Problem solving investigation on linear equation of two variables using independent learning of student

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Abstract: Mathematics is a field of study that are useful in solving various problems in everyday life that requires a skill and the ability to solve those problems. In this research, the author examines the constraints faced by the students on the material SPLDV. In this research, the author examines the constraints faced by the students on the material SPLDV. The author tried to examine how to resolve the problem of the students by applying a model of learning. This research aims to find out whether there are significant effects between independent learning model of problem-solving ability against Shiva on the material SPLDV of Class VII MTsN Batang Angkola. This research is quantitative research with experimental methods. The population of this research is the overall grade VIII MTsN Batang Angkola consisting of 5 classes as much as 175 people, samples taken from the class VIII\(_1\) and VIII\(_2\), and the number of 35 samples of students in the class VIII\(_1\) as class experiments and 35 students in control classrooms as VIII\(_2\). Data-collecting instruments is a test that is given twice, before being given treatment (pretest) and after (posttest) the treatment given. Data processing and data analysis was done using the formula t-test. Based on the results of a test of the hypothesis, retrieved \(t_{\text{hitung}} = 2.48\) \(t_{\text{ tabel}} > 1.6675\) at 0.05 significant level. Based on those results, the conclusion to be drawn there are significant effects between independent learning model against Shiva's problem solving on SPLDV material class VIII MTsN Batang Angkola.

1. Introduction

Mathematics is a subject that has significant role in education. By learning mathematics, students can develop logical, critical, analytical, systematic and creative thinking ability as well as cooperative skills [1]. To improve the quality of education cannot be separated from how the process of teaching and learning that takes place. Learning is a change in the activity of reaction on the environment. The position and role of mathematics education is very important for the development of science and knowledge given the mathematics is the science that is very important to note to everyone. Math is the symbolic language, and its main characteristic is the way of deductive reasoning, but also not forgetting the inductive reasoning. The study of mathematics is a field of study which is useful to help solve various problems in everyday life that relate to calculate the count or the figures relating to the wide range of problems, which require a skill and ability to break it. Therefore, students as one of the components in education should always be trained and conditioned to think independently to solve problems. Because, problem solving in addition to demand students to think is also the primary tool for performing or working in mathematics. Problem solving in learning mathematics this is a model of learning that should continue to be developed and enhanced its implementation in schools.
With this mathematical problem solving of students perform activities that can encourage the development of understanding and students against the principle, penghayatan nilai, and mathematical processes.

Problem solving is an integral part of all mathematics learning, and so it should not be isolated from mathematics program [2]. Krulik and Rudnick defined problem solving ability as a individuals means in using the knowledge and capabilities that have been had previously to be synthesized and applied to new and different situations [3]. Treffinger, Isaksen, and Dorval state that problem is ‘… any important, open ended, and ambiguous situation for which one wants and needs new options and a plan for carrying a solution successfully’ [4]. A problem is known as open ended since it gives so many various options, or in the other words, the answer is not figured out in singular option or one solution only, but also in many ways [5]. Therefore, it does not rely on true answers but on how the process to answer the problem goes. Mathematical problem solving has long been viewed as an important aspect of mathematics, mathematics teaching, and mathematics learning [6]. The importance of this problem solving significantly plays a important role in mathematics teaching and learning [7].

Lesh and Zawojewski defined "mathematical problem solving as the process of interpreting a situation mathematically, the which usually involves Several iterative cycles of expressing, testing, and revising mathematical interpretation and of sorting out, integrating, modifying, revising or refining clusters of mathematical concepts from various topics within and beyond mathematics ” [8]. Trough problem solving students can enhance reviews their thinking skills, apply procedures, deepen reviews their conceptual understanding ”. Meaning problem solving plays an important role in learning mathematics [9]. On the other hand, Ministry of National Education’s (MNE) 2012 mathematics teaching program vision included the expression of “Raising individuals who can use mathematics in life, solve problem, share the solutions and thoughts, work in teams, have self-reliance and develop positive attitude towards mathematics is remarkable.” In the general purposes of the same program, the expression of “…developing problem solving strategies and using these for overcoming the problems in the daily life” was included [10].

Polya (1945) describes the process of problem solving at four stages, including understanding the problem, determining the strategy, implementing the selected strategy and assessment [11]. At the stage of understanding the problem, the student is expected to state what he understood from the problem and to determine what are the given and unknown in the problem and also to suggest clearly the condition of the problem. At the stage of determining the strategy, the student is expected to determine which steps such as calculation, drawing, etc. to follow in order to reach the requested. By applying some phases of the problem-solving skills, such as: understanding the problem, devising a plan, execute the plan and look back a solution, students are expected to develop curiosity and motivation and logic that can creative, systematic thinking and student's to solve and deal with the problems of their daily lives. Problem solving can be seen as a process that integrated in every part of mathematics learning, which also provides skill as a context [12].

Based on the theory of learning advanced intellectual skills that Gagne high levels can be developed through a process of problem solving [13]. Teach problem-solving to students from a teacher is an activity where a teacher that awakens students to receive and respond to questions posed by him and then she guides students to get to problem solving. In resolving a problem, students are expected to understand the process of resolving the problem and be skilled in selecting and identifying relevant concepts and conditions, seeking, formulating the plan of the settlement and organizing skills that have been previously owned. Independent learning model is a model of learning which learners learn independently have freedom to learn given the teacher/educator classroom [14]. Discuss ways to create an effective community to learn and demonstrate that the environment self-learning must develop a climate where important people and respect the Group creating the trust, support and communication [15]. Based on the annual survey four TIMSS are coordinated by the IEA (International Association for the Evaluation of Educational Achievement) one of the Indicators is assessed cognitive ability of students to Troubleshoot the non routine.
Participation in the first year of 1999 Indonesia gained an average score of 403 and ranks to 34 from 38 countries, year 2003 obtained an average score of 411 and ranked at 35 to 46 of the country, in 2007 average values gained 397 and to be ranked 36 out of 49 countries, and in 2011 memperoleh the average value of 386 and ranked 38 out of 42 countries. The average standard value set by TIMSS is 500 this means Indonesia's position in any participation always gain value under average. Based on the results of TIMSS survey that has been put forward, see that there are still many students have trouble when facing problems of mathematics in non routine related to mathematical problem solving ability [16].

An independent person can make his own choices responsibly when he wants to learn or what he wants to learn. Such an opinion the first important step before self-learning skills can be developed for students is to understand the need to change. Unless they see this need and desire change, students have no reason to change their approach or any motivation to overcome old habits. Fridani and Lestari states, the principle of independence in learning means that in teaching and learning activities, as early as possible developed independence [17]. The realization of the principle of self-reliance in learning will place the teacher in the lead role as a facilitator and motivator. According to Nagpal, Priyamakhija, James, Gyanprakash learning independence is a process, method and an educational philosophy: in which a student acquires knowledge with his own efforts and develops the capacity for critical inquiry and evaluation [18].

According to Rusman the level of student learning independence of students is related to the selection of programs: (1) choosing program whose opportunities for dialogue are higher and less structured, or (2) programs that lack opportunities for dialogue and are highly structured. According to Grover, Miller, and Porter Individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes [19]. Johnson (2002) says that independent learning frees students to use their own learning styles, advance at their own pace, explore personal interests, and develop their talents by using the multiple intelligences they like. According to Bartholomew learning independence is the ability of students to self-assess their own learning needs to do activities to ask and find out about things they want to know, learning independence combines understanding of what is unknown with an understanding of what activities need done to get the knowledge needed [20].

Independence of learning is important for the creativity of students in producing the work to develop optimally [21]. This characteristic allows students to learn independently and optimize their creativity in learning. While learning using printed materials that contain material and guidance in understanding and practicing the lecture material also provides opportunities for students to learn independently. Independent learning is learning in which the learning goals, methods or direction to achieve the learning goals, and regulation of learning process is decided, guided and managed by the learner [22].Independent learning can be seen quite broadly to encompass a variety of situations and contexts where students are interpreting and scaffolding new knowledge and skills independently from those around them [23].The aim of independent learning is to teach students to learn for themselves and in turn empower them in their learning process regardless of their learning context or environment [24].Being an independent learner does not mean ‘learning on your own’ or in an isolated way [25].

Independent study is not an attempt to alienate students from learning and from an instructor/teacher. Independent study can also be translated when learners learn of their own accord, they will develop the capability of focus and reflect on [26]. Independent study can be done in small groups, where the students help each other each other in learning. This strategy can be used to develop the ability of students in making responsible decisions, analyzing problems. The process of independent study is a method which involves students in actions that include multiple steps, and produces good results that looked or didn't look. These steps use a variety of skills that have been written previously, also using academic knowledge. The most important thing in the process of independent study is the improvement of capabilities and skills of the learners in the learning process.
without the help of others, so that in the end the learners do not depend on a teacher or educator, mentor, friend or others in the study.

Researchers are trying to elucidate the more basic, what exactly into trouble troubleshooting, found students to achieve learning outcomes. High or low quality education should be seen from the root of the problem, especially mathematics. So the problem is examined more clearly, then any thing that makes students less successful on mathematical subjects, researchers held an interview with Mr. Subriadi, s. Pd as a teacher of Mathematics subjects in class VIII MTsN Batang Angkola. The author concludes, that the usual methods applied in the process of learning is a method of lecture and question and answer.

Aside from that, from the results of the initial observation, the author sees a lack of closeness between teachers so that students with learning how to be active in the learning process is not yet completed, because the learning that takes place there still are centered on the teacher's course so the students are still passive. According the results of the interviews, the writer also got information that the independent learning of students in Stem MTsN Batang Angkola, specifically class VIII is still insufficient, so the impact on the ways of solving the problem. Independent learning model is believed to be able to facilitate students in understanding the problem solving. In line with the lessons of mathematics which specifies for on problem solving must be mastered.

This learning model can increase the liveliness of students so as to positively impact to solving them, in the sense that if this learning model applied by the teachers concerned. The application of this model, namely by presenting examples of matter in the form of essay tests. In this case, students are expected to give motivated hypothesis requested teachers, so that within the learning activities of students play an active role.

Independent learning model can overcome boredom that is commonly experienced when students learn because of how education has adapted to the steps of the learning model. Independent study can train liveliness at the time the learning process of the students in the class. Thus, students will develop the ability of focus and reflect. As reference material for the enhancement of the learning process in the implementation of the learning model. In the process of independent learning, students are given the opportunity to opt in to determine the goals, resources, and evaluation of their learning.

The background of the authors describe above, the formulation of the problem in this research are as follows: are there any significant effects between independent learning model towards problem-solving capability of students on the material system of equations Two linear variable (SPLDV) class VIII MTsN Batang Angkola. In each research an author certainly had a definite goal, because without the objective possibilities of research done will be in vain and cause any harm; As for the goals of this research are as follows: to find out whether there are significant effects in the application of the model of independent learning, problem-solving ability against students on the material System of Linear equations two variables (SPLDV) class VIII MTsN Batang Angkola. As for the benefits of this research is with the application of independent learning model will be improved students’ problem-solving way on the material System of Linear equations two variables.

2. Research Methods
The method used in this study is quantitative research using experimental methods. According to Bambang Joon and Lina Miftahul Jannah, experimental research is one type of very strong quantitative research to measure the causal effect [27]. This research was carried out at the place of MTsN Batang Angkola. As for the population in this research is the student/students of class VIII MTsN Batang Angkola. In this study, researchers took samples using cluster random sampling with probability principles. Cluster random Sampling, namely by taking samples from the four classes that have the same opportunity that is by way of a random [28].So this study, samples were taken of students from two classes, namely class VIII-3 with 35 people as the number of experimental classes.
and class VIII-4 with a total of 35 people as the class of the control. In this study, researchers used a test instrument to obtain data about problem-solving mathematics students on the material system of linear equations two variables (SPLDV). Tests that use shaped essay. Essay test is often referred to by his essay examination, which is a question that demands the students answer in the form of elaborate, explain, discuss, compare, give reasons, and similar forms in accordance with the demands of the questions using the words and language of their own [29]. In this design the test done twice before and after experiment experimentation experiments or the classroom good classroom control. Tests conducted before the experiment is a pretest and posttest called experiment after the test.

3. Result and Discussion
Of the Research Results of this research is the result of testing instruments, research, and discussion of the results of research on data model of independent learning of mathematics problem solving towards students in the classroom experiment and use regular in-class learning control on material SPLDV in class VIII MTsN Stem Angkola. Initial Value Data Descriptions (Pre-built Test). Data that have been described are pretest results data grade VIII MTsN Angkola Rods on the Group eksprimen and also a control group. Pretest data obtained before treatment given in the class. Description of the data value of the pretest study results can be seen in the following table:

| Table 3.1 Description Of The Data Value Of The Pretest Study Results |
|----------------|----------------|
| Kelas Eksprimen | Kelas Kontrol |
| \( \sum X_1 \) | 2405 | 2270 |
| \( n_1 \) | 35 | 35 |
| \( \bar{X}_1 \) | 69 | 65 |
| \( S_1^2 \) | 246.09 | 240.42 |
| Me | 62.5 | 57.7 |
| Mo | 79 | 78.5 |

From the table 3.1 data is then retrieved test data analysis requirements based on a test of Normality and this calculation is done using the test chi square \( X^2 = \sum_{i=1}^{k} \frac{(f_o-f_h)^2}{f_h} \) criteria \( X^2_{hitung} < X^2_{table} \). Based on the results of the calculations for the control class obtained maximum value = 90, minimum value = 40, range = 50, many class = 7, length = grade 8, average = 57.7, raw = 16 junction and the price of chi - square \( X^2 = 6,518 \). While the results of the calculations for class experiments obtained maximum value = 90, minimum value = 40, range = 50, many class = 7, length = grade 8, average = 56, Junction 14 and price = raw chi – square \( X^2 = 7,736 \). The value of \( X^2_{table} = 13,276 \) with degrees of freedom (dk) = 4, and significant levels \( \alpha = 1\% \) (0.01). On the control class \( X^2_{hitung} = 16,518 < X^2_{table} = 13,276 \) nor experimental class \( X^2_{hitung} = 7,736 < X^2_{table} = 13,276 \). So that the data on the second class Gaussian.

Based on the above data were obtained at test data analysis requirements based on its homogeneity test \( n_1 = 35, n_2 = 35, S_1^2 = 246.09 \) and \( S_2^2 = 240.42 \). Then the obtained F count = 1.02 with a significant level of 5% and dk \( \alpha = 35 \) and 35, and of the F distribution list obtained \( F_{table} = 1.76 \). So it can be drawn the conclusion that \( F_{hitung} = 1.02 < F_{table} = 1.76 \), then there is no difference in variance between the two classes of (homogeneous). While the test of equality of the two averages are calculated using the formula t test with \( \bar{X}_1 = 69, \bar{X}_2 = 65, S = 15,96 \) similarity test two calculations then the average obtained \( t_{hitung} = 1.08 \) with dk = 68 and significant levels of 5%, then \( t_{table} = 1.6669 \). Then \( t_{hitung} = 1.08 > t_{table} = 1.6669 \), so Ho accepted meaning that there is no difference in average class experiment and the control class, this means the second class on study leave from the same initial situation. From the results of a pretest data analysis for the control class, obtained the highest and lowest values 90 40, as well as for a class experiment the highest value 90 and lowest values 40. Description of the Data the final value (Post-test) test the Normality of this calculation is
done using the chi square test \( X^2 = \sum_{i=1}^{k} \frac{(f_i - f_h)^2}{f_h} \) with the criteria \( X^2_{hitung} < X^2_{table} \). Based on the results of the calculations for the class control obtained maximum value = 100, value = minimum 40, span = 60, many class = 7, long class = 9, average = 60.6, raw = 16 junction and the price of chi – square \( X^2 = 5.287 \).

While the results of the calculations for class experiments obtained maximum value = 100, value = minimum 40, span = 60, many class = 7, long class = 9, average = 74.7, raw = 16 junction and the price of chi – square \( X^2 = 10.243 \) with degrees of freedom (dk) = 4, and significant levels \( \alpha = 1\% (0.01) \). On the control class \( X^2_{hitung} = 5.287 < X^2_{table} = 13.276 \), so also with the experimental class \( X^2_{hitung} = 10.243 < X^2_{table} = 13.276 \). So that the data on the second class Gaussian. Data based on the data of its homogeneity test \( n_1 = 35, n_2 = 35, S_1^2 = 294.62 \) dan \( S_2^2 = 275.71 \). Then the obtained \( F_{hitung} = 1.06 \) with significant level \( \alpha = 5\% \) and dk = 35 and 35, and of the F distribution list obtained \( F_{table} = 1.76 \). Then there is no difference in variance between the two classes of (homogeneous). Test the average difference is calculated by using the formula t test with \( X_1 = 79, X_2 = 69, S_1^2 = 294.62 \) and \( S_2^2 = 275.71 \) nd then test the difference calculation of average \( t_{hitung} = 2.57 \) obtained with dk = 68 and significant levels of 5%, then \( t_{table} = 1.6669 \). So \( t_{hitung} = 2.57 > t_{table} = 1.6669 \). Calculations based on the results of data analysis post test to see that math problem solving after being given the treatment better than before given the treatment.

From the results of the calculation of the test the hypothesis with the formula t test, retrieved \( t_{hitung} = 2.48 \). With \( \alpha = 0.05 \) obtained \( t_{table} = 1.6669 \), so \( t_{hitung} = 2.48 > t_{table} = 1.6669 \). Then it can be taken Ha and Ho denied conclusion is accepted, it means there are significant effects between independent learning model towards a mathematical problem solving on the material SPLDV in class VIII MTsN Batang Angkola. Based on the results of the research which has been described in the calculation result shows that both classes began in a balanced condition, while similarly when tested in common two average which shows that these two classes have the same average. On the results of the post-test problem solving test normality test and calculation of its homogeneity suggests that both the normal class and its homogeneous variances. So the used test-t seem that \( t_{hitung} 2.48 > t_{table} 1.6669 \). Then a research hypothesis to be accepted. In other words the troubleshooting tests students on SPLDV material through independent learning model is higher than that of ordinary learning to use in class VIII MTsN Batang Angkola.

**4. Conclusion**

Based on the results of research and discussion that is obtained, the researchers can take the conclusion that there are significant effects between independent learning model against the mathematical problem solving of students on the material SPLDV of class VIII MTsN Batang Angkola. And the conclusion is in accordance with the hypothesis of the study conducted by the researchers, because it accepted the hypothesis. This is in accordance with the results of the calculation of the post test that the mean – median on experimental classes better than on an average class – control. Where a class has an experiment – average 79 and control classes with an average – 69. So also with t-post test results test retrieved \( t_{hitung} = 2.33 > t_{table} = 1.6999 \), then Ho denied and Ha is received.

It is recommended to teachers in order to customize the learning model with learning methods used against the subject matter. In this case, specific to the subject matter with respect to the calculation, it is advisable that teachers can implement independent learning model to improve students ’ problem solving. It is recommended to students to be active in the learning process and more often practiced counting math by using independent learning models both at home and at school. It is recommended to the head of school, should more often provide information/coaching to teachers in order to develop ways of teaching, especially in using a mix of learning model with the method of learning. Especially in the subject of mathematics it is recommended that the use of the learning model. For fellow students or readers who want to examine the research who are able to perform more in-depth about the applicability of independent learning model towards problem-solving mathematics.
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