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Effectiveness of the Realistic Problem Based Learning Model Development Toward Communication Skills and Mathematical Disposition of Vocational High School Student

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***Abstract*—The effectiveness of Realistic Model PBLs is tested towards the communication skills and mathematical disposition of vocational high school students. For this purpose, it is used 2 × 2 factorial research design. The sample is determined by two stages of random sampling technique. From this research, it is found that 1) there is difference of mathematical communication ability of vocational high school students based on mathematical disposition level (high, low. 2) there is difference of mathematical communication ability of vocational high school students based on learning model (Realistic Model PBL, Conventional) 3) there is no interaction between learning model with mathematical disposition on the ability mathematical communication of vocational high school students.**

Keywords—*Realistic Model PBL, communication, disposition*

I. INTRODUCTION

The quality of education in Indonesia, among others, can be observed from the level of mathematical mastery possessed by the students. From the results of an international survey conducted by Trend In Mathematics and Science Study (TIMSS) in 2011, it has found the level of mastery of Indonesian students' mathematics skill is still less satisfactory. Observing the problem of the mastery of mathematical aspects in every level of education should be increased including in Vocational High School (SMK).

The subjects of mathematics in SMK are included in the compulsory subject group as it is a tool/means to master of other fields in science including the areas of expertise which is chosen by the students who study in vocational high schools. In addition, according to [1], mathematics has a large contribution in the achievement of Life Skills which include: problem solving ability, reasoning and proof ability, interconnection ability (connecting), the ability to communicate and ideas (in communication) and the ability to represent (representation). NCTM (2000)[1] states that the above abilities are skills that are needed by students in this century because it supports students to adapt to where the students live, work and in their community. This is in line with the opinion of [2] that senior vocational school graduates also have to master mathematics, in addition to the area of expertise that they studied. So it is not surprising that one of the goals of vocational education in developed countries like the United States (US) is to produce graduates with good math skills.

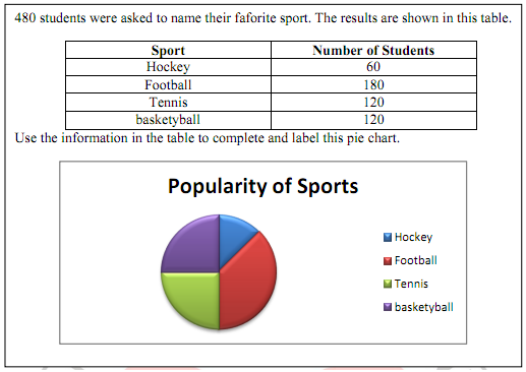
In a preliminary study that researchers did in one of Vocational high school (SMK) in Padang it is found that mathematics is a subject that is less interest by the students of that SMK to study. Students tended to distinguish mathematics with subjects related to their area of the proficience in SMK. The reason is that students do not realize that mathematics contributes greatly in solving everyday problems, including the areas of their proficiency that they study. In addition, from interviews that have conducted with SMK students, it is obtained a description that the experience of learning mathematics in the previous education level left a bad impression for the students themselves. Mathematics is always identified with complex, complex calculations, a tense learning environment and amount of tasks given. Mathematics learning obtained less meaningful for vocational students. In addition, these conditions make math a less prioritized subject for vocational students to learn.

Meanwhile, still about learning mathematics in SMK, [3] found that teachers of SMK in some provinces in Indonesia generally had difficulties in implementing contextual learning and realistic, and on the implementation of learning achievement goals related to concrete mathematical communication in their respective classes. The author also found in SMK of Padang, where learning is

still centered on teachers (teacher centered) and students are still difficult to answer the questions about the mathematical communication skills provided by the teacher. Students have not been able to communicate their ideas in the form of symbols, reading graphs or giving explanations on written answers.

These results can certainly be associated with TIMSS research conducted in 2011. In one aspect that is measured, namely aspects of mathematical communication ability, it is found that the achievements of Indonesian students have not achieved satisfactory results. Indonesia is in the ranks 38th among 63 countries. The average difficulty experienced by students is not being able to translate the questions into tables and diagrams, as shown in Figure 1.

In this study, only 28% of Indonesian students were able to answer the questions correctly, while the international average was 47%. Compared to other countries, the ability of Indonesian students to translate problems into language or mathematical ideas in the form of diagrams or graphs is still below the average [4].


480 students were asked to name their faforite sport. The results are shown in this table.

Sport	Number of Students
Hockey	60
Football	180
Tennis	120
basketyball	120

Use the information in the table to complete and label this pie chart.

Fig. 1. One of TIMSS Communcation Problems (2011).

The cause of the lack of mathematical communication among students is the lack of provision of opportunities for students to communicate their ideas. As a result, teachers rarely listen to student ideas in solving math problems.. [5] argues that giving opportunities and listening to ideas from students when solving problems is a key word in achieving mathematical communication skills. In an effort to develop students' mathematical communication skills, teachers need to confront students on real issues, thus giving students the opportunity to communicate their ideas in solving their existing problems ([6], and [27].

The poor ability of mathematical communication resulted in the students' difficulty solving mathematical problems encountered in everyday life. This difficulty positioned mathematics into subjects avoided by students. When students are exposed to mathematics, the attitudes of the students were lack of confidence, uninterested, lazy, and no appreciation of mathematics. The attitudes shown are called mathematical dispositions (Mathematical Disposition). A mathematical disposition is defined as an attraction and appreciation of mathematics, a tendency to think and act positively, including self-confidence, curiosity, perseverance, enthusiasm in learning, persistent problems, flexible, willing to share with others reflectively in math activities [7]. A low mathematical disposition will result in a lack of appreciation of the usefulness of mathematics in everyday life.

A mathematical disposition is said to be good if the student interest toward problems that are a challenge and involve themselves directly in finding or solving the mathematics problems. Mathematical dispositions can be observed when students solve mathematical problems; whether confident, diligent, interested, and flexible thinking to explore various alternative solutions to problems. The learning process is perceived by the students when solving the challenge. The student's mathematical disposition can develop when students learn other aspects of competence, [8]. Thus it can be concluded if the mathematical communication ability is developed then the student's mathematical disposition will also develop. Improvement of communication skills and mathematical disposition of vocational students can be facilitated by preparing mathematics learning well. One of them is by avoiding learning that is classic and not interesting for students.

Learning with classical patterns often provides unsatisfactory conditions and learning outcomes, because it does not provide sufficient space for students, making students more passive by simply hearing explanations from teachers. As a result students do not master mathematical concepts and lack the opportunity to do reinvention ([9], and [11]). Problem solving and starting with the current situation (contextual problem) at that time should become a habit for teachers in SMK (based on [12] and)[13]). Based on the exposure of the above problems serious efforts are needed to address the various problems that exist. One of them is by applying Problem Based Learning Model (PBL) with Realistic Mathematics Education (RME).

PBL model according to [14], is a model of learning where students do authentic problems with the intention to compile students' own knowledge, develop inquiry and high-level thinking skills, develop self-reliance and self-confidence. This model is in accordance with the characteristics of the existing problems. Problem solving and contextual problems are the hallmark of the PBL Model, and this model also strongly emphasizes the element of teamwork that strongly supports students to improve their communication skills.

One of the learning approaches specifically designed for mathematics is the Realistic Mathematics Education (RME) approach. The approach initiated by Freudhenthal (1970) is an approach that emphasizes students' mathematical process skills, discussing and collaborating, arguing with classmates so that students can find their own and eventually use math to solve problems both individually and in groups [10].

The RME approach begins with the use of realistic problems or problems that can be imagined by students to drive students toward the process of mathematization. This approach also has characteristics that can resolve communication problems and mathematical dispositions described previously.

PBL Model and RME Approach have some similarities, such as using real problem (contextual) and can be imagined by the students, familiarize student to communicate in the form of discussion, argumentation, or in written form. From

the uniqueness of PBL Model with RME Approach developed a Learning model called Realistic Model PBL. Realistic PBL model is expected to improve communication skills and mathematical disposition of vocational high school students. Based on the above explanation, this paper is focused on the effectiveness of Realistic Model Development of PBL on Mathematics Learning in Vocational High School (SMK).

II. Research Methods

This research is a development research by using Plomp method [15], consisting of 3 phases, namely: 1) preliminary phase, 2) prototyping & development phase and 3) assessment phase.

This paper is only focused on the effectiveness of PBL Realistic Model of mathematical communication skills and mathematical disposition of vocational students. This research took place from the beginning of August 2017 until the end of October 2017. To be able to achieve the expected research objectives then this research was designed by using 2 × 2 factorial design.

Determination of subjects aimed to trials conducted by the technique of two stages random sampling. Stages I is carried out by purposive sampling that is choosing a school that studies certain materials (matrix) in the current semester but not at the same time, otherwise it is expected that the school has a close location so as to facilitate the implementation of research. At this stage the selected schools are class XI of SMKN 4 Padang and Class XI of SMKN 8 Padang. The first school learn matrix (SMKN 4 Padang) is then positioned as the first trial while SMKN 8 Padang is referred to as second trial.

After the chosen place of execution of the research, then it will be performed the stages II, with random sampling technique in the population that has been established in both schools. To know the normality, homogeneity and equality test average in the population used software Statistical Product and Service Solution (SPSS). In this study, the normal population, homogeneous and have the same average so that it can be carried out to determine the experimental class and control class. From the activity of the stage II got the results; class XI Accounting A as control class and Class XI Accounting B as experiment class in SMK 4 Padang. In SMKN 8 Padang was chosen class Kriya Tekstil I as an experimental class and Kriya Tesktil II as a control class.

Tests on each school were held in four meetings. The experimental class is treated with the model being developed: Realistic PBL model with a syntax consisting of 7 phases; 1) presentation of realistic problems 2) understanding and problem solving 3) provision of assistance 4) presentation of work and reflection 5) discovery of knowledge and concepts 6) Exercising and 7) closing evaluation. While the learning in the control class is done by the usual classroom learning strategy (control class) /same as done before.

The instruments used to see the effectiveness of Realistic of PBL Model are 1). the test designed in accordance with predefined mathematical communication ability indicators and 2). questionnaire disposition scale. Before using those all then the first instruments validated by 6 experts and after revised in accordance with the input of experts and then in a trial to SMKN 1 Sumbar. The benefit of this trial is to obtain a truly qualified instrument in this study.

The test results of the seven problems of mathematical communication skills are:

1. Mathematical Problem Testing Problem.
   The test results show that all items are valid, validity processing was using Statistical Product and Service Solution (SPSS) software with Product Moment Correlation formula shows all values of $r > 0.3$. All items also have significant differences, and consist of problems with easy and moderate difficult indexes. Reliability of grain matter with formula Alpha Cronbach which gives reliability value r_{11} = 0,604 with criteria pertained high. All of these results confirm that a test of mathematical communication skills that have been prepared is appropriate to use in this study.

2. Questionnaire Disposition scale.
   The ability of mathematical disposition is measured by using a disposition scale questionnaire which is contained with 40 statements that measure students' interest to act mathematically. The indicators contained in the disposition scale are: 1) confident in using mathematics 2) flexible in doing mathematics work 3) firmly determined in solving mathematical problems 4) possessing high curiosity on everything about mathematics 5) able to think reflectively in mathematics. Assessment The scale of this mathematical disposition is made by referring to the Likert Scale form consisting of 5 response categories: Strongly Agree (SS), Agree (S), Doubt (R), Disagree (TS), and Strongly Disagree STS).

The disposition scale trial was conducted at SMKN 1 Sumbar and resulted in 5 items of declaration, leaving 35 statement items with all of them valid ($r_{count} > r_{table}$) and meeting the high reliability aspects.

a. Data Analysis Techniques Score Mathematical Communication Skills SMK Students.
   The answers given by students in the test of mathematical communication skills were assessed by using scoring rubrics where the indicators were specifically developed for students' mathematical communication skills. The results of the communication test are then analyzed to determine the mean final score and then converted into qualitative data to determine the category of student ability level. The degree category of students' mathematical communication ability is determined as in Table I.

TABLE I. Student's Communication Skills Category

Mastery skill (%)	Predicate	Level of Effectiveness
86 < score ≤ 100	Very good	Very effective
76 < score ≤ 86	Good	Effective
60 < score ≤ 76	Satisfactory	Effective enough
55 < score ≤ 60	Poor	Less effective
score ≤55	Very poor	Not effective

Source: Modifed From [16]

b. Data Analysis Techniques of the Student Mathematical Disposition.

Scores obtained from the disposition scale questionnaire which are given to the students must be known to mean. To find it out, a categorization process can be done normatively by utilizing descriptive statistics in interpreting disposition scale scores. Categorization is based on the assumption that the subject score in the group is an estimate of the subject score in the population and that the subject score in the population is normally distributed [17]. Step categorization can be done in the following way:

TABLE II. CATEGORY MATHEMATICAL DISPOSITION

Score	Category
Score < 60%	Very Low
60% ≤ Score < 70%	Low
70% ≤ Score < 80%	Average
80% ≤ Score < 90%	High
Score ≥ 90%	Very High

Sources : [18]

c. Hypothesis Testing Analysis Technique With Factorial Design.

Hypothesis Testing Analysis has the purpose To test the hypothesis in answering the effectiveness of Realistic PBL Model in the field of experiments with factorial design, which with factorial design it allows the interaction of the components of independent variables and bound.

TABLE III. FACTORIAL RESEARCH DESIGN

Learning Model / Mathematics disposition	Realistic Model PBL (X_1)	Conventional Model (X_2)
High mathematical disposition (Y_1)	X_1Y_1	X_2Y_1
low mathematical disposition (Y_2)	X_1Y_2	X_2Y_2

Information:

X_1Y_1 : mathematical communication ability of the students who have high mathematical disposition by using Realistic PBL Model

X_2Y_1 : mathematical communication ability of the students who have high mathematical disposition by using conventional learning model

X1Y2 : mathematical communication ability of students who have low mathematical disposition with development of Realistic Model PBL

X2Y2 : mathematical communication ability of students who have low mathematical disposition by using conventional learning model.

After that, the effectiveness test is done to test the main effect of the hypothesis and the interaction effect hypothesis. Each of the main effects and interaction of hypotheses effects and their data analysis techniques are described as follows:

1) Main effect hypothesis:

a) HO : There is no difference in the ability of mathematical communication between students taught by PBL Realistic Model with students taught by conventional learning model

H1 : There is a difference in the ability of mathematical communication between students who are taught by PBL Realistic Model with students taught by conventional learning model

HO : There is no difference in mathematical communication skills between students who have high mathematical dispositions with low mathematical dispositions

H1 : There is a difference in the ability of mathematical communication between students who have high mathematical disposition skills with students who have a low mathematical disposition

2) Hypothetical interaction effect:

a) HO : There is no interaction effect between learning model with mathematical disposition on students' mathematical communication ability

b) H1 : There is an interaction effect between learning model and mathematical disposition on students' mathematical ability.

For the purpose of hypothesis testing with factorial design that requires categorized data into two parts (high disposition and low disposition) then the categorization process is done by using Cut off point. For more details can be done as follows:

TABLE IV. DATA CATEGORIZATION FOR THE PUPRPOSE OF HYPOTESIS TESTING WITH FACTORIAL DESIGN

Distribution of Disposition Score	Cut off Point	Criteria	Disposition category
Normal	Mean	Disposition > mean score	High
		Disposition ≤ mean score	Low
Tidak Normal	Median	Disposition > median score	High
		Disposition ≤ mean score	Low

In this study the amount of data in each cell is not the same. Technique of Data analysis for main effect hypothesis and interaction effect used two path anava with n not equal [19].

III. RESULT AND DISCUSSION

1. Result

a. Mathematical Communication SkilL

Field tests that have been conducted at two schools (SMKN 4 Padang & SMKN 8 Padang), ended with a

measurement of students' mathematical communication skills. In summary, the average mathematical communication skills of students in the experimental and control classes in both schools are as in table V.

From the table average score of mathematical communication ability it is seen that experimental class taught by Realistic Model of PBL have higher mean value and standard deviation is smaller than control class at both schools.

TABLE V. THE AVERAGE OF MATHEMATICAL COMMUNICATION SKILLS STUDENTS SCORES OF SMK 4 AND SMK 8 PADANG

Class value	SMKN 4 Padang		SMKN 8 Padang	
	Experiment.	Control	Experiment.	control
N	29	23	30	27
$\bar{X}$	81,79	60,33	72,50	54,86
X_{max}	92	73	45,83	76,04
X_{min}	57	22	91,67	25,00
S^2	114,24	214,63	149,26	170,44
S	10,88	14,63	12,22	13,06
≥ KKM	24	11	16	3
< KKM	5	22	14	24

In simple terms this is understood that the experimental class has better mathematical communication skills than the control class. This can be reinforced by the qualitative interpretation of students' mathematical communication skills in detail in the table VI bellow:

TABLE VI. INTERPRETATION OF MATHEMATICAL COMMUNICATION SKILLS SCORES OF SMKN 4 PADANG AND SMKN 8 PADANG

Intr. Of efectivity level	**Communication Skill**	**SMKN 4**		**SMKN 8**	
		Eksp. Class	**Cont. Class**	**Eksp. Class**	**Cont. Class**
Very effective	Very good	15	0	5	-
Effective	Good	6	2	7	2
Efeective enough	Satisfactory	7	9	15	11
Less effective	Poor	1	12	1	2
Not effective	Very poor	0	0	2	12
Total		**29**	**23**	**30**	**27**

From Table VI, it can be seen that in the experimental class at SMKN 4, students' mathematical communication skills are mostly in the "very good" category whereas the control class is in the "less" category. Whereas in SMKN 8 Padang it is seen that in the experimental class, students' mathematical communication ability mostly in "good and satisfactory" category and effectiveness level is in "effective" category. The ability of students' mathematical communication in the control class of SMKN 8 is in the category of "satisfactory and poor" with the level of effectiveness is less effective. Details of each indicator percentage of communication on each question are as table VII.

The results of the each indicator achievement (%) also reinforce the finding that the experimental class studying with the PBL Realistic Model has on average better communication skills than the control class in both schools.

TABLE VII. DETAILS PERCENTAGE OF SCORE ACHIEVEMENT PER PROBLEM INDICATORS AT SMKN 4 PADANG AND SMKN 8 PADANG

No.	**Indicator of test**	**SMKN 4**		**SMKN 8**	
		Exp. (%)	**Cont. (%)**	**Exp. (%)**	**cont. (%)**
1	Linking real objects, drawings or diagrams into mathematical ideas.	100	27,17	80,33	80,74
2	Using terms, notations, mathematical symbols and structures to present ideas.	70,30	80,39	71,20	35,81
3	Explain ideas, situations and mathematical relationships with real objects, drawings or diagrams	85,8	58,9	70,08	41,27
4	Drawing conclusions, compiling evidence and giving reasons	70,45	53,17	68,33	60,66
	Average	81,7	54,9	72,50	54,7

b. Ability of Mathematical Disposition

In addition to mathematical communication skills, the desired learning impact of the PBL Realistic Model is the difference in students' mathematical disposition abilities of the experimental class students with the students in the control class. For this purpose, students are given a disposition scale questionnaire that contains some statements. Disposition scale questionnaire processing at SMKN 4 and SMKN 8 Padang gives the results as in table VII.

TABLE VIII. STUDENT DISPOSITION SCALES AT SMKN 4 AND SMKN 8 PADANG

Category	**SMKN 4**		**SMKN 8**	
	Exp. (%)	**Cont. (%)**	**Exp. (%)**	**Cont. (%)**
Very high	-	-	3,33	-
High	34,48	26,09	16,67	11,1
Satisfactory	48,27	30,43	53,33	40,64
Low	17,24	43,48	26,67	44,56
Very low	-	-		3,7
Total	100	100	100	100

From the table VIII shows that in SMKN 4 and SMKN 8 Padang, in the experimental class, it can be seen that the percentage of students with high and medium disposition ability categories is higher than control class. As if seen from the description of the scores per each indicator

mathematical disposition in the experimental class and control classes at two schools are as follows:

TABLE IX. PERCENTAGE OF DETAILS PER INDICATOR OF STUDENT MATHEMATICAL DISPOSITION SCALE AT SMKN 4 PADANG AND SMKN 8 PADANG

No.	Math disposition indicator	SMKN 4		SMKN 8	
		Exp. (%)	Cont. (%)	Exp. (%)	Cont. (%)
1	Confident in using math	71,29	66,3	77,17	70,19
2	Flexibility in solving math problem	73,91	69,86	72,11	70,37
3	Persistent in solving math problem	76,44	74,35	76,67	75,19
4	Have a high curiosity about everything that smells of mathematics	74,09	70	70,08	67,22
5	Able to think reflectively with math	73,45	69,07	71,9	65,19
	Average	73,84	69,92	73,59	69,63

The presentation of data for each disposition scale indicator in graphic form in both schools can be shown as follows:

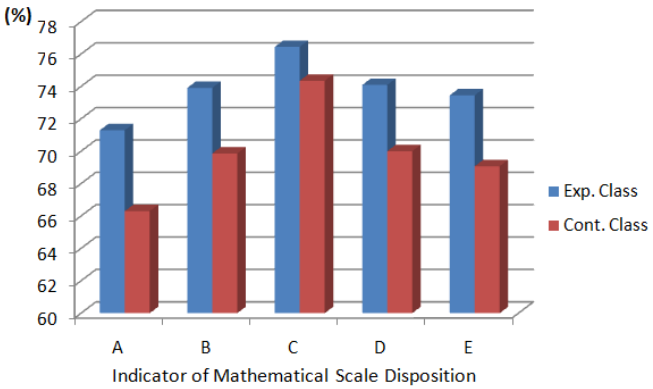


Fig. 2. Comparison of Student's Mathematical Dispostion Ability in SMKN 4 Padang

Graphic Comparison of Student Mathematical Disposition Ability in SMKN 8 Padang

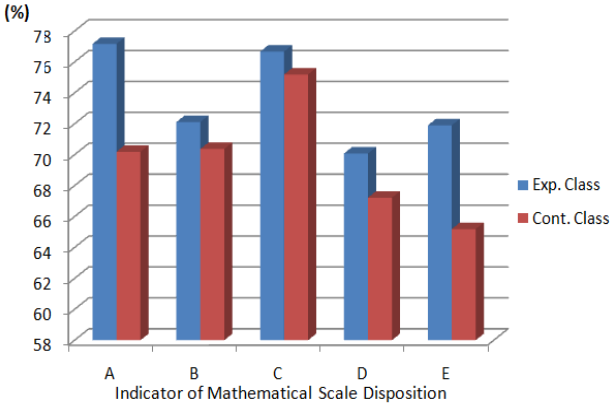


Fig. 3. Comparison of Student Mathematical Ability in SMKN 8 Padang

Description:
A : the Confident in using math
B : Flexible in doing mathematical work
C : Determined to resolve math problems
D : Have a high curiosity about everything that smells of mathematics
E : Reflective thinking about mathematics

c. Hypothesis Testing

Learning models developed are said to be effective when delivering results as expected. In this study it is expected that the development of learning model will provide significant differences, especially on the ability of mathematical communication and mathematical disposition ability of students in experimental class when compared with the control class. The significant difference will be investigated by using a 2 × 2 factorial design. To be able to test the hypothesis that has been proposed done some things as follows:

1) Test Requirements Hypothesis Analysis
To be able to test hypothesis with factorial design hence the data researched must fulfill requirement: normal distribution and have homogenous variation.
   a) the Data of Normality test. Test the normality of data is done with SPSS software and provide data as follows:

TABLE X. TEST OF NORMALITY

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
A1	0,105	59	0,171	0,962	59	0,065
A2	0,094	50	0,200	0,961	50	0,100
B1	0,106	45	0,200	0,965	45	0,189
B2	0,063	64	0,200	0,975	64	0,209
A1B1	0,098	25	0,200	0,949	25	0,233
A2B1	0,183	20	0,079	0,920	20	0,101
A1B2	0,112	34	0,200	0,945	34	0,089
A2B2	0,086	30	0,200	0,968	30	0,478

Liliefors Significance Correction*.
This a lower bound of true significance

Since all major p-value significance values of 0.05 all groups of data satisfy the criteria of normally distributed data.

b) Testing the homogeneity Data. The homogeneity test of all data groups for factorial purposes was done by Lavene Statistic test with SPSS and gave the following results:

TABLE XI. TEST OF HOMOGENEITY OF VARIANCES

Dependent Variabel	Levene Statistic	df1	df2	Sig.
A1A2	0,468	1	107	0,495
B1B2	2,269	1	107	0,135
A1B1-A2B1	0,504	1	43	0,482
A1B2-A2B2	0,004	1	62	0,951

Since the sig value. dependet variable> 0,05 then all data is said as homogeneous.

2). Hypothesis Testing.

Hypothetical testing was performed by Variance Analysis (Anava) two paths with unequal n-cells. For the purpose of the research results can be summarized some data as follows:

TABLE XII. AVERAGE AND AVERAGE AMOUNT

Disposition Scale	Learning Model: Realistic Model PBL	Learning Model: Conventional Model	Total	
High	80,57	62,50	143,07	A1
Low	74,58	55,28	129,86	A2
Total	155,15	117,78	272,93	G
	B1	B2		

Processing the values contained in table XII above produces a variance analysis table containing the values as below:

TABLE XIII. SUMMARY OF VARIANCE ANALYSIS

Variance source	A (Row)	B (Column)	AB (Interaction)	G (Galat)	Total
JK	1135,69	9088,70	9,85	17204,69	27438,93
Dk	1	1	1	105	108
Rk	1135,69	9088,70	9,85	163,85	
Statistic Count	6,93	55,47	0,06		
F table	3,92	3,92	3,92		
Decision	Ho is rejected	Ho is rejected	Ho is Accepted		

Based on the summary of the Anava table it appears that the F arithmetic (Stat. Test) on the source of the "row" diversity is greater than F table (6.93> 3.92) so that Ho is rejected, so is the Fhitung (Stat test) on the source the diversity of "columns" is greater than F table (55,47> 3,92) so Ho is also rejected.

At the source of interaction diversity, it is different from the previous one where the Fcount of the interaction diversity source is less than Ftable (0.06 <3.92). Based on this fact, the results of hypothesis testing are as follows:

a) There is a difference in mathematical communication ability of students who have high disposition skills with students who have low communication skills.

b) There are differences in the ability of mathematical communication of students who studying with Realistic PBL Model with students who learn with learning model other than Realistic PBL Model

c) There is no interaction between students' mathematical disposition abilities and the Learning Model used.

2. Discussion

The result of hypothesis testing shows that students' mathematical communication ability in SMK is influenced by mathematical disposition and learning model used. However, there is nocorrelation between the learning model and the mathematical disposition of students.

The results of this study add to the amount of research on PBL Model and RME Approach that has been done before such as; The PBL model can improve students 'mathematical communication and problem solving skills [20] and it is also recommended to be used as a meaningful learning strategy that can improve student learning achievement and improve students' beliefs about Nigerian mathematics [21].

The RME approach in various studies has proven to be effective in making students more active in learning mathematics ([22], [28]), improving students' math concepts [23], improving students' high-level thinking skills [24], improving students' achievement in learning mathematics [22], [28].

The research findings in this paper are also relevant to; 1) experimental research on the use of PBL Model with RME Approach with the help of E-Learning Edmodo. The result of the research shows that PBL with RME approach assisted by E-Learning Edmodo can improve students literacy ability of PBL [25], 2) experimental research on the development of students' mathematical connection ability through Problem Based Method Learning and Course Horay Review. The study was conducted in junior high school with the result of mathematical connection in experiment group is better than control group [26], 3) Development of Problem Based Learning Model with scientific approach on triangle material in junior high school. This research produces valid and practical triangle learning materials based on strong rational theory, and has internal consistency in the learning process [20].

IV. CONCLUSION

1. Conclusion

From the exposure of the research findings above it can be concluded things as follows:

a. There is a difference in the ability of mathematical communication between students who have high mathematical dispositions with students who have low mathematical dispositions. It is concluded from the

result of data analysis with anava of two different n-cell road, obtained the calculation of statistical test equal to 6,93 while the value of statistic F in table is 3,92. so the alternative hypothesis is accepted.

b. There is a difference in the ability of mathematical communication between vocational students who are taught by PBL Realistic Model with students who are taught by conventional learning. It is concluded from the results of data analysis with anava two different n-cell path, obtained statistical test calculation of 55.47 while the F statistic value in the table is 3.92 so that the alternative hypothesis is accepted

c. There is no interaction effect between learning model and mathematical disposition on mathematical communication ability. It is concluded from the data analysis with anava two n-cell unequal path, the calculation of statistical test of 0.06 while the statistical value in the table is 3.92 This resulted that alternative hypothesis rejected.

2.Suggestions

Based on the conclusions obtained then put forward some suggestions as follows:

a. Suggestions for policy makers. Realistic PBL model has been able to improve the ability of mathematical communication for vocational students. This is expected to be one of the alternative models of mathematics learning in vocational schools in order to improve and improve teacher competence. To realize this the policy makers (SMK leaders) need to facilitate the teacher by holding the required training.

b. Suggestions for teachers and education practitioners. Realistic PBL model effectively improves students 'activities in learning, improves student interaction in learning, improves students' courage in expressing opinions, improving communication skills and mathematical disposition of students. Teachers and education practitioners can use the PBL Realistic Model to overcome class constraints related to student activity, communication skills and mathematical disposition of students.

c. Suggestions for the next researcher. It is recognized that the development of this model has limitations, it is necessary to recommend to the next researcher to further develop the limitations of the development of this model so that it becomes more in line with the demands of each subject and education level respectively.

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