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# The effect of Problem Based Learning (PBL) and expository seen from learning style on the students' learning outcomes in senior high school level in indonesia: A case study

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**Abstract**
The purpose of this research is to investigate (1) the influence of PBL model on students' Mathematics learning outcomes, (2) the influence of students who have different learning styles on Mathematics learning outcomes, and (3) the interraction between learning model and students' learning style on students' Mathematics learning outcomes. This research was conducted in State Senior High School (SMAN) 4 and Senior High School (SMA) Ma'arif Bangkalan, East Java, Indonesia academic year 2017/2018. This research used experimental method with 68 students and two way ANOVA analysis utilizing SPSS 17 software. The results of the study indicated that the learning model of PBL (X1) with visual learning style, audiotorial and kinesthetic (X2) simultaneously influenced the students' mathematics learning outcomes in grade XI SMAN 4 and SMA Ma'arif academic year 2017/2018 by comparing the calculation result t arithmetic> t table (25,341> 2,92) while level of significance with error level 0,000. The findings of the study were as follows: (1) There was a significant influence of PBL model and expository learning on students' Mathematics learning outcomes in class XI SMAN 4 and SMA Ma'arif Bangkalan by comparing the calculation result t arithmetic> t table (3.289> 2.034) while the level of significance with error rate 0.002; (2) There was a significant effect of students who have vvisual, audiotorial and kinesthetic learning styles on Mathematics learning result in class XI of SMAN 4 and SMA Ma'arif Bangkalan by comparing the calculation of chi-square count> chi square table (11.73> 5.99) while the significance level with error rate of 0.003; (3) There was a significant interaction of learning model and learning style (visual, auditorial, kinesthetic) to the students' Mathematics learning outcomes in grade XI in SMAN 4 and SMA Ma'arif Bangkalan by comparing r table = 0,339 calculation result r count = 0.819 for GBV, 0.665 for GBA, and 0.342 for GBK, while the significance level with error rate = 0.000 for GBV and GBA, 0.041 for GBK. Based on the results of the study, it is suggested that besides the use of of PBL and expository learning, teachers could also adjust students' learning styles to improve students' learning outcomes.

**Keywords:** learning model, problem based learning (PBL), expository learning, learning styles, and learning outcomes

## 1. Introduction

In learning activities, teachers and students are involved in an interaction. In this interaction, students are expected to be more active. The activeness of students certainly includes physical and mental activities of individuals and group. Therefore, interaction is said to be maximum if there is an interaction between the teacher and students and students with students' learning environment. In the teaching and learning process, a teacher must refer to the learning objectives in a predetermined competency standard. To achieve the goal of teaching and learning, the teacher should be able to choose learning strategies, learning methods, and learning media that are in accordance with the characteristics of students and subjects.

Mathematics is one of the subjects that has an important role because it is a means of thinking in the development of science and technology. Mathematics is one of the subjects taught starting from elementary school to high school or even college. Suherman *et al*. (2003) [11] says that mathematics is a science obtained with rationale; mathematics is the science of logic regarding the form, arrangement, magnitude, and concepts that relate to another.

According to Ruseffendi (2006) [6], mathematics uses symbols, notations or symbols that mathematicians can understand all over the world. Soedjadi (2000) [8] said that the general purpose of providing mathematics at the primary and secondary education levels is: 1) to prepare students to always be able to deal with changes in the conditions of life and an ever-developing world, through practice acting on logical thinking, rationality, being critical, being careful, being honest, being effective, and being efficient; 2) preparing students to use mathematics and mathematical mindset in their daily lives and in learning various sciences. Despite the fact that most students in the Indonesian have difficulties to deal with the problem solving and translate the problems of daily life into mathematical models, it is found that mathematics lessons are considered by some students as difficult subjects, hence some students dislike and lack abilty to understand mathematics. Therefore, students' learning results are not satisfying. Therefore, to improve the student achievement, innovation is needed in learning in terms of approaches, methods, and media used in learning, so that students are more active and happy in learning, especially in mathematics subjects. From the fact above, it is necessary to conduct research dealing with the low achievement students toward the materials of sequence and series.

Expository learning model is a learning model that emphasizes the process of delivering material verbally from a teacher to a group of students with the goal that students can master the subjects optimally. The expository model emphasizes more on the speaking process, so it is often called as "chalk and talk" strategy. Through this strategy, the teacher can deliver certain materials structurally in order that students can master the materials well. In addition to learning models,

the low achievement students in mathematics are also due to compulsion in learning. Dealing with compulsion to learn is clearly not a pleasant thing. It will not be easy for students to concentrate on learning if they are forced. Therefore, solutions must be sought to make learning more enjoyable; one of which is by knowing students' learning styles. If students recognize their learning styles, they can manage the conditions where, when, and how to optimalize their learning. Dunn (as cited in DePorter & Hernacki, 2002) [2], a pioneer in the field of learning styles, has found many variables that influence how people learn. This includes physical, emotional, sociological, and environmental factors. Habits allow a person to have more than one learning styles. Students who can integrate various learning styles in the learning process have more possibilities for success.

According to Sanjaya (2013) [7], problem-based Learning (PBL) strategy is defined as a series of learning activities that emphasize the process of solving problems faced scientifically. There are 3 main characteristics of PBL; PBL is a series of learning activities that implement a number of activities that must be done by students. Also, through PB, students think actively, communicate, search, and process data, and finally conclude, and learning activities are directed to solve problems. Finally, PBL puts the problem as a key word of the learning process that is done using a scientific thinking approach. Thinking using scientific methods is a process of deductive and inductive thinking. This thinking process is carried out systematically and empirically. Dewey (1938) describes 6 steps of PBL which are then called problem solving methods; they are formulating problems, analyzing problems, formulating hypotheses, collecting data, testing hypotheses, and formulating problem solving recommendations.

Sanjaya (2013) [7] defines expository learning model as learning strategy that emphasizes the process of delivering material verbally from a teacher to a group of students with the intention that students can find out the subject matter optimally. Killen (as cited in Sanjaya, 2013) [7] called this expository strategy as direct learning strategies (direct instruction). The characteristics of the expository strategy is that it is carried out by conveying material verbally in which speaking verbally is the main tool in carrying out this strategy. The main objective of learning is mastery of the material itself. Expository learning strategy is a form of teacher-oriented approach.

Learning style is the key to developing work performance. Each student has their own type or style of learning. The ability of students to capture materials and lessons depends on their learning style. According to Nasution (2009) [5], learning style is a consistent way done by a student in capturing stimulus or information, how to remember, think, and solve problems. Whereas, DePorter and Hernacki (2002) [2] argue that learning style is a combination of absorbing, managing, and processing information.

There are three types of learning styles based on the modalities that individuals use in processing information. Visual learning styles are learning by seeing. This learning style relies on sight. Visual acuity is more prominent in some people and very strong in a person. The auditory learning style is learning by listening. This learning style relies on hearing. Kinesthetic learning styles are learning styles by moving, working, and touching. According to Sudjana (2011) [9], learning and teaching as a process contain three elements that cannot be distinguished, namely teaching (instructional) goals, teaching-learning experiences, and learning outcomes. Assessment of learning outcomes is the process of giving value to learning outcomes achieved by students with certain criteria. Student learning outcomes are essentially behavioral changes. Behavior as a learning result in a broad sense covers the fields of cognitive, affective, and psychomotor.

Therefore, based on the explanantion above, the problem formulations that the researchers propose are: (1) Are there differences in students' mathematics learning outcomes that follow the Problem Based Learning (PBL) and expository learning models, (2) Are there differences in learning outcomes of students who have visual, auditory, and kinesthetic learning styles, and (3) Is there an interaction effect between the use of the Problem Based Learning (PBL) model, the expository learning model, and the learning style on the learning outcomes of Mathematics. The research objectives were to find out whether there were differences in student learning outcomes in learning using PBL learning models with those using expository learning models on students 'mathematics learning outcomes, investigating whether there were differences in students who have visual, auditory, and kinesthetic learning styles toward students' mathematics learning results, and knowing whether there is an interaction between the use of PBL learning models, expository learning models and learning styles on students' mathematics learning outcomes.

## 2. Method

The type of research used was a quasi-experimental 2 x 3 factorial design. This experimental research involved two groups, namely the control group and the experimental group. The control group was a group that followed learning using the expository learning model, while the experimental group was the group that followed learning using Problem Based Learning (PBL) model. Through this, it was compared the influence of Problem Based Learning (PBL) model and the influence of expository learning model, and students' learning styles covering visual, auditory, and kinesthetic learning styles on students' mathematics learning outcomes in line and series subjects. The factorial design is presented in the following table:

**Table 1:** Factorial Design 2 x 3

| Learning Style | Model Learned(X) | |
|---|---|---|
| | **PBL** $X_1$ | **Expository** $X_2$ |
| Visual (V) | $Y_{11}, Y_{12}, Y_{13}, \ldots\ldots Y_{132}$ | $Y_{11}, Y_{12}, Y_{13}, \ldots\ldots Y_{136}$ |
| | $Y_{21}, Y_{22}, Y_{23}\ldots\ldots Y_{229}$ | $Y_{21}, Y_{22}, Y_{23}\ldots\ldots Y_{229}$ |
| Auditorial (A) | $Y_{11}, Y_{12}, Y_{13}\ldots\ldots Y_{132}$ | $Y_{11}, Y_{12}, Y_{13}\ldots\ldots Y_{136}$ |
| | $Y_{21}, Y_{22}, Y_{23}\ldots\ldots Y_{229}$ | $Y_{21}, Y_{22}, Y_{23}\ldots\ldots Y_{229}$ |
| Kinesthetic (K) | $Y_{11}, Y_{12}, Y_{13}\ldots\ldots Y_{132}$ | $Y_{11}, Y_{12}, Y_{13}\ldots\ldots Y_{136}$ |
| | $Y_{21}, Y_{22}, Y_{23}\ldots\ldots Y_{229}$ | $Y_{21}, Y_{22}, Y_{23}\ldots\ldots Y_{229}$ |

Information:

V = Visual Learning Style
A = Auditory Learning Style
K = Kinesthetic Learning Style
$X_1$ = Learning Method of Problem Based Learning
$X_2$ = Expository Learning Method
Y = Learning Outcomes of Mathematic

According to Sugiyono (2006) [10], the population is an area of generalization consisting of: objects/subjects that have certain qualities and characteristics set by the researcher to be studied and then drawn conclusions. Meanwhile, Mardalis (2009) [4] defines the population as a number of cases that

meet a set of criteria that are determined by researchers. Through the description of the population, the results of the research will be relevant. The population of this study is presented in the following table:

**Table 2:** Population recapitulation

| No | School | Class | Total |
|---|---|---|---|
| 1 | State Senior High School (SMAN) 4 Bangkalan | XI IPA1 | 32 |
| | | XI IPA2 | 32 |
| | | XI IPA3 | 36 |
| | | XI IPA4 | 33 |
| | | XI IPA5 | 33 |
| 2 | Senior High School (SMA) Ma'arif Bangkalan | XI IPA1 | 25 |
| | | XI IPA2 | 27 |
| | | XI IPA3 | 29 |
| | | XI IPA4 | 29 |
| | Total | | 276 |

According to Sugiyono (2006) [10], the sample is a part or representative of the population under study. Whereas, Mardalis (2009) [4] defines sample as an example that is taken from some researchers' population that can represent the population. The sample must have at least one property that is equally good for the specificity of a population, and the sample used in the study must be a mirror of the population and represent the population. The purpose of sampling from the population is important to obtain information about the population. In sampling the technique of a population, researchers used a random sampling technique. Random sampling technique is lottery sampling. The samples in this study are presented in the following table

**Table 3:** Recapitulation of research samples

| No | School | Class | Total | Group |
|---|---|---|---|---|
| 1 | State Senior High School (SMAN) 4 Bangkalan | XI IPA | 17 | exsperiment |
| | | XI IPA | 17 | control |
| 2 | Senior High School (SMA) Ma'arif Bangkalan | XI IPA | 17 | exsperiment |
| | | XI IPA | 17 | control |
| Total | | | 34 | exsperiment |
| | | | 34 | control |

According to Sugiyono (2006) [10], research instruments are used to make measurements with the aim of producing accurate quantitative data. The instruments used in this study were the questionnaire to collet the data in which they were obtained by distributing sheets (questionnaires) containing written questions to obtain information about students' learning styles. To get data about learning outcomes of mathematics, the documentation method was used. Documentation method is a method or research tool to collect the data through official records relating to the research problem. Assessments or tests were used to measure students' cognitive abilities, so researchers knew the value of the students' learning outcomes. The data collection technique used in this study was a combination technique between questionnaire and assessment. The settings used were natural that was done directly on the actual class. Questionnaire was used to find out students' responses to student learning styles. Assessments or tests were used to determine the value of learning outcomes of students. Before the data were used to test hypotheses, it was necessary to test the normality and homogeneity. Testing for each hypothesis was done after the data were known to be normally distributed and homogeneous. To find out the distribution of data obtained from the study to be normally distributed or not, the data were tested by normality test using SPSS 17. The data obtained is noted to be normal if the results of the calculated coefficient is greater than 0.05, but if the calculated coefficient is smaller than 0, 05, the data is not normal. Homogeneity test is used to determine whether the two variants of the population are homogeneous or heterogeneous.

## 3. Result and Discussion

Mathematics learning achievement scores of 34 students who used PBL learning models were that 5 students got score 70, 6 students got score 75, 8 students got score 80, 8 students got score 85, 4 students got score 90, and 3 students got score 95. While the Mathematics learning achievement scores of 34 students who used the expository learning model were that 3 students got score 65, 4 students got score 70, 9 students got score 75, 9 students got score 80, 6 students got score 85, and 3 students got score 90. In addition, learning achievement scores of 12 Mathematics students with visual learning styles using PBL model were that 2 students got scores 80, 5 students got score 85, 2 students got score 90, and 3 students got score 95. While learning achievement scores of 12 Mathematics students with auditorial learning styles using PBL model were that 2 students got score 70, 2 students got score 75, 5 students got score 80, 1 student got score 85, and 2 students got score 90. Also, Mathematics learning achievement scores of 10 students with kinesthetic learning styles that used PBL model were that 3 students got score 70, 4 students got score 75, 1 student got score 80, and 2 students got score 85. While, Mathematics learning achievement scores of 12 students with visual learning styles that used expository learning model were that 3 students got score 70, 4 students got score 75, 3 students got score 80, 1 student got score 90, and 1 student got score 100. Mathematics learning achievement scores of 12 students with auditorial learning style that used conventional model learning were that 3 students got score 65, 2 students got score 70, 3 students got score 75, 2 students got score 80, and 2 students got score 85. Whereas, Mathematics learning achievement scores of 10 students with kinesthetic learning styles who used expository learning model were that 5 students got score 65, 1 student got score 70, 1 student got score 75, 1 student got score 80, 1 student got score 85, and 1 student got score 90. To test the first hypothesis relating to the formulation of the first problem, "is there a significant influence of students given Problem Based Learning (PBL) and eexpository learning models on students' mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan, researchers used regression test. and comparisons with procedures. It was concluded that there was significant influence between students given problem Based Learning (PBL) and expository learning models on Mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan. To test the second hypothesis which relates to the formulation of the second problem, namely "Are there significant influences of students who have visual, auditory, and kinesthetic learning styles on mathematics learning achievement of students of class XI of SMAN 4 and SMA Ma'Arif Bangkalan using Regression and Comparative Tests (Comparison) with procedures. Conclusion: There is a significant influence on students who have Visual learning style towards mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan. There is a significant effect on students who have an Auditorial learning

style towards mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan, and there is a significant effect on students who have a kinesthetic learning style on mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan. To test the third hypothesis related to the formulation of the second problem, "are there interactions between problem Based Learning (PBL) learning model with visual, audiotorial, and kinesthetic learning styles on students' mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan", the researcher used regression and correlation tests with procedures. It was concluded that there was significant effect of learning using problem Based Learning (PBL) model with visual learning style on students' mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan. To identify the significant interactions / relationships between problem Based Learning (PBL) model and visual learning styles on students' mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan, researchers used correlation tests with procedures. It was concluded that there was significant interaction between problem Based Learning (PBL) model with learning style (visual, auditory, kinesthetic) toward students' mathematics learning achievement in class XI of SMAN 4 and SMAN Ma'arif Bangkalan. Based on the calculation result, it was obtained that t count=3.289 while t table: df=33, α=0.05 was 2.034 that was higher. While the significant level obtained from the calculation=0.002 was smaller than α=0.05. This means that $H_0$ was rejected or Ha was accepted. Hence, there was a significant influence on the Mathematics learning achievement between students who were given problem Based Learning (PBL) and expository learning model in class XI of SMAN 4 and SMA Ma'arif Bangkalan. The calculation score of t-count for the visual learning style was 2.449 while the t table: df=11, α = 0.05 was 2.201. Based on the calculation, t count > t table, while the significant level obtained from the calculation = 0.032 and α = 0.05, then $H_0$ was rejected. Therefore, there was a significant influence on mathematics learning achievement on students who had visual learning styles in class XI of SMAN 4 and SMA Ma'arif Bangkalan. The calculation score of t count for the auditorial learning style was 4.062 while the t table: df = 11, α = 0.05 was 2.201. While the significant level of calculation = 0.002 and α=0.05, $H_0$ was rejected. Hence, there was a significant effect of mathematics learning achievement on students who had audiotorial learning styles in class XI of SMAN 4 and SMA Ma'arif Bangkalan.

The calculation score of t count for kinesthetic learning style was 2.449 while t table: df = 11, α = 0.05 was 2.201. While the significant level of calculation=0.037 and α=0.05, $H_0$ was rejected. Thus, there was a significant effect of mathematics learning achievement on students who had kinesthetic learning style in class XI of SMAN 4 and SMA Ma'arif Bangkalan.

The calculation score of chi-squre count for different learning style was 11.730 while the chi-square table: df=2, α=0.05 was 5.99. And the Asymp level. Sigs obtained from calculations=0.003 and α=0.05, so $H_0$ was rejected. Hence, there was a significant effect of mathematics learning achievement on students who had visual, audiotorial, and kinesthetic learning styles in class XI of SMAN 4 and SMA Ma'arif Bangkalan.

The calculation score of chi-squre count for different learning styles in SMAN 4 and SMA Ma'Arif Bangkalan was 2,389 while the chi-square table: df=2, α=0.05 is 5,99. And the Asymp level. Sig obtained from calculation=0.002 and α=0.05, $H_0$ was rejected. Therefore, there was a significant effect of mathematics learning achievement on students who had visual, audiotorial and kinesthetic learning styles in class XI of SMAN 4 and SMA Ma'arif Bangkalan.

The calculation score of t count: for the visual learning style was 5.230 while the t table: df=33, α=0.05 was 2.034. And the significant level obtained from the calculation= 0.037 and α=0.05, then $H_0$ was rejected. Thus, there was a significant effect of learning PBL model with visual learning styles on students' mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan.

The calculation score of t count for the auditorial learning style was 2.225 while the t table: df=33, α=0.05 was 2.034. And the significant level obtained from the calculation =0.034 and α=0.05, then $H_0$ was rejected. Therefore, there was a significant effect of learning PBL models with audiotorial learning styles on students' mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan.

The calculation score of t count: for the kinesthetic learning style was 2.188, while the t table: df=33, α=0.05 was 2.034. And the significant level obtained from the calculation= 0.042 and α = 0.05, then $H_0$ was rejected. Therefore, there was a significant effect of PBL models with kinesthetic learning styles on students' mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan.

The calculation score of simultaneous (ANOVA test/ F-Test), F Calculate was 25,341 while Table F was 2,92. And sig. that was 0,000 <0, 05, so $H_0$ was rejected. Hence, Learning using PBL model with visual, audiotorial and kinesthetic learning styles influences simultaneously on students' mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan.

Considering the influence of PBL learning model with visual, audiotorial and kinesthetic learning styles simultaneously on students' mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan, PBL was learning system that was suitable for the students' brain performance to arrange patterns that embody meaning by connecting academic content with the context of the daily lives of students. This is important to be applied, so that the information received is not only stored in short-term memory, which is easily forgotten, but can be stored in long-term memory. Thus, it will applied in their works. There are eight components that underlie PBL systems; they are making linkages meaningful, doing meaningful work, doing self-regulated learning, collaborating, thinking critically and creatively, helping individuals to grow and develop, achieving high standards, and using authentic judgment. By applying PBL, the teachers has followed three modern scientific principles that support and regulate everything in the universe covering the principle of interdependence, the principle of differentiation, and the principle of self-regulation. The principle of interdependence teaches that everything in the universe is interdependent and interconnected. looking at the results of the regression that the constant was 1.161, it was stated that if there was no visual style, audiotorial style and kinesthetic style, the mathematics learning achievement of students in class XI of SMA 4 and SMA Ma'arif Bangkalan was 1.161 units of

value. While the regression coefficient (X1) was 0.703 for visual learning style, regression coefficient (X2) was 0.520 for audiotorial learning style, and regression coefficient (X3) was 0.232 for kinesthetic learning style. According to Arikunto (2005) [1], there are two factors that affect achievement learning; they are factor that is derived from within human beings and factor originating from outside the human. One of psychologically internal factors that influence learning achievement is learning style.

The calculation result of r count: was 0.819 for GBV, 0.665 for GBA, and 0.342 for GBK while r table: N = 34, $\alpha = 0.05$ was 0.339. And Sig.=0.000 for GBV and GBA, 0.041 for GBK, $\alpha = 0.05$. Hence, H0 was rejected. Therefore, there was a significant relationship between learning PBL model with visual learning style on students' mathematics learning achievement in class XI of SMAN 4 and SMA Ma'arif Bangkalan.

## 4. Conclusions

Based in the result of the study, it can be concluded that learning using PBL models was proved to be fun, active, and it increased the students' participantion in learning Mathematics. In teaching and learning Mathematics, students received direct learning, so they were able to understand the concept of operations to calculate addition and subtraction of integers and use them in their daily lives. In addition to this, learning style including visual, audiotorial, and kinesthetic affected the learning outcomes. Therefore, it is suggested to the teachers of senior high school to integrate Problem Based Learning (PBL) model in teaching Mathematics and consider the students' learning styles. Teachers could adjust the teaching strategy with the students' learning style in their teaching and learning activities. Therefore, through this experience, the students' learning achievement can increase.

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