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The Effect of the Missouri Mathematics Project Learning Model on the Tenth Grade Student's Mathematical Literacy Ability in Gender Perspective

Mulyanti Rahma[1*], Usman[1], Muhammad Ahsan[1]
[1]Mathematics Education Department, Institut Agama Islam Negeri Parepare, Parepare, Indonesia
** Correspondence: mulyantirahma@iainpare.ac.id*

Abstract

The students' low ability on mathematical literacy caused by teachers' monotonous learning process and lack of students' participation in teaching and learning process. This research aims to determine if Missouri Mathematics Project (MMP) is able to improve students' mathematical literacy ability more effectively than direct learning model. In addition, the researcher explores how gender affects the effectiveness of MMP. The gender contribution here is what the differences of male and female students' mathematical literacy ability are. The approach used in this research is quantitative research and the method is quasi-experimental having design of non-equivalent controlled group design. There are 70 students of grade X as sample consisting 35 students in experimental classes and 35 students in controlled classes (simple random sampling technique). The data taken in this research through mathematical literacy written test as the instrument and documentation. The analysis technique used is a two-way analysis of variance. The research results shows that students who are taught using the MMP model have significant effect on mathematical literacy ability than the students who are taught using direct learning. Female students' mathematical literacy ability is better than the male students' ability. There is a correlation between learning model and gender differences on mathematical literacy ability. Both male and female students' mathematical literacy ability who are taught using MMP learning model is higher than male and female students' ability who are taught using direct learning model Thus, MMP can be implemented as an alternative learning model to develop students' mathematical literacy ability.

Keywords: Gender; Mathematical Literacy Ability; Missouri Mathematics Project

Abstrak

Kurangnya kemampuan literasi matematis dikarenakan oleh proses pembelajaran yang lebih monoton pada guru serta minimnya keaktifan siswa dalam proses pembelajaran. Studi ini untuk mengetahui apakah MMP (*Missouri Mathematics Project)* lebih efektif dalam mengembangkan literasi matematis daripada pembelajaran langsung. Selain itu, akan diekplorasi bagaimana gender mempengaruhi efektifitas MMP. Kontribusi gender yang dimaksud yaitu bagaimana perbedaan kemampuan literasi matematis antara laki-laki dan perempuan. Metode penelitian yang digunakan adalah kuantitatif dengan desain *quaisy experimental.* Sebanyak 70 siswa kelas X yang dijadikan sebagai sampel yang terdiri dari 35 kelas eksperimen dan 35 kelas kontrol (teknik *simple random sampling*). Instrumen penelitian dilakukan melalui tes literasi matematis, dan dokumentasi. Teknik analisis data menggunakan analisis varians dua jalur. Penelitian tersebut menemukan bahwa siswa yang diajar dengan model pembelajaran MMP memiliki literasi matematis lebih baik dibandingkan siswa yang diajarkan menggunakan pembelajaran langsung. Kemampuan literasi matematis siswa perempuan lebih tinggi daripada laki-laki. Terdapat interaksi antara MMP dengan perbedaan gender terhadap kemampuan literasi matematis. Kemampuan literasi matematis siswa laki-laki yang menerapkan MMP lebih tinggi dibandingkan dengan yang menerapkan pembelajaran langsung. Kemampuan literasi matematika siswa perempuan dengan menerapkan MMP lebih tinggi dibandingkan kemampuan siswa yang menerapkan pembelajaran langsung. Sehingga, MMP dapat dijadikan alternatif model pembelajaran untuk mengembangkan kemampuan literasi matematis siswa.

Kata Kunci: Gender; Kemampuan Literasi Matematis; Missouri Mathematics Project

Introduction

Mathematics is a widespread science that underlies current innovation development. Arithmetic improvement is an effort to improve students' mathematical abilities and intelligence. The mathematical abilities here include numerical thinking, numerical portrayal, numerical associations, numerical correspondence, and numerical critical thinking. The development of these mathematical abilities supports mathematical literacy ability (Yusuf & Amin, 2016).

Kusumah suggested that literacy is related to written communication ability, namely the ability to write and the ability to read. Mathematical literacy capability is a person's capability to formulate, use, and interpret mathematics in various contexts (Styawati & Nursyahida, 2017). Several studies related to mathematical literacy potential said that with mathematical literacy competencies, humans can remedy issues associated with diverse contexts in lifestyles mathematically according to mathematical concepts (Hayati & Kamid, 2019).

One of the targets in learning arithmetic is to maximize students' learning outcomes which are still relatively low. Through mathematical literacy, students can

reason mathematically in the learning process (Mujulifah, Sugiatno, & Hamdani, 2015). Therefore, studying arithmetic in schools has to be addressed to expand spractice mathematical understanding to resolve actual-existence issues or conditions (Sumirattana, Makanong, & Thipkong, 2017).

The definition of mathematical literacy is mathematic literacy as the knowledge to know and apply the basic mathematics in our daily live (Nurutami, Riyadi, & Subanti, 2018). This means that mathematical literacy is a knowledge that is used to know and apply mathematics in everyday life (Sulistio, Nindiasari, & Jaenudin, 2020). The process of learning mathematics relies heavily on students' mathematical literacy ability. Students' ability to reason, argue, and be creative does not develop due to a lack of mathematical literacy ability, making it difficult for them to solve everyday mathematical problems (Tabun, Taneo, & Daniel, 2020).

Based on the research results on The Trends in International Mathematics and Science Study (TIMSS) in 2018, there were three categories grouped, namely countries having achievement above the average, countries having achievement in average, and countries having achievement below the average. Indonesia was in the third category. Then, based on the Program for International Student Assessment (PISA) result in 2012-2018, Indonesia was in the 73rd ranking ranked 73 out of 78 participating countries having students' mathematics average score of 379 out of 591 as the highest score. This shows that Indonesian students' mathematical literacy ability is very low compared to other countries (Masfufah & Afriansyah, 2021).

The researcher's response regarding to this matter is concerned to see students' mathematical literacy ability result which is still in very low category. Thus, learning innovation is needed to improve students' ability to be better than before (Elfitra, Wahyusari, Pujiastuti, Indrayatti, & Lestari, 2022). Learning cannot be separated from learning model created by an educator. A lot of students tend to feel bored, do not understand and are sleepy in the learning process, so they lack of motivation to participate actively. Educators need to try to create learning innovations by using learning model concept. In schools, there are several innovative learning methods or models that can be implemented in learning process so that students actively listen and pay attention to the material provided by the teachers (Fatchurrohim & Rukayah, 2016).

The fact occurring in an ongoing learning process, is there are many teachers using their own boring learning models such as giving lectures, providing questions, and giving assignments. Unconsciously the methods make students bored and unable to understand the topic given. Teachers should use learning models that

make learning process more enjoyable, like Missouri Mathematics Project (MMP) learning model (Tinda, Wahyuni, & Mandasari, 2019).

One of the abilities needed in the global era is mathematical literacy ability. Mathematical literacy ability needs to be developed, considered, and established on students. Through mathematical literacy ability students are able to think mathematically in the learning process (Habibi & Suparman, 2020). The students' mathematical literacy ability is different. One of the factors that can affect mathematical literacy ability is gender differences. Gender is the nature and behavior or division of roles. There are some differences in gender such as knowledge, behavior, attitudes, personality, ability and etcetera. According to the American Psychological Association (APA), recent analysis of international research, women around the world are better at math than men, even though men are more confident than women at math (Hasanusi, 2019).

The researcher interested to conduct research related to missouri mathematics project learning model, mathematical literacy ability and gender because mathematical literacy is an ability that must be possessed by Indonesian students, both male and female students. Mathematical literacy as an ability and a knowledge is needed not only for living in financial aspect but also as something needed to develop individual socially, economically and culturally in modern life (Sartika & Fatmanissa, 2020). Missouri mathematics project is chosen for this research because based on researcher opinion it is a learning model having steps to help students to be more creative.

Based on the interview results with a mathematics teacher, male and female students' mathematical literacy ability is low. It is because they lack of understanding especially when they are facing math problems and some them have short-term memory. In studying technique, students have low motivation in receiving knowledge. In fact, they rarely ask questions when they do not know what topic being discussed is in the classroom. This students' passiveness causes unclear information for teachers on students' knowledge and mathematical ability. (Rosyid & Umbara, 2019).

To understand the problems above, teachers may implement suitable learning model like MMP. The Missouri mathematics project is a mastering version advanced by Thomas L. good and Douglas Grows. They described the missouri mathematics project as follows; *"The missouri mathematics project is a program designed to help teachers to use practices that have been identified from prior correlation research to be characteristic of teachers whose students make outstanding gains in achievement".* The definition says that the missouri mathematics project is

the application designed to help instructors in the powerful use of physical activities so that scholars achieve super improvements (Fatmawati, Sutopo, & Fitriana, 2019).

The missouri mathematics project learning model has five stages, specifically like survey, improvement, controlled work out, seatwork or autonomous work and tasks. At the survey stage, the teacher reviews the past learning topic related to the topic to be delivered. The development stage brings activities in the form of presenting new ideas, discusses and links them to prior topic. In a controlled exercise, students are asked to form a group to answer questions that are given under teachers' supervision. In the seatwork stage, students are given questions as an exercise in expanding the concept of the topic that has been studied in order to find out how deep students' understanding is. The assignment stage, both students and teachers provide conclusions for the topic that has been discussed. In addition, teachers provide additional assignments to students as homework (Fitriana, 2019).

Based on the descriptions above, the researcher is interested to implement MMP get knowledge on both male and female students' numerical ability. Thus, the main purpose of the research is the effect of the MMP learning model on mathematical literacy ability in a gender perspective. The formulation of problem and the objective of this research are to find whether there is significant effect implementing missouri mathematics project and direct instruction learning models on students' mathematical literacy ability or not, whether gender affects students' mathematical literacy ability or not, whether the MMP and students' gender have correlation to students' mathematical literacy ability or not. Missouri mathematics project and direct instruction studying model affect male students' mathematics literacy ability or not and whether missouri mathematics project and direct instruction studying model affect female students' mathematics literacy ability or not (Novalia, Sobar, Ismaya, Marini, & Sumantri, 2021). The research theoretical benefits are the research result can be used as beneficial input to improve teachers' knowledge on teaching models especially for things related to mathematical literacy. And for the practical benefit, this research is expected to be able to use for all educators and teachers to help all students in enhancing mathematics knowledge.

Method

This research method is quasi-experimental research using non-equivalent controlled group design. The purpose of the quasi-experimental research is to investigate possible causal relationships by using treatments and to compare the results with the untreated controlled group (Payadnya & Jayantika, 2018). The population is 161 students of class X MIPA at SMA Negeri 7 Pinrang and the sample used in this research is 70 students. 35 students from class X arithmetic and herbal

sciences 2 are in experimental class and another 35 students from class X mipa 4 are in controlled class. The sampling technique used in this research is simple random sampling. Simple random sampling is an easy sampling technique due to the fact that the sample is taken randomly without regarding to the existing strata in the population (Swarjana, 2022).

This layout has a manipulate group to manipulate outside variables affecting the implementation of the experiment (Sugiyono, 2014). The design stated in this research is a factorial layout 2×2 by means of taking instructions from the population, in particular experimental class and the controlled class. The experimental class is treated using MMP learning model and the treatment implemented in controlled class is direct instruction studying model. The factorial plan of this research can be seen in Table 1.

Table 1. Study Factorial Design

Moderator variable \ Treatment variable	Learning model	
	Missouri Mathematics Project(A_1)	*Direct Instruction*(A_2)
Man(B_1)	A_1B_1 $[X, Y]_{11k}$ $k = 1,2, \dots, n_{11}$	A_1B_2 $[X, Y]_{21k}$ $k = 1,2, \dots, n_{22}$
Woman(B_2)	A_2B_1 $[X, Y]_{12k}$ $k = 1,2, \dots, n_{12}$	A_2B_2 $[X, Y]_{22k}$ $k = 1,2, \dots, n_{22}$

Annotation:

A_1 : Missouri mathematics project learning model
A_2 : Direct instruction learning model
B_1 : Male student
B_2 : Female student
A_1B_1 : The male students' group with MMP learning model
A_1B_2 : The female students' group with MMP learning model
A_2B_1 : The male students' group with direct instruction model
A_2B_2 : The female students' group with direct instruction model
X : Students' mathematical literacy scores before getting treatment
Y : Mathematical literacy students' score after getting treatment
k : Sample group

The variables used in this research are independent and dependent variables. The dependent variable is a variable affecting students' ability and referred to *X* variable. The *X* variable here is the model mastering and gender (male and female students). The independent variable here is the variable that is affected or the element measured in this research referred to *Y* variable. The structured *Y*

variable is mathematic literacy. The instruments used in this research are mathematical literacy documentation and questions (X_1X_2)

Data collection strategies used in this research are mathematical literacy ability assessments, and documentation. The purpose of using students' mathematical literacy ability test is to get students' mathematical literacy ability data and they are analyzed and used as a research hypothesis test. The analysis approach in this research is implemented by examining the hypotheses requirement through normality and homogeneity test. After the requirement assessments for normality and homogeneity test are met, the researcher uses two-way ANOVA test for examining hypothesis. (Nur, Halimah, Yovita, & Thalhah, 2019).

Results

The data collected in this research are in the form of students' mathematical literacy ability test data on trigonometry topic. The test is given to 70 students in 2 different classes. 35 students are in experimental class and 35 students are in controlled class. However, before conducting the test, the researcher performs learning activities for 4 meetings in the experimental class using the MMP learning model and using the direct instruction model in the controlled class.

Observed Data Description

The observation results on the implementation of mathematics learning using MMP learning model on trigonometry topic can be seen in Table 2.

Table 2. Description of the Implementation of MMP Learning Model

the meeting	Percentage of Learning Implementation		Average
	Teacher activities	Student activities	
1	92.30%	87.50%	89.90%
2	96.15%	91.66%	93.91%
3	96.15%	91.66%	93.91%
4	98.07%	100%	99.04%
Average	95.67%	92.70%	94.19%
Category			Very good

Based on Table 3, the average percentage of learning implementation conducted for all meetings is 94.19% with a very good category.

The Results of Students' Mathematical Literacy Ability

Research hypothesis test is conducted after all data from all variables are collected the summary of students' mathematical literacy ability scores data from each group is presented completely in Table 3.

Table 3. Students' Mathematical Literacy Ability Test Scores

Gender (B)		Learning model				Σ	
		Missouri Mathematics Project (A_1)		Direct Instruction (A_2)			
		X_i	Y_i	X_i	Y_i	X_i	Y_i
Male (B_1)	N	11	11	10	10	21	21
	Min	65	80	60	75	60	75
	Max	80	95	75	85	80	95
	Mo	70	80	72	75	70	80
	Me	70	84	70,50	80	70	81
	SD	6.12	5.20	4.49	4.08	5.64	5.43
	$\overline{X}/\overline{Y}$	73.09	85.00	69,20	79.30	71.24	82.29
Female (B_2)	N	24	24	25	25	49	49
	Min	68	83	65	75	65	75
	Max	95	100	89	95	95	100
	Mo	75	90	75	90	75	90
	Me	79.5	91	75	84	79	89
	SD	6.98	5.18	5.86	4.88	6.74	6.39
	$\overline{X}/\overline{Y}$	80.42	92.33	76.04	84.40	78.18	88.29
Σ	N	35	35	35	35	70	70
	Min	65	80	60	75	60	75
	Max	95	100	89	95	95	100
	Mo	79	90	72	75	75	90
	Me	79	90	72	82	75	85
	SD	7.47	6.17	6.27	5.17	7.14	6.68
	$\overline{X}/\overline{Y}$	78.11	90.03	74.09	82.94	76.10	86.49

Requirements Analysis Test

Normality test

The data normality test formulation used in this research is Lilliefors formulation. Students' mathematical literacy ability test results for each group, experimental and controlled class are presented in Table 4 below:

Table 4. Normality Test by Group

Literacy Ability Test Results	Group	Statistics	df	Sig.
	A_1	.104	35	.200*
	A_2	.117	35	.200*
	B_1	.146	21	.200*
	B_2	.129	49	.102
	A_1B_1	.173	11	.200*
	A_1B_2	.174	24	.078
	A_2B_1	.254	10	.067
	A_2B_2	.131	25	.200*

Based on sig > 0.05 column, the data for each group are accepted or the data are normally distributed.

Homogeneity Test of Variance by Class

In this homogeneity test using homogeneity test of variance with a significance level of 5% or 0.05, the statistical requirements are based on the fulfillment of homogeneous distribution with sig > 0.05 (see Table 5).

Table 5. Homogeneity Test of Variance by Class

		Levene Statistic	df_1	df_2	Sig.
Mathematical Literacy Ability Test Results	Based on Mean	.942	1	68	.335
	Based on Median	1.055	1	68	.308
	Based on Median and with adjusted df	1.055	1	67.266	.308
	Based on trimmed mean	.963	1	68	.330

The calculation results show that 0.335 is more than 0.005 (0.335> 0.05). It means H_0 is accepted or it can be concluded that the data are from homogeneous population.

Homogeneity Test by Gender

The homogeneity test (see Table 6) based on gender is conducted for experimental class and the controlled class (male and female students).

Table 6. Homogeneity Test of Variance by Gender

		Levene Statistic	df_1	df_2	Sig.
Mathematical Literacy Ability Test Results	Based on Mean	1.061	1	68	.307
	Based on Median	1.178	1	68	.282
	Based on Median and with adjusted df	1.178	1	67.982	.282
	Based on trimmed mean	1.195	1	68	.278

From the calculation of the homogeneity test of mathematical literacy ability based on gender, the value of sig = 0.307 is obtained. The calculation result shows the value of 0.307 is more than 0.05 (0.307 > 0.05). It means that H_0 is accepted or the data are from homogeneous population.

Barlett Test

This is for homogeneity test of variance of the four groups, namely $A_1B_1, A_1B_2, A_2B_1,$ dan A_2B_2. This is completed through variance test of students' mathematical literacy ability test scores (see Table 7).

Table 7. Barlett test results

Box's M		.744
F	Approx.	.240
	df_1	3
	df_2	5125.301
	Sig.	.868

Based on the calculation of Barlett test (see Table 7) for the homogeneity test of the four sample groups, the value of Sig = 0.868, which means Sig > 0.05. Thus, it can be concluded that the data of the four groups are from homogeneous population.

Hypothesis Test

The hypothesis test in this research relates to the main effect of the independent variables, namely the missouri mathematics project and direct instruction learning model. In addition, hypothesis test also relates to correlation test between the MMP learning model and students' mathematical literacy ability

based on gender (see Table 8). The data analysis technique used in this research hypothesis is the ANOVA treatment by test 2 × 2 (Muijs, 2016).

Table 8. Summary of ANOVA Hypothesis Test Results.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1470.052[a]	3	490.017	20.095	.000
Intercept	426684.073	1	426684.073	17497.555	.000
Learning model	681.894	1	681.894	27.963	.000
Gender	567.137	1	567.137	23.257	.000
Learning model * Gender	18.299	1	18.299	.750	.389
Error	1609.433	66	24.385		
Total	526664.000	70			
Corrected Total	3079.486	69			

The analysis of variance result in two-way variance analysis table shows that the variance on learning model is 0.000 Sig value. It is less than 0.05 (<0.05) and H_0 is rejected (see Table 8). The analysis of variance result on gender related to mathematical literacy ability is 0.000 Sig value. It is less than 0.05 (<0.05) and H_0 is rejected (see Table 8).

The analysis of variance result on the correlation between the missouri mathematics project learning model and gender differences on students' mathematical literacy ability is 0.389 Sig value. It is more than 0.05 (> 0.05) and H_1 is accepted. The result can be seen in the following ANOVA correlation graph (see Figure 1).

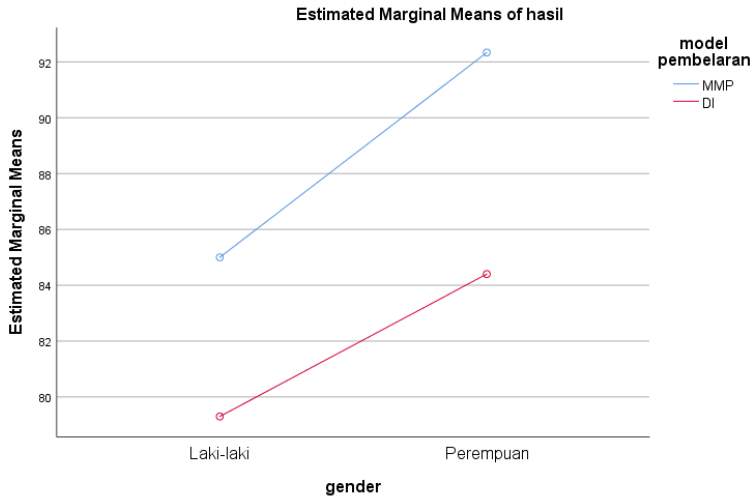

Figure 1. ANOVA Correlation Graph

The graph above shows that there is a line misalignment. it is suspected that there is an effect using the missouri mathematics project learning model on students' literacy ability based on gender (see Figure 1).

Table 9. Mathematical Literacy Ability Test Result on Male Students Using MMP and Direct Instruction Learning Model

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	170.186[a]	1	170.186	7.697	.012
Intercept	141399.710	1	141399.710	6395.131	.000
KELOMPOK	170.186	1	170.186	7.697	.012
Error	420.100	19	22.111		
Total	142780.000	21			
Corrected Total	590.286	20			
a. R Squared = .288 (Adjusted R Squared = .251)					

The results of the ANOVA calculation show that the result in the sig column is 0.012. It is less than 0.05 (< 0.05) and H_1 is accepted (see Table 9).

Table 10. The Results of Mathematical Literacy Ability Test of Female Students Using MMP And Direct Instruction Learning Model

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	770.667[a]	1	770.667	30.455	.000
Intercept	382465.361	1	382465.361	15114.242	.000
Group	770.667	1	770.667	30.455	.000
Error	1189.333	47	25.305		
Total	383884.000	49			
Corrected Total	1960.000	48			

The results of the ANOVA calculation show that the result in the sig column is 0.000. It is less than 0.05 (< 0.05) and $H_1$is accepted (see Table 10).

Discussion

There are three things discussed in this research, namely gender, mathematical literacy ability, and the MMP learning model. This research is viewed from learning outcomes, mathematical literacy ability, and the effect of learning models.

Based on the results of hypothesis test, it is found that the missouri mathematics project learning model affects students' mathematical literacy ability. The missouri mathematics project is also a learning model that is able to train students to be more active and independent in completing questions given. The results of this research also follows the result of prior research where the MMP learning model makes students more independent in solving contextual problems existing in everyday life (Komalia, Waluya, Sri, & Asih, 2016). So that students have more opportunity to build their own knowledge. The stages in the MMP learning model play a role in improving student learning outcome. Learning activities in this learning model involve students working individually and collectively in solving the problems given (Yazidi, 2014).

The MMP learning model implementation improves students' mathematical literacy ability outcome. In the process, the teacher must actively guide students' activities working individually and collectively, so all students are more active in the learning process (Rosyid, 2017). Missouri Mathematics Project is a program designed to assist teachers in learning effectiveness by using exercises so that students achieve extraordinary progress (Handayani, Januar, & Purwanto, 2018). The MMP learning model involves students working individually and collectively, in solving problems given.

Missouri mathematics project makes students to enjoy the process and they are not pressured in learning mathematics. In this learning model, stages are available where students and teachers review all topics that have been studied. At the end of learning process, students provide conclusion related to the topic that they have discussed (Sapr & Hati, 2018). The missouri mathematics project is a fun learning model but it is challenging. So male and female students' mathematical literacy ability can be managed properly (Winardi & Dwijanto, 2017).

Based on research conducted by Mahiuddin, Masi, Kadir, & Anggo (2019) written in their article entitled an analysis of junior high school students' mathematical literacy ability in gender perspective at konawe regency, the result shows that students' mathematical literacy ability are still low. The findings are contrary to the results of this research. The result in this research shows that MMP learning model improves students' mathematical literacy ability.

There is a significant effect using MMP model with Direct Instruction on both classes after treatment. Learning mathematics by implementing MMP model is more effective than learning mathematics by implementing Direct Instruction in terms of gender and mathematical literacy ability. Descriptively it is known that the average

score in experimental class (implementing MMP) is higher than the average score in the controlled class (implementing direct instruction).

Conclusion

Based on the data analysis and hypothesis test result, it can be concluded that first, there is significant effect implementing MMP (Missouri Mathematics Project) learning model on students' mathematical literacy ability. Second, there is no effect on literacy ability for male and female students. Third, there is correlation between the MMP learning model and students' gender for mathematical literacy ability. Fourth, there is significant effect implementing missouri mathematics project and direct instruction learning models on male students' mathematical literacy ability. Fifth, there is significant effect implementing missouri mathematics project and direct instruction learning models on female students' mathematical literacy ability. However, this research has limitations. The limitation of this research is that the participants in this research only involved one school.

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