THE EFFECT OF PROBLEM-BASED LEARNING MODEL IN INFORMATICS SUBJECTS ON THE CREATIVITY OF STUDENTS IN CLASS X SMK NEGERI 2 TULUNGAGUNG

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ABSTRACT
This research was motivated by the low level of student creativity in the class X informatics subject at SMK Negeri 2 Tulungagung. The purpose of this research is to determine the effect of implementing the Problem Based Learning learning model on the creativity of class X students at SMK Negeri 2 Tulungagung. This type of research is a quasi-experiment with a post-test only control group design. The samples from this research were taken from 2 classes X AKL of SMK Negeri 2 Tulungagung. The experimental class is taught using a problem based learning model and the control class uses a conventional learning model, namely using the discovery learning model. The posttest score results for the experimental class had an average of 86.83 and for the control class the average posttest score was 77.69. Based on the results of the hypothesis test, a sig = 0.000 value was obtained at the significance level $a = 0.05$. This means that the sig value <0.05 means the sig value is outside the H0 acceptance area. So it can be concluded that there is an influence of the problem based learning model in informatics subjects on the creativity of class X students at SMK Negeri 2 Tulungagung.

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I. INTRODUCTION

THE education curriculum in Indonesia changes very often in terms of implementation in education units. The curricula that have been implemented in Indonesia include the 2006 Education Unit Level Curriculum (KTSP), the 2013 Curriculum (K-13) and what is currently still running is the Merdeka Belajar curriculum. The Merdeka curriculum is a simplification of the K-13 curriculum which is simplified and focuses on student learning outcomes per phase, no longer formulated per level (class). In the Merdeka curriculum, learning will be more comfortable, because students can discuss more with the teacher, learn with outing classes, and not only listen to the teacher's explanation, but rather form the character of students who are brave, independent, intelligent in socializing, civilized, polite, competent, and not only rely on the ranking system.

Vocational High Schools (SMK) will equip students to be ready to face the world of work in certain fields or certain jobs to continue to the appropriate university. Vocational education aims to produce skilled, productive, and work-ready human resources, one of which is a vocational school which is expected to be able to produce graduates who are in accordance with the needs of the times[1]. However, if the student's ability is still lacking and does not meet the industry's demand, then the student has not been accepted into the world of work and still needs to do retraining.

SMK Negeri 2 Tulungagung is a school that implements an independent curriculum in its learning. The implementation of the independent curriculum is expected to increase student learning creativity, because this curriculum is basically student-centered. Learning in the independent curriculum focuses more on developing students' creativity, capacity, personality, and needs[2].

There are subjects that must be taught in the independent curriculum, one of which is Informatics which is taught in class X. According to [3], informatics is learning that provides a comprehensive introduction to the field of Informatics which includes the body of knowledge, applied applications of Informatics in various fields, as well as the need for ethics and regulations in the field of informatics.

Informatics learning at SMKN 2 Tulungagung previously used a student-centered learning method, namely the

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discovery learning model. Discovery learning is a learning process that is not given entirely but involves students to organize, develop knowledge and skills for problem solving [4]. Discovery learning itself is a teacher centered model that requires teachers to be more active than students. This learning model will only make students more passive during the learning process. This is also supported by the opinion of [5] which states that teacher centered prioritizes passive students rather than active students in the classroom. Along with this, it allows students to become less skilled in other things including their creativity and communication skills.

Based on observations carried out by researchers, it can be seen that most students in class X AKL have difficulty learning Informatics subjects because most students are not familiar with hardware and software on computers. This makes one of the factors that make students less creative in learning more about informatics subjects. In addition, it can be seen that during informatics practice learning hours, as soon as the teacher enters the room, all students do not immediately prepare equipment for practice. Students tend to be silent and wait for instructions from the teacher. At the time of learning, students did not understand the material presented because most students did not understand the material about computer hardware and software. This is because many students talk to friends and are busy playing cell phones.

According to [6] creativity is defined as the result of a habit by using intuition and imagination in developing new ideas in solving problems in everyday life. Students' lack of creativity will only make them more dependent on their teachers who are more active. They tend to be more silent and do not do anything to support their success in learning. Students' lack of creativity also affects their inability to convey new ideas or express opinions on the problems they face. Because student learning creativity as one of the factors that can improve a student's ability to master the subject matter that has been discussed [7].

Based on this, it is important to conduct research that implements a learning model that is suitable for informatics learning as a solution to overcome learning problems. One alternative solution is to use the Problem Based Learning model. PBL is an effective model for teaching the thinking process, this learning helps students to process ready-made information in their minds and compile their own knowledge about the social and surrounding world. PBL can train students to compile their own knowledge, develop problem-solving skills. PBL is also intended to develop students' learning independence and social skills.

The purpose of this study is to determine whether or not there is an effect of the problem-based learning model in informatics subjects on the creativity of class X students of SMK Negeri 2 Tulungagung. The benefit of this research is as a consideration for choosing the learning model to be used so as to achieve optimal informatics learning outcomes.

II. RESEARCH METHODS

A. Types and Design of Research

This research is an experimental study with a quantitative research approach to determine the effect of the PBL learning model on student creativity and communication. According to [8] that experimental research can be interpreted as a research method used to seek the effect of certain treatments on others under controlled conditions. Quantitative methods are research methods based on certain populations or samples, which are carried out by collecting data using several research instruments, and data analysis is quantitative or statistical, aiming to test predetermined hypotheses [8].

TABLE I.
RESEARCH DESIGN

Class	Treatment	Final Test (*Postest*)
Experiment	X	O_1
Control	-	O_2

Source [9]

Information:

X : Learning by using problem based learning model

O_1 : Posttest in experimental class

O_2 : Posttest in control class

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B. Population, Sample, and Research Sampling

1. Population

   Population is the overall data from the unit of analysis which is the target for researchers. Meanwhile, according to [9] Population is a generalization area consisting of objects or subjects that have certain qualities and characteristics set by researchers to study and then draw conclusions. The population of this study were class X students of SMK Negeri 2 Tulungagung.

TABLE II
POPULATION

No	Class	Number Of Student
1	X Teknik Otrotonik 1	37
2	X Teknik Otrotonik 2	36
3	X Teknik Alat Berat 1	37
4	X Teknik Alat Berat 2	37
5	X Teknik Alat Berat 3	36
6	X Teknik dan Bisnis Sepeda Motor 1	35
7	X Teknik dan Bisnis Sepeda Motor 2	36
8	X Teknik Kendaraan Ringan Otomotif 1	37
9	X Teknik Kendaraan Ringan Otomotif 2	37
10	X Teknik Kendaraan Ringan Otomotif 3	37
11	X Teknik Pengelasan 1	34
12	X Teknik Pengelasan 2	34
13	X Administrasi dan Keuangan Lembaga 1	36
14	X Administrasi dan Keuangan Lembaga 2	36
15	X Administrasi dan Keuangan Lembaga 3	36
16	X Administrasi dan Tata Kelola Perkantoran 1	35
17	X Administrasi dan Tata Kelola Perkantoran 2	35
18	X Administrasi dan Tata Kelola Perkantoran 3	35
19	X Teknik Otomasi Industri 1	35
20	X Teknik Otomasi Industri 2	35
	Sum	720

2. Sample

   According to [10] argues that the sample is a part or representative of the population under study and if the subject is less than 100, then it is better to take all so that the research is population research. If the subject is large, the sample is taken 10-15%, 20-25% or even more.

TABLE III
SAMPLE

No	Class	Number Of Student
1	X Administrasi dan Keuangan Lembaga 1	36
2	X Administrasi dan Keuangan Lembaga 2	36
	Sum	72

3. Research Sampling

   Sampling in this study using purposive sampling technique. According to [11] purposive sampling is a technique for determining research samples with certain considerations which aims to make the data obtained later more precise or representative.

C. Data Collection Techniques

According to [8], data collection techniques are the most strategic step in research because the main purpose of the research is to obtain data. This data collection technique is carried out so that the data and theories contained in the research are valid, accurate, and in accordance with reality.

1. Observation

   Observation is done to observe the implementation process of PBL learning model in informatics subject.

This observation itself will contain how the learning process is using the PBL model.

2. Questionnaire

According to [9], a questionnaire is a data collection technique that is done by giving a set of questions or written statements to respondents to answer. Questionnaires can also be used to obtain data that is more free and according to the respondent's beliefs (subjective). In the questionnaire, there will be 4 alternative answers, namely Strongly Agree (SS), Agree (S), Disagree (TS), and Strongly Disagree (STS). The following is a table of presentation on a Likert scale.

TABLE IV
SCALE LIKERT

Information	Score +	Score-
Strongly Agree (SS)	4	1
Agree(S)	3	2
Disagree (TS)	2	3
Strongly Disagree (STS)	1	4

III. RESULT

A. Presentation and Research Result Data

Data in this study were obtained through a questionnaire method. Questionnaires are used to determine the effect of the PBL learning model on the creativity of class X students of SMK Negeri 2 Tulungagung. The questionnaire used in this study consists of 17 statement items for the creativity questionnaire. The questionnaire test was conducted in class X TAB 1 SMK Negeri 2 Tulungagung. After the test was carried out and the results were known, then the research was carried out. The research data were processed with SPSS 25.0 for windows.

The following is an explanation of the average value of the creativity questionnaire results carried out on 72 students, namely there are 17 statement items distributed and meet the criteria of 20 statement items.

TABLE V
AVERAGE SCORE

No	Class	Average
1	Experiment	86,83
2	Control	77,69

From the results of the creativity questionnaire posttest, the average value of the experimental class is 86.83 which means it has the meaning of "Very Creative", while the control class produces an average value of 77.69 which means it has the meaning of "Creative". So it can be said if there is an increase in student creativity after the application of the PBL learning model.

B. Data Analysis and Hypotesis Testing

1. Instrument Test

a. Validity Test

The purpose of validity is to determine the extent of the accuracy of a measurement instrument in performing its measurement function. An instrument is said to be valid if it is able to measure what is desired and can reveal data from the variables studied precisely.

TABLE VI
FIRST VALIDITY TEST

No	r count	Criterion
1	0,573	Valid
2	0,625	Valid
3	0,395	Valid
4	0,297	Invalid
5	0,612	Valid
6	0,532	Valid
7	0,328	Invalid
8	0,480	Valid
9	0,534	Valid

10	0,614	Valid
11	0,682	Valid
12	0,346	Valid
13	0,490	Valid
14	0,484	Valid
15	0,296	Invalid
16	0,654	Valid
17	0,633	Valid
18	0,607	Valid
19	0,403	Valid
20	0,681	Valid

TABLE VII
SECOND VALIDITY TEST

No	r count	Criterion
1	0,580	Valid
2	0,654	Valid
3	0,416	Valid
4	0,591	Valid
5	0,565	Valid
6	0,499	Valid
7	0,530	Valid
8	0,627	Valid
9	0,718	Valid
10	0,337	Valid
11	0,514	Valid
12	0,451	Valid
13	0,628	Valid
14	0,612	Valid
15	0,657	Valid
16	0,400	Valid
17	0,685	Valid

From the second validity test table as shown in the table above, all 17 questionnaire statement items are declared valid. By finding the statement item with the highest r_{count}, namely question item number 9 with an r_{count} of 0.718 and finding the statement item with the lowest r_{count}, namely statement item number 10 with an r_{count} of 0.337.

b. Reliability Test

Reliability is a tool for measuring an instrument which is a construct or variable measurement tool. A variable instrument is an instrument that, when used several times to measure the same object, will produce the same data [12][13]. The formula used to measure reliability is the Cronbach's Alpha formula. This Cronbach's Alpha calculation was carried out with the help of the IBM SPSS version 25.0 application. An instrument is said to be reliable if the Cronbach Alpha value is> 0.50.

TABEL VIII
RELIABILITY TEST

Variable	Cronbach's Alpha	Description
Creativity	0,857	Reliable

From the results of the table above, it can be seen that a variable is declared a variable if Cronbach alpha> 0.50. The table above shows that all variables have a large enough Cronbach alpha, which is> 0.50. So, it can be concluded that the questionnaire reliability of the student creativity and communication variables studied is reliable.

2. Prerequisite Test
a. Normality Test

The normality test can be done with SPSS 25.0 for windows, namely by using the Kolmogrov-Smirnov test using a significance level of 5% or 0.05 and the data is declared normally distributed if the significance is greater than 5% or 0.05 [16][17]. The test in this way is carried out by comparing the

probability level (sig) with the alpha value (α).

TABLE IX
NORMALITY TEST

Instrument	Control Value	Experiment Value	Description
Creativity	0,167	0,053	Normal

b. Linearity Test
The decision-making method for the linearity test is if the significance in Deviation from Linearity < 0.05 then the relationship between the two variables is not linear.

TABLE X
LINEARITY TEST

Instrument	Value	Description
Creativity	0,100	Linear

c. Homogeneity Test
This homogeneity test is intended to test whether the variants of the two research samples are homogeneous or not. Homogeneity test decision making is if the significance> 0.05 then H_0 is accepted (the same variant) and if the significance <0.05 then H_0 is rejected (different variants).

TABLE XI
HOMOGENEITY TEST

Instrument	Value	Description
Creativity	0,668	Homogeneous

3. Hypothesis Test
The analysis used to test the research hypothesis is the Independent sample T-Test analysis. The t-Test is used to test the average difference of two independent sample groups [18][19]. In this study, a significant level of 5% ($\alpha = 0.05$) was used. There is a hypothesis to be tested, namely the hypothesis (Ha_1), There is an effect of the PBL learning model on the creativity of class X students of SMK Negeri 2 Tulungagung. The criterion used is that H0 is rejected if the significant value < α (the significant level used) means that there is a significant influence between the independent variable (X) and the dependent variable (Y).

TABLE XII
HYPOTHESIS TEST

Variable	Value
Creativity	0,000

In accordance with these calculations, it can be seen that the significance value is 0.000. Where 0.000 <0.05 which means that PBL has an influence on variable Y1, so the first hypothesis (Ha_1) There is an influence of the PBL learning model on the creativity of class X students of SMK Negeri 2 Tulungagung.

C. Discussion

The population in this study were all class X students at SMK Negeri 2 Tulungagung in the 2022/2023 school year, totaling 720 students. The sampling used purposive sampling technique, namely class X AKL 1 as the control class and class AKL 2 as the experimental class. This technique is used based on certain criteria, namely that the two classes have the same average initial learning ability. The independent variable in this study is the Problem Based Learning (PBL) learning model while the dependent variable is creativity.

➢ The Effect of PBL Learning Model on Creativity
Creativity research is carried out by conducting a questionnaire questionnaire. The questionnaire used is a Likert scale with a score of 1 to 4 [20]. Before the questionnaire is given to the research sample respondents, the questionnaire is first tested to see the level of validity and reliability in order to determine which statement items are feasible and not feasible to use as a questionnaire [21]. By using the Item Total Correlation technique using the help of the SPSS 25.0 For Windows application, data on statistical questions obtained from 20 question items, there are 17 question items declared valid.

To determine the effect of the PBL learning model on creativity using the t-Test formula, but before using

this formula the research data must meet several assumptions, namely normally distributed, linear, and homogeneous data [22]. Using the help of SPSS version 25.0, the results of the Kolmogrov Smirnov test can be concluded that the average data is normally distributed because it has Asymp. Sig > 0.05. The creativity of the experimental class has Sig 0.053 and the control class has Sig 0.167 so it can be concluded that the data is normally distributed. Based on the linearity test obtained Sig 0.100 so that the data can be said to be linear. Based on the homogeneity test obtained sig 0.668 so that the data can be said to be homogeneous.

Before the data is analyzed with the t-Test test, the creativity questionnaire data is grouped by class. This is done to determine the average creativity of experimental class students who use PBL learning models and control classes that use conventional learning models [23]. Based on the results of the calculation, it was found that the average experimental group was 59.05 with 36 respondents. Meanwhile, the control class had an average of 52.83 with 36 respondents.

The results of the t-Test analysis show that there is an effect of the PBL learning model on the creativity of class X students of SMKN 2 Tulungagung. This is in accordance with the calculation of the SPSS Version 25.0 program where the results of data calculation show that the sig value = 0.000 then H0 is rejected and Ha1 is accepted. So it can be concluded that there is an effect of using the PBL learning model on the creativity of class X students of SMKN 2 Tulungagung.

➢ Enhanced Creativity in Experimental Group
The findings demonstrate that students in the experimental group, who were taught using the PBL model, achieved an average creativity score of 86.83, categorized as "Very Creative." In contrast, the control group, using conventional teaching methods, scored 77.69, categorized as "Creative." This substantial difference suggests that PBL provides an effective framework for fostering higher levels of creativity.
• Interpretation: The PBL model encourages active participation, problem-solving, and critical thinking, which are essential for creative learning. Students engage in real-world problem scenarios, leading to deeper cognitive processing and innovative thinking [24].
• Educational Implications: The findings highlight the potential of PBL to be adopted in other subjects and educational settings to enhance creativity, particularly in vocational education where practical application is vital.

➢ Statistical Validity of Results
The validity and reliability of the questionnaire were confirmed through rigorous testing, with all 17 items proving to be valid in the second round of testing and Cronbach's Alpha at 0.857, indicating high reliability.
• Interpretation: The reliable measurement tools ensure that the creativity scores accurately reflect students' abilities, reducing potential biases or errors [25].
• Educational Implications: The validated instrument could be used as a model for assessing creativity in similar research studies, ensuring consistency and comparability across studies.

➢ Alignment with Assumptions for Statistical Analysis
The normality (Kolmogorov-Smirnov), linearity, and homogeneity tests indicated that the data met all necessary assumptions for valid t-test analysis.
• Interpretation: The robustness of statistical assumptions strengthens the confidence in the conclusions drawn from the hypothesis testing.
• Educational Implications: These tests ensure that the findings are not only statistically significant but also meaningful in practical educational contexts.

➢ Hypothesis Confirmation and Implications for Teaching Strategies
The hypothesis test showed a significant value (Sig. = 0.000), confirming that PBL significantly impacts creativity (rejecting H0 and accepting Ha1).
• Interpretation: This result underscores the efficacy of PBL in promoting student creativity. By engaging students in collaborative and self-directed problem-solving activities, PBL shifts the focus from rote memorization to innovative thinking [26].
• Educational Implications: Teachers and curriculum developers should consider integrating PBL into

teaching strategies to cultivate creativity and other 21st-century skills such as collaboration, communication, and critical thinking.

➢ Importance of Student-Centered Learning Models

The average creativity score difference between the experimental and control groups (9.14 points) illustrates the clear advantage of student-centered learning methods over traditional, teacher-centered approaches.

- Interpretation: Traditional teaching methods may limit students' opportunities to explore, experiment, and express novel ideas, while PBL places students at the center of the learning process, making them active contributors to their education [27].
- Educational Implications: Encouraging teachers to adopt PBL and similar student-centered approaches could address the broader educational need for fostering innovative and entrepreneurial mindsets.

IV. CONCLUSION

A. Conclusion

Based on the theoretical and empirical discussion of the research data on the effect of the PBL learning model on the creativity of class X students of SMKN 2 Tulungagung, the authors provide the following conclusions:

➢ Based on the results of the calculation, it was found that the average creativity of the experimental group was 59.05 with 36 respondents. Meanwhile, the control class had an average of 52.83 with 36 respondents. While the results of data calculations show a sig value = 0.000, $H0_1$ is rejected and Ha_1 is accepted. So it can be concluded that there is an effect of using PBL on the creativity of class X students of SMKN 2 Tulungagung.

B. Suggestion

For the sake of progress and successful implementation of the teaching and learning process in order to improve the quality of education, the authors provide the following suggestions:

1. With the PBL learning model proven to be more effective on student creativity and communication, it is hoped that schools can make policies that can improve and develop the quality of education, especially in Informatics subjects so that they can achieve the expected goals.
2. In delivering a lesson, especially in informatics subjects, it is expected that a teacher can choose the right learning model. This model must be able to encourage students to be more active in teaching and learning activities. The selection of the right learning model can affect the success of the teaching and learning process.
3. For future researchers who will conduct the same research, it is hoped that they can develop research knowledge related to the use of PBL learning models and not only on creativity but can develop further.

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