The effectiveness of Realistic Problem-Based Learning Model Development Toward Communication Skills and Mathematical Disposition of Vocational High School Student

by Rivdya Eliza

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***Abstract*—The effectiveness of realistic problem-based learning (PBL) model is tested towards 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 skills of vocational high school students based on mathematical disposition level (high, low); 2) there is difference of mathematical communication skills 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 mathematical communication ability 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 was found that the mastery level of mathematics skills of Indonesian studens is still les satisfactory. Therefore, there is a needs to improve the mastery of mathematical aspects in every level of education in Indonesia, including in vocational high schools (SMK)

In SMK, mathematics includes in compulsory subject group as it is a tool/means to master 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 National Council of Teacher of Mathematic/NCTM (2000) [1], mathematics has a large contribution in the achievement of life skills, such as: problem solving ability; reasoning and proof ability, interconnection ability (connecting); the ability to communicate 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 Benson (1997)[2] that senior-vocational-school graduates also have to master mathematics, in addition to the area of expertise that they have 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 is done in one of Vocational high school (SMK) in Padang, it is found that mathematics is a subject that is less interested by the students to study. Students tended to distinguish mathematics with subjects related to their area of the proficiency 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 benn conducted with SMK students, it is obtained a description that the experience of mathematics learning in the previous education level left a bad impression for the students themselves. Mathematics is always identified with complex calculations, a tense learning environment and amount of tasks given. Mathematics learning is obtained as less meaningful for vocational students. In addition, these conditions make mathematics become a less prioritized subject for vocational students to learn.

Meanwhile, still about mathematics learning in SMK, [3] found that teachers of SMK in some provinces in Indonesia generally had difficulties in implementing contextual and realistic learning and in achieving learning achievement goals related to concrete mathematical communication in their respective classes. It is also found in SMK of Padang that learning is still centered on the teachers and the 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 situations can certainly be associated with TIMSS research conducted in 2011. One aspect that is measured is mathematical communication ability. It is found that the

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achievements of Indonesian students have not achieved satisfactory results. Indonesia is at 38th ranks 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 are able to answer the questions correctly, while the international average is 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 (TIMSS, 2011) [4].

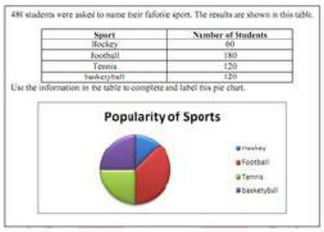

Fig. 1. One of TIMSS Communcation Problems (2011)

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. Turmudi (2008)[5] argues that giving opportunities and listening to student's ideas when solving problems is a key 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 (Sumarmo, 2013[6], and Permana, 2014)[27].

The poor ability in mathematical communication results in students' difficulty while solving mathematical problems encountered in everyday life. This difficulty positions mathematics into a subject avoided by students. When students are exposed to mathematics, the attitudes of the students are lack of confidence, uninterested, lazy, and no appreciation of mathematics. The attitudes shown are called mathematical dispositions. 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 and reflectively in math activities. (Wardani, 2008)[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 students are interest toward problems as a challenge and involve themselves directly in finding or solving the mathematics problems. Mathematical dispositions can be observed when students solve mathematics problems. They are confident, diligent, interested, and have flexible thinking to explore various alternative solutions to problems. The learning process is perceived by the students when solving the challenge. Student's mathematical disposition can develop when they learn other aspects of competence, [8]. Thus it can be concluded that if mathematical communication skills is developed then student's mathematical disposition will also develop. The Improvement of communication skills and mathematical disposition of vocational students can be facilitated by preparing mathematics learning well. 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, the students do not master mathematical concepts and lack the opportunity to do reinveation (Abdi, 2004) [9], and Sumarmo (1993) [11]). Problem solving started with the current situation (contextual problem) should become a habit for teachers in SMK (based on Permendiknas No. 41 year 2007 [12] and Permendikbud no. 22 of 2006) [13]. Based on the exposure of the above problems, serious efforts are needed to address various problems that exist. One of them is by applying Problem Based Learning Model (PBL) with Realistic Mathematics Education (RME). According to Arends (1991) [14], PBL is a model of learning where students to 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 PBL Model. This model also strongly emphasizes the element of teamwork that strongly supports students to improve their communication skills.

One of earning approaches specifically designed for mathematics is Realistic Mathematics Education (RME) approach. The approach initiated by Freudhenthal (1970) is an approach that emphasizes students' mathematical-processing 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].

Realistic mathematics education (RME) approach begins with the use of realistic problems or problems that can be imagined by students to drive them 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; and familiarize student to communicate in the form of discussion, argumentation, or in written form. From the uniqueness of PBL model with RME approach, it is developed a learning model called Realistic PBL Model. 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 the development Realistic Model PBL on Mathematics Learning in Vocational High School (SMK).

II. Research Methodology

This research focused on the effectiveness of PBL Realistic Model of mathematical communication skills and

Commented [K13]: Please delete, please recheck to all references mathematical disposition of vocational students. This research was a development research by using Plomp method (2013) [15] consisting of 3 phases, namely: 1) preliminary phase; 2) prototyping & development phase, and 3) assessment phase. was

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.

The determination of subjects was conducted by the technique of two stages random sampling. Stages I was carried out by a purposive sampling that was by choosing schools that studied certain materials (matrix) in the current semester but not at the same time, otherwise it was expected that the school has a close location in order 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 learned matrix (SMKN 4 Padang) was then positioned as the first trial, while SMKN 8 Padang referred as the second trial.

After choosing places for the execution of the research, then the stages II (applying random sampling technique for the population, which was established in both schools) was carried out. To know the normality, the homogeneity and the equality of test average in the population, Statistical Product and Service Solution (SPSS) software was used. In this study, the population was normal and homogeneous as well as had the same average, so that it allowed to determine an exeperimental class and a control class. In addition, the result of stage II pointed that in SMK 4 Padang, class XI Accounting A as control class and Class XI Accounting B as experimental class. Meanwhile, in SMKN 8 Padang, class Kriya Tekstil I was chosen as an experimental class and Kriya Tesktil II as a control class.

Tests for both schools were held in four meetings. The experimental class was treated with the developed model, 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 was done by the usual learning strategy, the same as done before.

Two instruments were used to see the effectiveness of Realistic PBL Model, namely: 1). the test designed in accordance with predefined mathematical communication ability indicators and; 2). Questionnaire Disposition scale. Before using both instruments, firstly, the instruments were validated by 5 experts. Afterwards, the instruments were revised in accordance with the input of the experts and finally the instruments were used as a trial to SMKN 1 SUMBAR. The benefit of this trial was to obtain a truly qualified instrument in this study.

The results of the trial for both test (seven problems of mathematical communication skills) and questionnaire of mathematical disposition were described as followings.

1. Test of mathematical communication skills.
   The test results showed that all items were valid where the validity was determined by Statistical Product and Service Solution (SPSS) software (the Product Moment Correlation formula showed all values of $r > 0.3$). All items also had significant differences consististing of problems with easy, moderate and difficult indexes. The reliability was determined by the formula Alpha Cronbach, which gave reliability value $r_{11} = 0{,}604$ with criteria pertained high. All of these results confirmed that the test of mathematical communication skills that have been prepared was appropriate to use in this study.

2. Questionnaire of mathematical disposition
   The ability of mathematical disposition was measured by using a disposition scale questionnaire which is consisting of 40 statements that measured students' interest to act mathematically. The indicators contained in the disposition scale were: 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; and 5) able to think reflectively in mathematics. The scale of this mathematical disposition was 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, which all of them were valid ($r_{count} > r_{table}$) and meeting the high reliability aspects.

a. Data Analysis of Mathematical-Communication-Skills's Score of 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 were then analyzed to determine the final mean-score and then converted into qualitative data to determine the category of student ability. The category of students' mathematical communication ability was shown 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 of Student's Mathematical Disposition.

Scores obtained from the disposition scale which were given to the students must be interpreted obviuosly. To find it out, a categorization process can be done normatively by utilizing descriptive statistics in interpreting disposition scale scores. The categorization was based on the assumption that the subject score in the group was an estimate of the subject score in the population in which the subject score in the population was normally distributed (Azwar, 2010) [17]. The category of mathematical disposition was shown by Table II.

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: Sugiar (2012)[18]

c. Hypothesis Testing Analysis Technique with Factorial Design.

Hypothesis testing analysis had the purpose to test the hypothesis to find out the effectiveness of Realistic PBL Model in the field of experiments with factorial design where the use of factorial design allowed 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 had high mathematical disposition by using Realistic PBL Model

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

X_1Y_2 : mathematical communication ability of students who had low mathematical disposition with development of Realistic Model PBL

X_2Y_2 : mathematical communication ability of students who had low mathematical disposition by using conventional learning model.

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

1) Main effect hypothesis:

a) H_0 : There was no difference in mathematical communication ability between students taught by PBL Realistic Model and students taught by conventional learning model

H_1 : There was a difference in mathematical communication ability between students taught by PBL Realistic Model and students taught by conventional learning model

H_0 : There was no difference in mathematical communication skills between students who had high mathematical dispositions with low mathematical dispositions

H_1 : There was a difference in the ability of mathematical communication between students who had high mathematical disposition skills and students who had a low mathematical disposition

2) Hypothetical interaction effect:

a) H_0 : There was no interaction effect between learning model with mathematical disposition on students' mathematical communication ability

b) H_1 : There was an interaction effect between learning model and mathematical disposition on students' mathematical ability.

For the purpose of hypothesis testing with factorial design requiring data to be categorized into two parts (high disposition and low disposition), then the categorization process was done by using Cut off point, as shown in Table VI below.

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 was not the same. The technique of data analysis for main effect hypothesis and interaction effect used two path Anava with n was not equal (Supardi, 2013) [19].

III. RESULT AND DISCUSSION

1. Result

a. Mathematical Communication Skills

Field tests that had been conducted at two schools (SMKN 4 Padang & SMKN 8 Padang) ended with a measurement of students' mathematical communication skills. In the summary, the average of mathematical communication skills of students in the experimental and control classes in both schools were shown in table V.

TABLE V. THE AVERAGE OF MATHEMATICAL COMMUNICATION SKILLS STUDENTS SCORESOF 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

From the table V, it can be seen that score of mathematical communication ability got by both experimental classes taught by Realistic Model of PBL had higher mean value than that got by the control classes. However the standard deviation of experimental class was smaller than that got by control class at both schools.

Sketchily, it can be said that the experimental class had better mathematical communication skills than the control class. This can be reinforced by the qualitative interpretation of students' mathematical communication skills in detail as shown in table VI bellow.

TABLE VI. Interpretation of Mathematical Communication Skills Scores of SMKN4 Padang and SMKN 8 Padang

Intr. Of effectiveness 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 was mostly in the "very good" category whereas the control class was in the "less" category. Whereas in SMKN 8 Padang, it was seen that in the experimental class, students' mathematical communication ability mostly was in "good and satisfactory" category and the effectiveness level was in "effective" category. The ability of students' mathematical communication in the control class of SMKN 8 was in the category of "satisfactory and poor" with the level of effectiveness was less effective. Details of each indicator percentage of communication on each question were shown by table VII.

TABLE VII. Details Percentage of Score Achievement Per Problem Indicators at SMKN4 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	Explaining 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

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

b. Ability of Mathematical Disposition

The desired learning impact of the PBL Realistic Model was the difference of students' mathematical disposition abilities between the students in the experimental class and the students in the control class. For this purpose, students were given a disposition scale questionnaire containing some statements. The results of disposition scale questionnaire processing at SMKN 4 and SMKN 8 Padang were shown in Table VIII.

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

Table VIII showed that the percentage of students with high and medium disposition ability in experimental class were higher than control class for both schools.

Additionally, the description of the scores per each indicator of mathematical disposition in the experimental class and control classes for both schools was shown by Table IX.

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 for both schools was shown by Fig.2 and Fig.3.

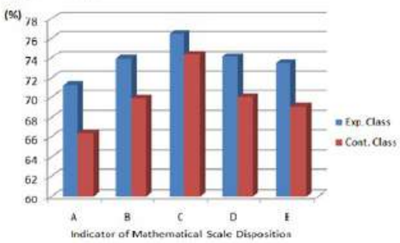

Fig. 2. Comparison of Student's Mathematical Dispostion Ability in SMKN 4 Padang

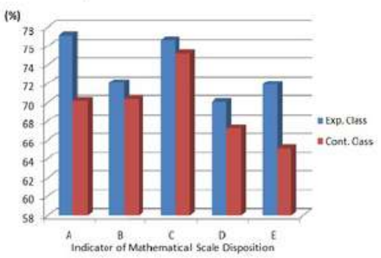

Fig. 3. Comparison of Student Mathematical Ability in SMKN 8 Padang

Description:

A : 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

The Learning model developed was said to be effective when delivering results as expected. In this study it was 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 had been proposed, it was done some steps as follows:

1) The Requirements's Test of Hypothesis Analysis

To be able to test hypothesis with factorial design, then the data must be normally distributed and had homogenous variation.

a) *Normality test.*

The normality test of the data was done by using SPSS software, which was described in Table X.

TABLE X. TEST OF NORMALITY

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistc	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

Lilefors SignificanceCorrection[a]

This a lower bound of true significance

Since all significance values (p-value) were higher than 0.05, then all groups of data satisfied the criteria of normally distributed data.

b) *Homogeneity Test*

The homogeneity test of all data groups for factorial purposes was done by Levene Statistic test with SPSS and gave the following results:

TABLE XI. HOMOGENEITY TEST OF VARIANCES

Dependent Variable	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 values of dependent variables were higher than 0.05 then all data was said as homogeneous.

2). Hypothesis Testing.

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

TABLE XII. AVERAGE AND AVERAGE AMOUNT

Learning Model

Disposition Scale	Realistic Model PBL	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		

Score's tabulation contained in table XII above produces a variance analysis as shown in Table XIII 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 in Table XIII, it appeared that the F arithmetic (Stat. Test) on the source of the "row" diversity was greater than F table (6.93> 3.92) so that Ho was rejected. Besides, because the Fcount (Stat test) on the source the diversity of "columns" was greater than F table (55,47> 3,92) , Ho was also rejected.

On other hand, at the source of interaction diversity, it can be seen that the Fcount of the interaction diversity source was less than Ftable (0.06 <3.92). Based on this fact, the results of hypothesis testing were as follows:

a) There was a difference in mathematical communication ability between students who had high disposition skills and students who had low communication skills.

b) There were differences in the ability of mathematical communication between students studying with Realistic PBL Model and students who learned with learning model other than Realistic PBL Model

c) There was no interaction between students' mathematical disposition abilities and the learning model used.

2. Discussion

The results of hypothesis testing showed that students' mathematical communication ability in SMK was influenced by mathematical disposition and learning model used. However, there was no correlation between the learning model and the mathematical disposition of students.

The results of this study added to the amount of research on PBL Model and RME Approach that had been done before, such as; The PBL model can improve students 'mathematical communication and problem solving skills [20] and it was also recommended to be used as a meaningful learning strategy that can improve student's 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], and improving students' achievement in learning mathematics [22], [28].

The research findings in this study were also relevant to some previous studies, such as: 1) experimental research on the use of PBL Model with RME Approach with the help of E-Learning Edmodo. The result of the research showed 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 was better than control group [26]; 3) Development of Problem Based Learning Model with scientific approach on triangle material in junior high school. This research produced valid and practical triangle learning materials based on strong rational theory, and had internal consistency in the learning process [20].

IV. CONCLUSSION

1. Conclusion

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

a. There was a difference in the ability of mathematical communication between students who had high mathematical dispositions and students who had low mathematical dispositions. It was concluded from the result of data analysis with Anava of two different n-cell road in which it was obtained that the calculation of statistical test was equal to 6,93 while the value of statistic F in table was 3.92, so the alternative hypothesis was accepted.

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

c. There was no interaction effect between learning model and mathematical disposition on mathematical communication ability. It was concluded from the data analysis with Anava two n-cell unequal paths. The calculation of statistical test was 0.06, while the statistical value in the table was 3.92. This directed to the rejection of the alternative hypothesis

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 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, student's interaction in learning, students' courage in expressing opinions, and 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. Therefore, 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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