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The Effect of Indonesian Realistic Mathematics Approach on Linear Program Learning Achievement

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Abstract- This research aims to know the difference of students' learning achievement that use Indonesian Realistic Mathematics Education approaching (PMRI) and the students' outcomes that do not use PMRI approaching (Conventional) at linear program topics in SMK Negeri 1 Tomohon. This research uses experiment methods. The obtained population is all tenth graders of SMK Negeri 1 Tomohon which consists of three classes whereas the sample is two homogenous classes, i.e. class X TKJ as experiment class and class X GB as control class. Experiment class consists of 24 students and control class consists of 24 students. This research is design model of *Nonequivalent Control Group Design*. The used learning tools are RPP and LKS. The data is obtained and collected from students' test result. Based on data analysis using t test, it obtains that $t_{count} = 3.549 > t_{table} = 1.645$ for $\alpha = 0.05$. Therefore, it is obtained that students' learning achievement using PMRI approaching is higher than students' learning achievement which do not using PMRI approaching at linear program topic.

Keywords- *PMRI, Learning Achievement, Linear Program*

I. INTRODUCTION

Mathematics is needed in various knowledge branches and life aspects. In daily life, mathematics plays an important role, for example, a child sold ice cream. The price of chocolate ice cream is Rp 1,000 and strawberry ice cream is Rp 750. The profit of chocolate ice cream is Rp 300 whereas the profit of strawberry ice cream Rp 250. The capital owned by this child is Rp 100,000 and a box for selling ice cream which can contains 50 ice creams. How much profit can be obtained by this child? This issue example in accordance with the topic of linear programs that are taught in Vocational School (SMK).

Based on interviews with mathematics teachers in SMK Negeri 1 Tomohon, the students' learning achievement in linear program topic do not meet the mastery standard given by the teacher. The mastery standard grade in previous years, especially on the linear programs topic showed unsatisfactory results, which is about 45 percent of students score is below the mastery standard. The mastery standard given by the school special for linear program topics is 65.

The unsatisfactory learning achievement occurs because the learning process positioned students as listener of teachers' lecture. As a result, the learning process tends to be boring and makes the student lazy to learn. The success of the learning and teaching process in mathematics class can be measured by the success of students who take these activities. That success can be seen from the level of understanding, mastery of the material as well as student achievement. The higher the understanding and the mastery level and the learning achievement, the higher the success rate of learning. But in reality it can be seen that the learning achievement of students is still low.

One promising approach to the teaching and learning of mathematics are expected to address the problem is realistic mathematics education (RME). RME is a theory of teaching mathematics that has been developed in the Netherlands since the early 70s.[1,2,3,4,5]. The teachers who concerns with this issue are developing and implementing various models to make students interested and excited in learning Math. One of them is through PMRI.

PMRI is a math learning approach that uses contextual problems as an initial step. Based on the research result in some countries, Freudenthal (MKPBM Team 2001) states that PMRI very advantageous because (1) it can make Math more interesting, relevant and meaningful, not too formal and not too abstract, (2) it considers the level of student ability, (3) it emphasizes the mathematics learning in "learning by doing", (4) it can facilitate the completion of math problems without the use of standard completion (algorithm), (5) it uses context as a starting point for learning mathematics.[6]

PMRI emphasizes how students find back (reinvention) concepts or procedures in mathematics through contextual issues. Soedjadi (2001) suggested that the study of mathematics by PMRI approach is basically the utilization of reality and environment to facilitate the learning process of mathematics so as to achieve the goal of mathematics education. Further, Soedjadi explains that reality is the real or concrete things that can be observed or understood by the learners through imagining, while the environment is the environment where the learners are being, e.g. school, family and community that can be understood learners. This environment is called daily environment.[7]

- From the discussion above, it appears that PMRI is a learning approach that departed from the problems according to the student experience. In this case,

active students and teachers act as facilitators. In relation to mathematics as a human activity, students should be given the widest opportunity to rediscover the idea of mathematical concepts independently as a result of the student experience in interacting with reality. After discovering mathematical concepts, students can use them in solving related problems to strengthen their capacity to think about the mathematical concept.

- There are three key principles in designing PMRI-based learning i.e.:

1. *Guided reinvention* and *progressive mathematizing*
2. *Didactical phenomenology*
3. *Self developed models.*[4,8]

PMRI has 5 (five) characteristics which is the operationalization of the PMRI principles PMRI. The characteristics are the followings.

1. 1. Using contextual problems
2. 2. Using models, bridging by vertical instruments
3. 3. Using students contribution
4. 4. Interactivity
5. 5. Intertwining.[4,8]

The main PMRI principles are translated into PMRI characteristics. Furthermore, the characteristics of PMRI are translated into operational steps in learning. Based on the definition of the main PMRI principles and characteristics, it can design the core steps (activities) in PMRI-based mathematics learning, i.e.:

1) Understanding the contextual problems

The teachers give contextual problems and ask the students to understand the problems. If there is certain part which is not understood yet by some students, then the students who already understand that part would be asked to explain their friends who do not yet understand. If the student who does not yet understand is not satisfied yet, the teacher would explain it further by giving some hints or limited suggestions about the situation and condition of the problem. The hints in this context is in the form of questions that direct the students to understand the problem, e.g. "What is already known in that problem?", "What is being asked?", "What strategy or procedure should be used to solve that problem?". At this stage, the revealed PMRI characteristic is using contextual problem and interaction.

2) Solving contextual problem

Students individually are asked to solve the contextual problems at Student's Worksheet in their own way. The different solving way and answer is preferred. The teacher motivates students to solve that problem by giving guiding questions to direct students solving the problem. For example: "How do you know that?", "How?", "Why do you think that?", etc. At this stage, students are guided to rediscover the concept or principle of mathematics through a given contextual problem. Teachers are expected not need to tell about the problem completion or the problem itself, before students get their own way to solve. In this step, the PMRI characteristic is using model and interaction.

3) Comparing and discussing the answer

The students are asked to compare and discuss their answer in small group. After that, the result of that discussion is compared at class discussion led by teacher. This stage is also useful to train the students expressing opinions even though it is different with their friends or teacher, through interactive communication. PMRI characteristics that appear at this stage are the use of an idea or the student contribution and interaction between students and students, between teachers and students and among students with the learning resources.

4) Concluding

Based on the result of group and class discussion, teacher directs students to make conclusions about the concepts or definitions, theorems, principles or mathematical procedures related to the new contextual issues resolved. PMRI characteristics that appear in this step are the use of an idea or the student contribution and interaction.

Based on the description above, the problem is studied in this research is: Is there a difference of student learning achievement which follow PMRI learning with the students who take conventional learning on linear program topics at SMK Negeri 1 Tomohon?

II. RESEARCH METHODS

This study is experimental research because the researcher intends to provide treatment to the research to determine the effect of the treatment further. That treatment is PMRI learning in the experiment class and conventional learning in the control class. The independent variable in this study is the PMRI and conventional learning approaches. The dependent variable in this research is the student learning achievement in linear program topic. The result of this study is the difference of pretest scores and posttest scores.

The used experiment design is *Nonequivalent Control Group Design*. That experiment design can be described as follows:

TABLE I. RESEARCH DESIGN

Class	***Pretest***	***Treatment***	***Posttest***
Experiment	Y_{1E}	X	Y_{2E}
Control	Y_{1K}		Y_{2K}

Y_{1E} : Pretest score of experiment class
Y_{1K} : Pretest score of control class
X : Learning process, that is the realistic mathematics learning implementation of the linear program
Y_{2E} : Post-test score of experiment class
Y_{2K} : Post-test score of control class.[9]

The research population is all students of class X SMK Negeri 1 Tomohon that contains of the three classes. While the sample in this study is randomly selected 2 classes of 3 existing class and the acquired classes are Computer and Networking Engineering (TKJ) as the experimental class and Building Picture (GB) class as the control class.

To obtain the data in this study, the test instruments that have already tested its validity and reliability are used. From the obtained quantitative data of achievement test, the data is analyzed to be described for granted interpretations. Quantitative data processing is done through two main phases.

1. First phase: test the statistic requirement as the basic in hypothesis testing, i.e. data distribution normality test of sample subject and variance homogeneity test
2. Second phase: test the difference of each group by using t-test, ANOVA one lane with help of SPSS-17 *for Windows* software.

III. RESULT AND FINDINGS

In this study, prior to hypothesis testing using t-test, the normality and variance homogeneity tests are conducted first. The used data is the difference of the pretest results and the post-test result of the two classes, i.e. the experiment class and control class.

The data analysis of the pretest result and the post-test result is conducted to determine the normality and homogeneity of data as a condition for doing experiments on both classes which are taken by randomization. Therefore, tests of normality and variance homogeneity and the hypothesis testing are presented as follows.

A. Analysis Requirement Test

In inferential analysis, prior to the hypothesis testing using t-test, the normality and variance homogeneity tests are conducted first. And the used data is the difference of the pretest results and the post-test result of the two classes, i.e. the experiment class and control class.

The data analysis of the pretest result and the post-test result is conducted to determine the normality and homogeneity of data as a condition for doing experiments on both classes which are taken by randomization. Therefore, tests of normality and variance homogeneity and the hypothesis testing are presented as follows.

1) Normality Test using Minitab Software

a) Experiment Class

The difference data of pretest and post-test scores of the experiment class for the normality test can be seen in the graph below:

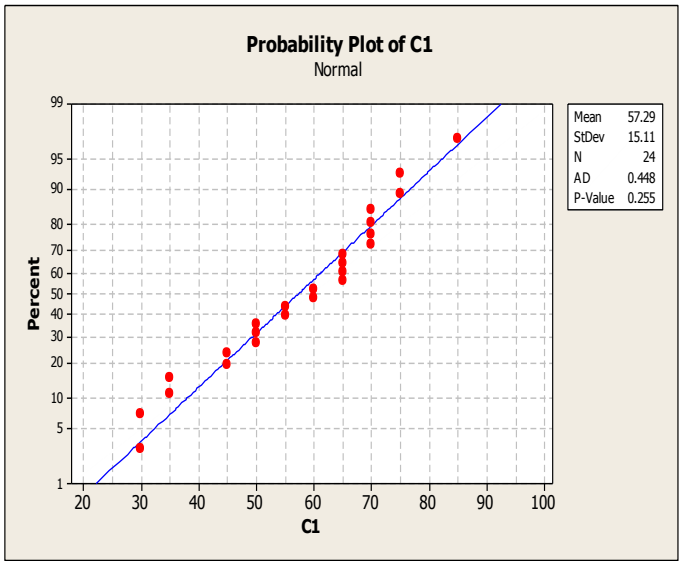

Figure 1. Graph of the Normal Distribution Chance of Experiment Class.

At the Figure 1 above, it can be seen that *p - value* = 0.255 and the data plots tend to converge on a single straight line. Therefore *p - value* (0.255) > α (0.05) then the pretest score of experiment class is normally distributed.

B. Control Class

The difference data of pretest and post-test scores of the control class for the normality test can be seen in the graph below:

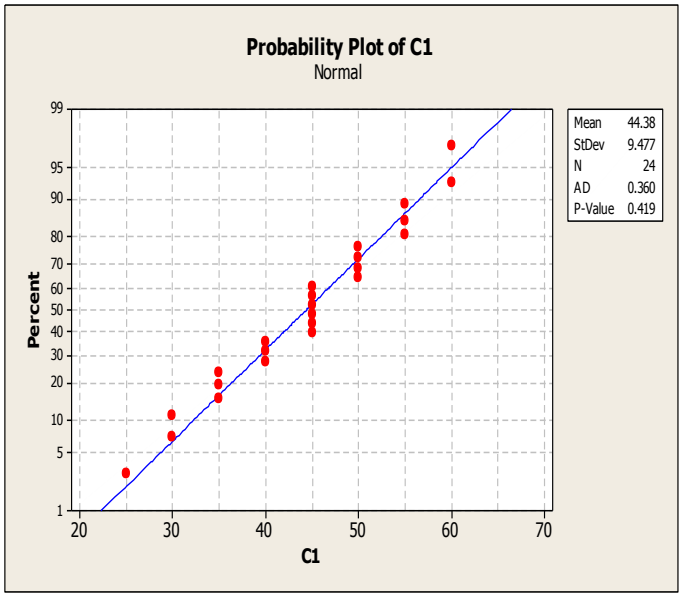

Figure 2. Graph of the Normal Distribution Chance of Control Class

At the Figure 2 above, it can be seen that *p - value* = 0.419 and the data plots tend to converge on a single straight line. Therefore *p - value* (0.419) > α (0.05) then the pretest score of experiment class is normally distributed.

1) Variance Homogeneity Test Using SPSS Software

Based on the homogeneity test using *f* test statistic at the pretest result data, with $s_E{}^2$ = 125.36 and $s_K{}^2$ = 79.30 it is obtained f_{count} = 1.58. Because $f_{1-\frac{\propto}{2}} = 0{,}43 < f_{count} = 1{,}581 < f_{\frac{\propto}{2}} = 2{,}21$ then $H_0 : \sigma_1{}^2 = \sigma_2{}^2$. So, the variance of two classes, i.e. experiment class and control class, is homogenous or same.

C. Hypothesis Test

$H_0 : \mu_E = \mu_K$

$H_1 : \mu_E > \mu_K$

With:

μ_E = the average of students' learning achievement who are taught using PMR,

μ_K = the average of students' learning achievement who are taught without using PMR,

Because the normality and homogeneity tests have been fulfilled, then the t-test statistic may be continued.

Based on the criteria of hypothesis testing, H_0 is rejected if the test statistic falls in the critical region. From the results of hypothesis testing with the *t* test, the significance level (α) = 0.05 obtained t_{count} = 3.549 and t_{table} = 1.645. So, t_{count} = 3.549 > t_{table} =1.645, which means the test statistic falls in the critical region. This shows sufficient evidence to accept H_1. it can be concluded that reject H_0 and accept H_1, i.e.: $\mu_E > \mu_K$.

This means that the "average of students' learning achievement who are taught using PMRI is higher than the average of student's learning achievement who are taught without using PMRI".

From the results of inferential analysis above, it was found that the experiment class which is taught using PMRI, generally indicate a difference on students' learning achievement. It is shown by the average score of the post-test minus the pre-test scores at the two classes. At the experiment class, the average of post-test score minus the pre-test score is 57.29 which is greater than the average of the post-test score minus the pre-test score at the control class that is 44.37.

After being analyzed using t-test, the mean difference obtains t_{count} = 3.549 > t_{table} = 1.645. This suggests that there is significant difference from the learning achievement of these two classes, where the learning achievement of students who are taught using PMRI approach is higher than the learning achievement of students who are taught without PMRI approach on the linear program topic. This is in accordance with the opinion of Mangelep (2010) which states that PMRI is a mathematics learning approach that reveals the experiences and events that are close to the students as a means to understand the mathematical problem so that the learning mastery is achieved in which students learn to solve problems gradually with mathematical logical thinking ability of the students.[10]

IV. CONCLUSION

Based on the research result and the discussion above, it is concluded that the learning achievement of students who are taught using PMRI is better than the learning achievement of students who are taught without using PMRI.

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