PAPER • OPEN ACCESS

IMPROVE Learning Model and Learning Independence: Influence and Interaction on Mathematics Problem-Solving Abilities in Islamic Boarding School

To cite this article: Muhamad Yasin *et al* 2020 *J. Phys.: Conf. Ser.* **1467** 012003

IMPROVE Learning Model and Learning Independence: Influence and Interaction on Mathematics Problem-Solving Abilities in Islamic Boarding School

Muhamad Yasin[1,*], Syamsul Huda[1], Fredi Ganda Putra[2], Muhammad Syazali[2], Rofiqul Umam[3], Santi Widyawati[4]

[1]Institut Agama Islam Negeri Kediri, Indonesia
[2]Universitas Islam Negeri Raden Intan Lampung, Indonesia
[3]School of Science and Technology, Kwansei Gakuin University, Japan
[4]Universitas Nahdlatul Ulama Lampung, Indonesia
*Correspondent author: yasinmuhammad106@yahoo.com

Abstract. Problem-solving ability is a basic ability in the process of learning mathematics. The purpose of this study is to determine whether there is an effect of the IMPROVE learning model on mathematics problem-solving abilities, the effect of students' learning independence on mathematics problem-solving abilities, and the interaction between learning model and learning independence in term of mathematics problem-solving abilities. The research method used was quasi-experimental with post-test-only control group design. The data analysis technique used was the analysis of the variance of two unequal cells. The results showed that there were differences in mathematics problem-solving abilities between students who had high, medium, and low learning independence. The values of the results of the comparison are $F_{Aobserved} = 3.271$ and $F_{Acritical} = 3.170$, $F_{Bobserved} = 6.945$ and $F_{Bcritical} = 4.020$, $F_{Iobserved}= 0.554$ and $F_{I\ critical}= 3.170$ at a significance level of 5%. Based on the norm, where $F_{observed} > F_{critical}$, H_0 is rejected. So, it can be concluded that there is an influence between the IMPROVE learning model and mathematics problem-solving abilities, there is an influence between learning independence and mathematics problem-solving abilities, and there is no interaction between the IMPROVE learning model and the learning independence on mathematics problem-solving abilities.

1. Introduction

Mathematics plays an important role in the development of science and technology [1]. Mathematics is a field of study that is studied by students from elementary school to university level [2-4]. This is due to the importance of mathematics to solve problems in daily life [2]. Problem-solving abilities are considered important in the process of learning mathematics because it is the general goal in learning mathematics and problem solving is its basic ability [5, 6]. However, the students' problem-solving ability is still relatively low. This is because mathematics learning is still based on the concepts contained in the book where the teacher only explains what is in the book then gives assignments to the students [7]. The low ability to solve mathematics problems is also due to the students' low learning independence [8]. Based on the problems, the learning models and strategies that are appropriate, effective, and efficient are needed. The right learning model to apply is the IMPROVE learning model. IMPROVE is an acronym for Introducing the new concepts, Metacognitive questioning, Practicing, Reviewing and Reducing Difficulties, Obtaining mastery, Verification, and

Enrichment [9]. The IMPROVE learning model is a model in mathematics learning that is designed to assist students in developing a variety of mathematical skills optimally and to increase the activities in learning [10]. The previous studies that have used the IMPROVE learning model including IMPROVE affects; problem-solving skills, critical thinking skills [10, 11]. Essentially, a problem, in essence, is a question that invites answers [12]. A question has a certain opportunity to be answered appropriately if it is formulated properly and systematically [13]. This means, solving a problem requires certain abilities in individuals who want to solve the problem [10]. The process in which the individuals take the initiative in planning, implementing [14], and evaluating their learning systems is called learning independence [6]. Learning independence is one important factor in determining students' learning outcomes because those who have good independence will find their concepts and ways of learning so that they can understand and can solve problems [15].

Research on the IMPROVE learning model has been widely studied because this model has a positive impact on learning, namely the ability of critical mathematical thinking [16]. The students who were taught using the IMPROVE learning model were better than students who were taught using conventional learning [11]. Research on learning independence [6, 17, 18] and research on mathematics problem-solving abilities have also been carried out by previous researchers [19–28]. However, there are no studies that use the IMPROVE learning model to influence the ability of mathematical problems. Based on previous research, the researchers are interested in researching with renewal, specifically on the influence and interaction of the IMPROVE learning model and Learning Independence on the mathematics problem-solving abilities [29]. Then, the purpose of this study is to find out whether there is an effect of the IMPROVE learning model on mathematics problem-solving abilities, the effect of students' learning independence on mathematics problem-solving abilities and the interaction between learning models and learning independence on mathematics problem-solving abilities.

2. Research Methodology

The method of this study is experimental research [30]. The type of research used in this study is the quasi-experimental with posttest only control group design. sampling in this study using randomized class techniques. Data collection techniques used in this study were interview, observation, questionnaire, documentation, and test. The data analysis used was a two-way analysis of variance after the normality and homogeneity had been tested. The design procedures are presented in Table 1.

Table 1. Research Design

Learning Model (A_i)	**Learning Independence (B_j)**		
	High (B_1)	**Medium (B_2)**	**Low (B_3)**
IMPROVE (A_1)	A_1B_1	A_1B_2	A_1B_3
Conventional (B_2)	A_2B_1	A_2B_2	A_2B_3

Description:
A_i :Learning model.
B_j : Learning independence.
A_1B_1 : IMPROVE with high learning independence.
A_1B_2 : IMPROVE with medium learning independence.
A_1B_3 : IMPROVE with low learning independence.
A_2B_1 : Conventional with high learning independence.
A_2B_2 : Conventional with medium learning independence.
A_2B_3 : Conventional with low learning independence.

3. Results and Discussion

In this study, before conducting the parametric statistical test, the assumption tests were carried out in the form of normality test and homogeneity test. The normality test was carried out to determine whether the data distribution was normally distributed or not and the homogeneity test was carried out to determine whether the variance of two data distributions was the same. The results of the normality test data can be seen in Table 2.

Table 2. Summary of the Normality Test for Mathematics Problem Solving

No.	Class	$L_{observed}$	$L_{critical}$	Conclusion
1	Experimental	0,100	0,161	H_0 accepted
2	Control	0,116	0,161	H_0 accepted

Based on Table 2, $L_{observed}$ in the experimental class is 0,100 and $L_{critical}$ = 0,161. The control class got $L_{observed}$ = 0.116 and $L_{critical}$ = 0.161. With the tested hypotheses:
H_0: The data are normally distributed
H_1: The data are not normally distributed

The data is normally distributed if $L_{observed} \leq L_{critical}$. If $L_{observed} \geq L_{critical}$, then the sample is not normally distributed. Based on Table 2, the result of each sample is $L_{\text{observed}} \leq L_{critical}$, so, H_0 is accepted. It means that each distribution data comes from a normally distributed population. The summary of the results of the learning independence normality questionnaire can be seen in Table 3.

Table 3. Summary of Normality Test for Learning Independence

Category		Class	$L_{observed}$	$L_{critical}$	Conclusion
Learning Independence	High	Experimental and Control	0.209	0.212	H_0 Is Accepted
	Medium	Experimental and Control	0.117	0.154	H_0 Is Accepted
	Low	Experimental and Control	0,148	0,242	H_0 Is Accepted

Based on Table 3, learning independence is high since $L_{observed}$= 0.209 with $L_{critical}$ = 0.212. The learning independence is medium since $L_{observed}$= 0.117 with $L_{critical}$ = 0.154.learning independence is low since $L_{observed}$= 0.148 and $L_{critical}$= 0.242. With the tested hypotheses:

H_0: The data are normally distributed
H_1: The data are not normally distributed

The data is normally distributed if $L_{observed} \leq L_{critical}$. If $L_{observed} \geq L_{critical}$, then the sample is not normally distributed. Based on Table 3, the result of each sample is$L_{\text{observed}} \leq L_{critical}$, so, H_0 is accepted. It means that each distribution data comes from a normally distributed population. After knowing that the data was normally distributed, then the homogeneity test was conducted. A summary of the homogeneity test results can be seen in Table 4.

Table 4. Summary of the Homogeneity Test on Mathematics problem-solving Ability

Group	N	si^2	Dk	$dk.si^2$	$logSi^2$	$dk.logsi^2$
Experimental	30	301,908	29	8,755,326	2,480	71,916
Control	30	602,299	29	17,466,657	2,780	80,615
Total	-	-	58	26221.98	-	152,531
s^2 gab	452,103					
B	154,004					
$x^2_{observed}$	3,391					

$\mathbf{x^2_{critical}}$	3,481

The homogeneity test of mathematics problem-solving ability used a significant level $(\alpha) = 0.05$ and degree of freedom (dk) = 1 with the hypothesis:

H_0: Both samples come from the same population

H_1: Both samples do not come from the same population

Based on table 4, $\mathbf{x^2_{critical}}$= 3.481 and the results of calculation$\mathbf{x^2_{observed}}$=3.391.Based on the results of these calculations, it can be seen that the$\mathbf{x^2_{observed} \leq x^2_{critical}}$. So, it can be concluded that H_0 is accepted. It means that both samples come from the same population (homogeneous). The homogeneity of learning independence of the experimental class and the control class can be seen in Table 5:

Table 5. Summary of Homogeneity Test on Learning Independence

Group	N	si^2	Dk	$dk.si^2$	$logSi^2$	$dk.logsi^2$
High	16	7.2	17	122.4	0.857	14.575
Medium	32	2,129,032	31	660	1,328	41,174
Low	12	16.75	11	184.25	1,224	13,464
Total	-	-	57	966.65	-	69,212
s^2 gab	16,959					
B	70,075					
$\mathbf{x^2_{observed}}$	1,987					
$\mathbf{x^2_{critical}}$	3,481					

Test homogeneity of learning independence used a significant level $(\alpha) = 0,05$ and the degree of freedom (df) = 1 with the hypothesis:

H_0: Both samples come from the same population

H_1: Both samples do not come from the same population

Based on table 5, $\chi^2_{critical}$ = 3.481 and the $\chi^2_{observed}$ =1.987. Based on the results of these calculations, it can be seen that the $\chi^2_{observed} \leq \chi^2_{critical}$. So, it can be concluded that that H_0 is accepted. It means that both samples come from the same population (homogeneous).

The prerequisite tests of normality and homogeneity have been fulfilled so that parametric statistical tests can be performed, namely by the analysis of the two-ways variance analysis of unequal cell. The procedure of the testing are:

a. H_{0A}: $\alpha_1 = \alpha_2$(there is no influence of the use of IMPROVE learning model and conventional learning models on problem-solving abilities)
   H_{1A}: $\alpha_1 \neq \alpha_2$ (there is an effect of using IMPROVE learning model and conventional learning models on problem-solving abilities)
b. H_{0B}:$\beta_1 = \beta_2 = \beta_3$(no influence Low learning independence, medium learning independence and high learning independence on mathematics problem-solving ability)
   H_{1B}: $\beta_i \neq \beta_j$for i $\neq j$(there is an influence of high learning independence, medium learning independence, and low learning independence on mathematics problem-solving ability)
c. H_{0AB}: $(\alpha\beta)_{ij} = 0$ for each i = 1, 2 and j = 1, 2, 3 (there is no interaction between the use of the IMPROVE learning model and the conventional learning model on high learning independence, medium learning independence, and low learning independence on mathematics problem-solving ability)
d. H_{1AB}: $(\alpha\beta)_{ij} \neq 0$ for every i = 1, 2 and j = 1, 2, 3 (there is an interaction between the use of theIMPROVE learning model and conventional learning model with high learning independence,

medium learning independence, and low learning independence of mathematics problem-solving abilities)

After the final test was conducted, the problem-solving ability data and the level of students' learning independence in the experimental class and class control were obtained [31]. The results showed that the IMPROVE learning model had more influence on students' mathematics problem-solving abilities and the students who had a high level of learning independence, their problem-solving abilities are also better. This can be seen from the test of mathematics problem-solving ability by doing calculations on both samples. The results of the calculations can be seen in Table 6:

Table 6. Results of Two-Way Analysis of Variance

The Summary of Two-Ways Variance Analysis						
Source	**JK**	**Db**	**KT**	**$F_{observed}$**	**$F_{critical}$**	**conclusion**
Learning model (A)	2422,204	1,000	2422,204	3,271	3,170	H_0 is Rejected
Learning independence (B)	2281,667	2,000	1140,833	6,945	4,020	H_0 is Rejected
Interaction	386,361	2,000	193,180	0.554	3,170	H_0 is Accepted
Error	18833,702	54,000	348,772			
Total	23923,933	59,000				

Two-way anava test states that the hypothesis is rejected if $F_{observed} > F_{critical}$. So, if $F_{observed} \leq F_{critical}$, then the hypothesis is accepted. Based on Table 6 it can be concluded that:

a. $F_{Aobserved} = 3.271$ and $F_{Acritical} = 3.170$. Based on these calculations, it can be seen that$F_{Aobserved} > F_{Acritical}$, it can be concluded that H_{0A} is rejected. It means that there is an influence between students who were taught using the IMPROVE learning model and students who were taught using the conventional learning model on the mathematics problem-solving ability.

b. $F_{Bobserved} = 6.945$ and $F_{Bcritical} = 4.020$. Based on these calculations, it can be seen that$F_{Bobserved} > F_{Bcritical}$, it can be concluded that H_{0B} is rejected. It means that there is an influence between students with high, medium, and low learning independence on the mathematics problem-solving ability.

c. $F_{ABobserved} = 0.554$and $F_{AB\text{critical}} = 3.170$. Based on these calculations, it can be seen that the $F_{ABobserved} < F_{ABcritical,}$ it can be concluded that $H_{0AB}$is received($F_{ABobserved} \leq F_{ABcritical}$). It means that there is no interaction between the learning model and learning independenceon mathematics problem-solving abilities.

Since the results of the analysis of variance tests are that H_{0A} and H_{0B} are rejected, the Scheffe' method was used as a follow-up to the two-ways variance analysis test. The summary of test results can further be seen in Table 7.

Table 7. Summary of Mean and Marginal Mean

Learning Model	**Learning Independence**			**Marginal Mean**
	High	**Medium**	**Low**	
IMPROVE	94.2	79 357	68.33333	241.89
Conventional	91	78 722	64.5	234 222
Marginal Average	185.2	158 079	132 833	

Based on the analysis of the data in Table 6, $F_{Aobserved} = 3.271$ and $F_{Acritical} = 3.170$, thus, it can be concluded that H_{0A} is rejected. It means that there is an influence between students who were taught using the IMPROVE learning model and students who were taught using the conventional learning model. To find out which learning model is better, there is no need to do a double interline comparison test since to see which one is better can be done by observing the marginal average between the lines of the two learning models. Based on Table 7, it is known that the marginal mean between lines for the IMPROVE learning model is 241.890 and the marginal mean for conventional learning model is 230.063 which means $238.357 > 234.2222$. Based on this, it can be concluded that students who were taught using the IMPROVE learning model are better than students who were taught using the conventional learning model[32]. Based on Table 7, the marginal mean between columns is high learning independence or $\mu_1 = 185.2$. The marginallearning independence is medium or $\mu_2 = 158.079$. The marginal mean of learning independence is low or $\mu_3 = 132.833$. This shows that not all learning independence owned by students has the same effect on the ability to solve mathematical problems, so, a double comparison between columns with the Scheffe' method needs to be done to see the significant mean differences[33]. A double comparison test was performed on each group of data, namely the marginal mean group with high learning independence with medium learning independence (μ_1 vs μ_2), marginal mean group with high learning independence with low learning independence (μ_1 vs μ_3), and the marginal mean group with medium learning independence with low learning independence (μ_2 vs μ_3). The summary of the multiple column comparison tests can be seen in Table 8.

Table 8. The Summary of the Multiple Column Comparison Tests

No.	Interaction	$F_{observed}$	$F_{critical}$	Conclusion
1	(μ_1 vs μ_2)	22,495	4,020	H_0 is rejected
2	(μ_1 vs μ_3)	53,915	4,020	H_0 is rejected
3	(μ_2 vs μ_3)	15,949	4,020	H_0 is rejected

Based on the results of the calculation of the multiple comparison tests between columns in Table 8 can be concluded as follows:

a. Between μ_1 vs μ_2, it was obtained that $F_{observed}$ = 22.495 and $F_{critical}$ = 4.020. Based on these calculations, it can be seen that $F_{observed} > F_{critical}$. Thus, it can be concluded that H_0 is rejected. It means that there is a significant difference in the mathematics problem-solving abilities between students who have high and medium learning independence and students who were taught using IMPROVE learning model and conventional learning model. Based on the marginal mean of the multiple comparison tests in Table 7, it is known that the marginal mean of students who have high learning independence is 185.2 which is better than students who have medium learning independence with marginal mean of 158.079. The difference is significantly different, so it can be concluded that students who have high learning independence are better than students who have medium learning independence on mathematics problem-solving abilities[34].

b. Between μ_1 vs μ_3,it was obtained that $F_{observed}$ = 53.915 and $F_{critical}$ = 4.020. Based on these calculations, it can be seen that $F_{observed} > F_{critical}$. Thus, it can be concluded that H_0 is rejected. It means that there is a significant difference in the mathematics problem-solving abilities between students who have high and low learning independence and the students who were taught using IMPROVE learning model and conventional learning model[14]. Based on the marginal mean in the multiple comparison tests in Table 7, it is known that the marginal mean of students who have high learning independence is 185.2 which is better than students who have low learning independence with the marginal average of 132,833. These differences are significantly different, so it can be concluded that students who have high learning independence are better than students who have low learning independence on mathematics problem-solving abilities.

c. Between μ_2 vs $\mu_{3,}$ it was obtained that $F_{observed}$ = 15,949 and $F_{critical}$ = 4,030. Based on these calculations, it can be seen that $F_{observed} > F_{critical}$. Thus, it can be concluded that H_0 is rejected. It means that there are significant differences in the mathematics problem-solving ability between learners who have medium and low learning independence and students who were taught using

IMPROVE learning model and conventional learning model. Based on the marginal mean in the multiple comparison tests in Table 7, it is known that the marginal mean of students who have medium learning independence is 158.079 which are better than students who have low learning independence with the marginal mean of 132.833. The difference is significantly different, so it can be concluded that students who have medium learning independence are better than students who have low learning independence on mathematics problem-solving abilities [35].

IMPROVE is an acronym for Introducing the new concepts, metacognitive questioning, Practicing, Reviewing and Reducing Difficulties, Obtaining mastery, Verification, and Enrichment. The IMPROVE learning model is a model in mathematics learning that is designed to assist students in developing a variety of mathematical skills optimally and to increase the activities in learning [10]. According to Mavarech and Kramarski, the IMPROVE learning model is based on self-questioning through the use of metacognitive questions that are focused on understanding problems, connecting between past and present knowledge, using appropriate problem-solving strategies, and reflecting on processes and solutions [36]. The IMPROVE learning model is an abbreviation of all steps in the teaching, namely: [10, 11]

1) Introducing the new concepts
   At this stage, the teacher introduces a new concept. In the IMPROVE learning model, a teacher conveys a new concept by giving questions that make students more actively involved so they can explore their abilities.
2) Metacognitive questioning
   At this stage, the teacher gives metacognitive questions in the form of what, why, and how.
3) Practicing
   At this stage, the students are invited to solve problems directly. The teacher gives exercises to students in the form of questions or problems.
4) Reviewing and Reducing Difficulties
   At this stage, the teacher tries to review the mistakes that students face in understanding the material and solving problems. Furthermore, the teacher provides solutions to deal with existing problems.
5) Obtaining mastery
   At this stage, the teacher gives tests to students. This test aims to determine the mastery of the material.
6) Verification
   At this stage, the teacher separates which students have reached the passing limit and which students have not reached the passing limit.
7) Enrichment
   The final stage of the IMPROVE learning model is to enrich students who have not reached the passing limit or have not mastered the material. This is done by remedial activities.

A problem is essentially a question that invites answers. A question has a certain opportunity to be answered appropriately if the question is formulated properly and systematically. This means that solving a problem requires certain individuals' abilities [10]. Problem-solving is a part of the mathematics curriculum which is very important because in the learning process and its completion, it is possible for students to gain experience using the knowledge and skills that they have to apply in problem-solving [24]. With the IMPROVE learning model, the students' problem-solving abilities will be better than students who learn using conventional learning model [10].

According to Sutarami Imam Bernadib, independence includes behavior that can initiate, able to overcome problems, have confidence, and can do something on their own [3]. Regarding the relationship of learning independence with the ability to solve problems, the more independent someone is in their learning, the more the mathematics problem-solving abilities will increase [37]. This is in accordance with the results of research conducted by Tahar and Enceng who discover that the more independent the students, the higher the learning achievement [6]. Therefore, the development of students' learning independence is very important for individuals who study mathematics [38]. This is in line with the analysis of research data which shows the results of students who were taught using IMPROVE learning model are better than students who were taught using the conventional learning model. It means that there is an influence of the IMPROVE learning model on the ability to solve mathematical problems [39]. Students who have high learning independence are better than students who have medium learning independence and students who have medium learning independence are better than students who have low learning independence [40]. It means that there is an influence of learning independence on the mathematics problem-solving abilities. However, based on the calculation of two-ways analysis of variance, there is no interaction between learning models and learning independence on the mathematics problem-solving abilities. The difference in the research results with the theory is due to students' dishonesty in filling out the questionnaire. This affects the results and causing them not in accordance with the theory which is supposed to be an interaction between the learning model and learning independence on the mathematics problem-solving abilities.

4. Conclusions and Recommendations

Based on the results of research and discussion, there are differences in the problem-solving abilities between students who have high, medium, and low learning independence. The results of the comparison produce the value of $F_{A\ observed} = 3.271$ and $F_{A\ critical} = 3.170$, $F_{B\ observed} = 6.945$ and $F_{B\ critical} = 4.020$, $F_{I\ observed} = 0.554$ and $F_{I\ critical} = 3.170$ at a significance level of 5%. Based on the rules of a decision where $F_{observed} > F_{critical}$, H_0 is rejected. It can be concluded that there is an influence of the IMPROVE learning model on mathematics problem-solving abilities, there is an influence of learning independence on mathematics problem-solving abilities, and there is no interaction between the IMPROVE learning model with learning independence on mathematics problem-solving abilities.

Based on the conclusions of this study, it is suggested for further researchers to look for other models that influence the problem-solving abilities or to use the same model with other influences, as well as to use models that have the same effect but in terms of learning motivation. Hopefully, this research can be useful and be a source of reference for future research.

References

[1] F. G. P. Putri Wulandari, Mujib 2016 Pengaruh Model Pembelajaran Investigasi Kelompok berbantuan Perangkat Lunak Maple terhadap Kemampuan Pemecahan Masalah Matematis *Al-Jabar J. Pendidik. Mat.* **7** 1 101–107

[2] F. G. Putra 2016 Pengaruh Model Pembelajaran Reflektif dengan Pendekatan Matematika Realistik Bernuansa KeIslaman Terhadap Kemampuan Komunikasi Matematis Peserta Didik *Al-Jabar*. **7** 2 105–116

[3] I. Isnaniah 2017 Peningkatkan kreativitas dan kemandirian belajar mahasiswa melalui model pembelajaran berbasis proyek pada perkuliahan media pembelajaran matematika *Suska J. Math. Educ.* **3** 2 83-91

[4] A. Fauziah 2010 Peningkatan Kemampuan Pemahaman dan Pemecahan Masalah Matematik Siswa SMP Melalui Strategi React *Forum Kependidikan*. **30** 1 1-13

[5] Netriwati 2016 Analisis Kemampuan Mahasiswa Dalam Pemecahkan Masalah Matematis Menurut Teori Polya *Al-Jabar*. **7** 2 181-190

[6] R. Sundayana 2016 Kaitan antara Gaya Belajar, Kemandirian Belajar, dan Kemampuan Pemecahan Masalah Siswa SMP dalam Pelajaran Matematika *Mosharafa J. Pendidik. Mat* .**5** 2 75-84

[7] M. Syazali *et al.* 2019 Islamic-Nuanced Linear Algebra Module with Problem-Based Learning Approach for Linear Equation System Material *J. Phys. Conf. Ser.*, **1155** 1

[8] Abdurrahman, A. Saregar, and R. Umam 2018 Assessment Toward The Quantum Physics Concept Mastery Of The Prospective Physics Teachers," *J. Pendidik. IPA Indones.* **7** 1 34–40

[9] R. Diani, H. Herliantari, I. Irwandani, A. Saregar, and R. Umam 2019 The Effectiviness of SSCS Learning Model: Its Impact on the Students' Creative Problem-Solving Ability on the Concept of Substance Pressure *J. Penelit. Fis. dan Apl.* **9** 1

[10] H. Ansori and S. Lisdawati 2014 Pengaruh Metode Improve Terhadap Kemampuan Pemecahan Masalah Siswa Pada Konsep Bangun Ruang Di Kelas Viii SMP *EDU-MAT J. Pendidik. Mat.* **2** 3 279 – 286

[11] Mujib 2016 Mengembangkan Kemampuan Perfikir Kritis Melalui Metode Pembelajaran Improve *Al-Jabar J. Pendidik. Mat.* **7** 2 167–180

[12] F. Lestari, B. Saryantono, M. Syazali, A. Saregar, D. Jauhariyah, and R. Umam 2019 Cooperative Learning Application with the Method of Network Tree Concept Map : Based on Japanese Learning System Approach *J. Educ. Gift. Young Sci*. **7** 1 15–32

[13] R. Diani *et al.* 2019 Physics Learning through Active Learning Based Interactive Conceptual Instructions (ALBICI) to Improve Critical Thinking Ability *J. Penelit. dan Pembelajaran IPA*. **5** 1 48

[14] S. Hartinah *et al.* 2019 Teacher's performance management: The role of principal's leadership, work environment and motivation in Tegal City, Indonesia *Manag. Sci. Lett*. **9** 14 1–12

[15] D. Yuningrih 2016 Meningkatkan Kemandirian Belajar Matematika melalui Metode Jigsaw bagi Siswa Kelas XII Ap Semester Gasal SMK Negeri 1 Jogonalan Klaten Tahun Pelajaran 2016/2016 *J. Saintech Politek. Indonusa Surakarta*. **2** 70

[16] F. Gulgor and H. S. Tortop 2018 Marriage Adaptation : A Glance at Gifteds *J. Gift. Educ. Creat.* **5** 2 45–58

[17] F. Fitri 2016 Peningkatan Kemandirian Mahasiswa Pendidikan Fisika Pada Mata Kuliah Mekanika Melalui Metode Reciprocal Teaching *J. Pendidik. Fis.* **4** 1 26–35

[18] S. Suciati, I. Septiana, and M. F. A. Untari 2015 Penerapan Media Monosa (Monopoli Bahasa) Berbasis Kemandirian Dalam Pembelajaran Di Sekolah Dasar *Mimb. Sekol. Dasar*. **2** 2 175–188

[19] I. Kurniasari, Dwijanto, and E. Soedjoko 2014 Keefektifan Model Pembelajaran MMP Dengan Langkah Pemecahan Masalah Polya Terhadap Kemampuan Berpikir Kreatif Siswa *Unnes J. Math. Educ.* **3** 2 1–6

[20] M. Ristiani, N. Ratu, and T. N. H. Yunianta 2015 Strategi Pemecahan Masalah Dalam Menyelesaikan Soal Cerita Pada Materi Persamaan Dan Pertidaksamaan Linier Satu Variabel *Satya Widya*. **31** 1 8–16

[21] S. W. Kusumawati 2014 Penerapan Model Pembelajaran SAVI Untuk Meningkatkan Keterampilan Pemecahan Masalah di Sekolah Dasar *JPGSD*. **2** 2 1–10

[22] Sukayasa 2014 Karakteristik Penalaran Siswa Smp Dalam Memecahkan Masalah Geometri Ditinjau Dari Perbedaan Gender *AKSIOMA J. Pendidik. Mat.* **3** 1 81–90

[23] R. Yustianingsih, H. Syarifuddin, and Yerizon 2017 Pengembangan Perangkat Pembelajaran Matematika Berbasis Problem Based Learning (PBL) Untuk Meningkatkan Kemampuan Pemecahan Masalah Peserta Didik Kelas VII," *J. JNPM (J. Nas. Pendidik. Mat).* **1** 2 258–274

[24] D. Lipianto, M. T. Budiarto 2013 Analisis kesalahan siswa dalam menyelesakan soal yang berhubungan dengan persegi dan persegipanjang berdasarkan taksonomi solo plus pada kelas vii *Mathedunesa*. **2** 1

[25] R. Ramadhani 2017 Kemampuan Pemecahan Masalah Matematika Siswa SMA Melalui Guided Discovery Learning Berbantuan Autograph *JPPM*. **10** 2 72–81

[26] F. M. Alba, M. Khotim, and I. Junaedi 2013 Keefektifan Model Pembelajaran Generatif dan

MMP Terhadap Kemmpuan Pemecahan Masalah *Kreano J. Mat. Kreat.* **4** 2 131–137

[27] S. R. Muslim 2017 Pengaruh Penggunaan Model Project Based Learning Terhadap Kemampuan Pemecahan Masalah Matematis Peserta Didik SMA *Supremum J. Math. Educ.* **1** 2 88–95

[28] R. Faelasofi, Y. Arnidha, and A. Istiani 2015 Metode Pembelajaran Mind Mapping untuk Meningkatkan Kemampuan Komunikasi Matematik Siswa Dalam Pemecahan Masalah Matematika *J. e-DuMath*. **1** 2 122–137

[29] O. Cetin and H. S. Tortop 2018 The Role of Image Analysis in Revealing Family Experiences and Future Drafting of Gifted Children *J. Gift. Educ. Creat.* **5** 1 108–129

[30] Sugiyono 2016 *Metode Penelitian Pengembangan*. (Bandung: Alfabeta)

[31] B. Yilmaz and H. S. Tortop 2018 Values Education and Gifted *J. Gift. Educ. Creat.* **5** 1 10–27

[32] S. Huda, I. Tsani, M. Syazali, R. Umam, and K. Jermsittiparsert 2019 The management of educational system using three law Auguste Comte : A case of Islamic schools *Manag. Sci. Lett.* **10** 3

[33] I. Maulidi, V. Apriliani, and M. Syazali 2019 Fungsi Zeta Riemann Genap Menggunakan Bilangan Bernoulli *Desimal J. Mat.* **2** 1 43–47

[34] T. Sriyakul, R. Umam, and K. Jermsittiparsert 2019 Supplier Relationship Management , TQM Implementation , Leadership and Environmental Performance : Does Institutional Pressure Matter *Int. J. Innov. Creat. Chang.* **5** 2 211 – 227

[35] Abdurrahman *et al.* 2019 Optimization and Interpretation of Heat Distribution in Sterilization Room Using Convection Pipe *Indones. J. Sci. Technol.* **4** 2 204–219

[36] Ade Andriani 2016 Peningkatan Kemampuan Pemecahan Masalah Matematik Mahasiswa FMIPA Pendidikan Matematika Melalui Model Pembelajaran Improve *J. Tarb.* **23** 1 83-100

[37] R. Ramadhani, R. Umam, A. Abdurrahman, and M. Syazali 2019 The Effect Of Flipped-Problem Based Learning Model Integrated With LMS-Google Classroom For Senior High School Students *J. Educ. Gift. Young*. **7** 2 137 – 158

[38] B. Habibi *et al.* 2019 Factor Determinants of Teacher Professionalism as Development of Student Learning Education at School of SMK PGRI in Tegal City, Indonesia *J. Gift. Educ. Creat.* **6** 2 125–134

[39] M. Syazali *et al.* 2019 Partial correlation analysis using multiple linear regression: Impact on business environment of digital marketing interest in the era of industrial revolution 4.0 *Manag. Sci. Lett.* **9** 1875–1886

[40] R. Sagala, R. Umam, A. Thahir, A. Saregar, and I. Wardani 2019 The Effectiveness of STEM-Based on GenderDifferences: The Impact of PhysicsConcept Understanding *Eur. J. Educ. Res.* **8** 3 753–763