) determine that there are five student abilities must have through learning mathematics. One of the student abilities must have after following mathematics learning is problem solving ability. This it can be said that the main focus in learning mathematics is to develop problem solving abilities.

According to Afgani (2011) meaningfulness in learning mathematics will emerge when the activities developed in learning contain the processes standard of learning mathematics, namely understanding, reasoning, communication, connections, problem solving, and representation. According to the National Education Standards Agency (BSNP, 2006) is students have the ability to solve problems that include the ability to understand problems, design mathematical models, solve models, and interpret the solutions obtained. Weitheimer, as quoted by Afgani (2011) emphasizes that study

can occur because of the discovery of various ways of solving problems. Therefore the teacher must be able to help students provide meaningfulness in learning mathematics and build students mathematical problem solving abilities to deepen students' understanding of mathematics. In reality, students' mathematical problem solving abilities in Indonesia are still very low. This can be seen from the PISA results which shows that Indonesian students are ranked 64 out of 65 countries in the world. These results have occurred over the past ten years. Not much different, the 2015 TIMSS results which showed the achievements of Indonesian students in mathematics were ranked 46 out of 51 countries with a score of 397.

Indonesian students mastered routine questions, simple computing and measured knowledge will facts that daily contexts. Therefore it is necessary to strengthen the ability to integrate information and provide conclusions related to mathematical problems. This is in accordance with the opinion of Branca as quoted by Sumarmo (2004) who argues that solving problems is at the heart of mathematics. A person's mathematical ability can be described based on his ability to solve mathematical problems. In addition to problem solving skills, learning independence is also an important factor in learning mathematics. Because at this time the concept of learning mathematics has changed from giving a concept and procedure passively and not contextually to the active formation of meaning as a result of linking new ideas to previous understanding. This implies that students must be students who have independence in the learning.

Addressing the problems that arised in mathematics education, and the expectations to be achieved in learning mathematics, it needs innovative efforts to overcome the problems. Students need to be accustomed to being able to construct knowledge and be able to transform their knowledge in other more complex situations so that knowledge will become their self. The process of constructing knowledge can be done by students based on previous experience, and it can also be in the discovery result involving the

environment as a factor in the process of acquiring knowledge.

The low independence of learning and mathematical problem solving in students is caused by these two factors, including external factors and one of them is the teacher, the teacher is less able to implement the correct strategy or learning model. This is one of the reasons that makes student reluctant to learn mathematics. Students tend to have difficulty working independently on the material provided, and the lack of asking the teacher so that in solving mathematical problems students will feel difficulties too. This is what causes the independence of learning and solving mathematical problems of students is still relatively low.

Many efforts can be made to create a conducive of learning ambience so that students experience meaningful learning, including trying kinds of learning models that are considered in accordance with the conditions of students in the class and the material to be taught. One of them using a generative model which learning model based on constructivism. The generative learning model such as four stages, namely the stages of exploration (preparation), focusing (direction), challenges (discussing) and application of concepts. Theoretically, the stages in generative learning models can develop mathematical problem solving and student learning independence. This is seen at the application stage, students are invited to be able to solve problems related to the practical matters in daily life by using their new concepts.

Based on this description, it is necessary to conduct research on the ability of problem solving in generative learning in terms of the students' learning independence of the Pythagorean theorem material which aims to find out: (1) describing the generative learning of quality to improve the mathematical problem solving abilities of the Pythagorean theorem material; (2) testing the effect of students learning independence on their abilities about problem solving mathematic, and (3) defining problem solving abilities in terms of the students' learning independence.

## METHODS

The research method used is a combination of quantitative methods and qualitative methods used together in a research activities, in order to obtain more comprehensive, valid, reliable, and the objective data (Sugiyono, 2015). The combined research model used is concurrent triangulation, which is a research model that combines qualitative and quantitative research methods by mixing the two methods, used together, at the same time, but independently to answer the problem formulation (Sugiyono, 2015).

The population of this study was students of class VIII of SMP Negeri 35 Semarang in 2018/2019 school years. The study sample was a group of students gathered in one class as an experimental class and a group of students gathered in one class as a control class. With the provisions of the experimental class students are treated with generative learning models, while for the control class students use the direct learning models. The sampling was done by cluster random sampling technique.

The research variables used in this study includes the independent variables and the dependent variables. The independent variable in this study is the learning model, which consists of two levels, namely the generative learning model and the PBL model. The dependent variable in this study is the abilities of mathematical problem solving and the student learning independence.

There are five kinds of data collection techniques in these studies study, which are questionnaire, test, documentation, observation, and interview. The validation analysis in this study is based on recommendations from expert validators. The instrument assessment consist of: Syllabus, RPP (lesson plan), LKS (student worksheet), Student Book and problem solving ability of tests. Validation determined based on the evaluation of a validator who is competent in the math field. The data obtained from the validation sheets of the results of each validator's study on the learning devices are then analyzed base on the average score of each device which is calculated by dividing between the average

number of scores of each device divided by the aspects numbers assessed on the device.

The analysis results of the test of the problem solving ability of test instrument and was carried out on students of class VIII C SMP N 35 Semarang even semester of the 2018/2019 school year. The analysis test of problems by confirming with the analysis of test items. The analysis test is necessary because (1) to determine the strengths and weaknesses of the test items, so that selection can be done, (2) to provide information about the specifications of the items in full so that it will be easier to arrange the set of questions that will meet the needs of the test in the field and certain level. For the analysis of the test items of problem solving abilities in this study are validity, reliability, level of difficulty and distinguishing power.

Analysis quantitative is performed to test the effectiveness of learning. To do this, the prerequisite test is normality test and variance homogeneity test. The normality test used the Kolmogorov-Smirnov test and the homogeneity variance test used the F test. To test whether the average student reached the KKM of 75, one sample comparative of test was used with the right-side t-test (Sudjana, 2005). To test whether each student is complete, use the proportion test with the right-hand z-test (Sudjana, 2005).

The ability of solve problems of each student is said to be complete, if they meet the requirements of mastery learning individually with the KKM of SMP N 35 Semarang 75% classical completeness in the class. The comparative test, namely the difference in learning outcomes of the experimental group and the control group, was carried out using the t-test on the right. Before choosing the right t-test formula, the variance similarity test is done first. In this study for statistical tests using SPSS assistance (Sukestiyarno, 2012). Simple linear regression analysis is also used to see the effect of students' problem solving of abilities on learning independence.

## RESULTS AND DISCUSSION

### Generative Model Learning Tools

Before the researcher plunges into the field in class VIII C of SMP Negeri 35 Semarang, it is necessary to develop a learning tool that will be used in analyzing problem solving of abilities. For a device to be feasible to be applied in research, it must be validated. The learning tools used in this study include syllabus, lesson plans, student worksheets and student books have been declared valid by the validators.

### Implementation of Generative Model Learning

The first activity carried out at this stage is to provide a preliminary test in advance to determine the extent of students' mathematical problem solving of abilities. From the test given, six students were taken as research focus subjects in the high, medium and low group categories, where 2 students were selected based on the category groups.

Students selected in the high group categories are students with codes E-1 and E-7, for medium group students are they used the codes E-18 and E-24, while for low group students are students with codes E-13 and E-14. To obtain more in-depth information, interviews were conducted for the six selected students. In the first activity of the study provided a preliminary test of problem-solving abilities to students of class VIII C. Through the initial tests of problem-solving abilities given to 30 students, none of the students achieved KKM completeness. This shows that the problem solving ability of students is classified as very low. In addition, students are also not accustomed to working on problems that measure the ability of problem solving.

This was reinforced by interviews with several students that during learning students have never been given problems solving skills. Based on the results of the work, the way students answer questions on the initial problem solving abilities varies greatly presented in Table 1.

Table 1. Differences in The Problem Solving Ability of High, Medium and Low Group Students

Indicator of problem solving capability	Independence learning		
	High group student	Medium group student	Low group student
Identifying the problem	Students are able to identify problems well	Students are quite able to identify problems well	Students are less able to identify problems well
Make a mathematical model	Students are able to make mathematical models well	Students are quite capable of making mathematical models well	Students are not able to make mathematical models well
Implement a settlement strategy	Students are able to implement completion strategies with their own ideas	Students are quite capable of implementing completion strategies with their own ideas	Students are not able to apply the completion strategy with their own ideas
Explain the results	Students are able to explain the results in more detail	Students are quite able to explain the results in detail	Students are not able to explain the results in detail
Complete a mathematical model	Students are able to explain the model in various ways	Students are quite able to explain the model in various ways	Students are not able to explain the model in various ways
Use mathematics meaningfully	Students are able to use mathematics significantly	Students are quite capable of using mathematics significantly	Students are not able to use mathematics in a meaningful way

**Mathematical Problem Solving of Capability with Generative Models Reaching Minimal completeness Criteria**

Based on the test scores of the experimental class problem solving skills in class VIII C Semarang 35 Junior High School after using the Generative learning model, the highest score was 92 and the lowest value was 44. Data processing assisted by SPSS Statistics 21 found that the average score was 76.47; middle score (median) 80.00, mode 80.00 and standard deviation of 11.26.

Furthermore, to find out whether students' learning outcomes are complete or incomplete, the KKM from the school for mathematics is 75. Based on the results of the test with the category of completeness or have fulfilled the KKM as many as 24 students or 80%, while the category does not complete or not meet the KKM of 6 students or 20%. So it can be concluded that the existence of learning with generative models increases the ability to solve mathematical problems.

**Mathematical Problem Solving of Ability with Generative Models Reaching The Minimal Classical of Completeness Criteria**

After the treatment of learning with the generative model, the results of the test of problem solving abilities of 24 students from 30 students completed KKM. This means that there were only 6 students in the class who did not complete the KKM. The results of mathematical

problem solving of ability tests for students of SMP N 35 Semarang with the KKM completeness category were 80%. Furthermore, find out students reach the classical minimum completeness criteria, the school determines the classical KKM stipulation of 75%. So it can be concluded that the results obtained indicate that the classical KKM results by 80% exceeded the provisions determined by the school. This means that the mathematical problem solving ability with the generative model achieves the minimal classical of completeness criteria.

**The Mathematical Problem Solving of Ability Using Generative Models Is Better than PBL Models**

Based on the test results, the problem solving of ability is given to two classes, namely the experimental and control classes with different treatments. Where the experimental class with learning using the generative model, and the control class with learning using the PBL models. From the test results of the two classes, it can be chosen that there are many differences, it is from the experimental class of the highest value is 92 and the lowest value is 44. While in the control class the highest value is 76 and the lowest value is 44. The test results of the experimental class and control class problem solving skills details are in the appendix. Data processing assisted with SPSS Statistics 21 is known that the average value in the experimental class was 76.47 while in the control class was 53.73. From these

results it can be concluded that, the problem-solving ability with the generative model is better than the problem-solving ability with the PBL model.

### **Independence Learning With Generative Models Is Better than PBL Models**

In accordance with the calculation results of student learning independence of questionnaire experimental class and control class, it can be seen in the data of processing assisted with SPSS Statistics 21. The results obtained mean a value of 31.23 and a standard deviation of 4.22. While the results of processing the learning independence questionnaire score in the control class, a mean of 24.00 and a standard deviation of 2.91 were obtained. Based on the calculation results presented it can be concluded that there is a difference between student learning independence in the experimental class and the control class. In this case that the mean value in the experimental class is more than the mean value in the control class, so it can be concluded that the independence of learning with generative models is better than the results of learning independence with PBL models.

### **The Effect of Student Learning Independence on Mathematical Problem Solving of Ability**

In accordance with the scores of the test results of problem solving abilities as well as the results of the calculation of student learning independence of questionnaire experimental and control classes, explained the magnitude of the relationship value of 0.669 and obtained a coefficient of determination of 0.447 which implies that the mathematical problem solving ability of student learning independence by 44.7%. It is known that the calculated  $F_{\text{value}} = 22.661$  with a significance level of  $0.000 < 0.05$ . From these calculations it can be concluded there is an influence between the ability to solve problems with the independence of student learning.

### **Problem Solving Ability of Judging from the Independence of Student Learning**

Learning independence is an attitude that has the characteristics of initiating learning,

monitoring, managing and controlling performance or learning independently. Based on the data analysis, the study results shows that there is an influence of the ability to solve mathematical problems with high, medium and low learning independence. The grouping results of learning independence scale are presented in Table 2.

**Table 2.** The Categories of Student Learning of Independence Scales

Interval	Category	The number of students
43 – 59	Low	4
60 – 76	Medium	4
77 – 93	High	22

Learning in the experimental class encourages students to be more active and confident in answering questions about problem solving abilities. The whole series of learning with generative models in the experimental class causes better problem solving skills than the control class. The results of the analysis were obtained that the problem-solving ability of students in the experimental class had reached completeness both individually and classically. The problem solving ability of students in the experimental class is better than the problem solving ability of students in the control class.

### **Description of Improving Troubleshooting of Abilities**

#### **High ability students**

When given the initial test the subject E-1 gets the test results in the high category and when given the final test the subject E-1 scores increase so that the E-1 subject remains in the group of high ability students. From the results of the interview it can be concluded that students are interested in the generative learning models. Because the generative model can foster student learning independence.

#### **Medium ability students**

At the time of the initial test the subject E-24 gets a score in the medium categories, and after being given the final test of the value of the E-24 subject is increased so that the value obtained is included in the high category. From

the results of the interview it can also be concluded that students are interested in generative learning models.

Low ability students

When given a preliminary test the subject value of E-14 falls into the low categories, after being given a final test the value rises and falls

into the high categories. From the interview results problem solving it can be concluded that the E-14 subject also felt no difficulty after taking the final test because the E-14 subject was trained to work on the questions as given. The difference between the test answers with the generative models and PBL Models can be seen in the following Table 3.

**Table 3.** Example Result of Test Answers to Problem Solving

Category	The result of the test answers to the problem solving ability	
	Generative models	PBL models
High ability students		
Medium ability students		
Low ability students		

**CONCLUSION**

Based on the study results, it can be concluded that students lack enthusiasm and interest in learning the Pythagorean theorem materials, Students do not understand the concept and feel confused about the formula of the Pythagorean theorem formula , so that it has not demonstrated the ability of problem solving. Mathematical learning with generative models on the pythagorean theorem material is declared effective, which is shown by the problem solving ability of students reaching KKM, generative models produce problem solving abilities and student learning independence better than PBL, and the problem solving ability of students on

generative models influences student learning independence. Students are interested in the generative learning model because it can foster independent learning and improve students problem solving abilities.

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