

Research Article

The influence of model of eliciting activities on improving mathematical problem-solving ability

M. Taufik Qurohman[✉], Prasetya Putra Nugraha, Syaefani Arif Romadhon, Ahmad S.F.

Politeknik Harapan Bersama, Jl. Mataram No.9 Pesurungan, Kota Tegal, Indonesia

[✉]Corresponding Author: taufikqurohman87@gmail.com | Phone Number [+6285642502323]

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ABSTRACT

The aims of this study is to improving problem-solving skills by combining the Model of Eliciting Activities (MEA) with Learning Model on the level of student independence. The technique used for sampling is cluster random sampling, namely by selecting two experimental classes and two control classes take one experimental class and one control class. Sample are students in grade 2A and 2B in Academic Year 2021/2022 with eigen-values material from Mechanical Engineering Study Program. In this study takes variables, namely problem-solving ability as a result with parameters i.e. with or without Model of Eliciting Activities (MEA). Data collection in unison with documentation, questionnaires, and test methods. And data processing using a two-way ANAVA 2 in unison with a 2x2 factorial design interaction as well as a determinant test using a benpheroni test. Based on the research, provide an understanding that students will gain learning in unison with the MEA get high problem-solving abilities than students Where students who get treatment with learning is carried out conventionally, and students who have a high level of comfort have high problem-solving ability results abilities compared to students who have a fairly low level of independence, so they have an influence on self-reliance and learning methods on students' problem solving Capabilities. Thus, students who have high comfort and get learning with the Eliciting Activities Model have a higher problem-solving ability compared to other types of learning interactions in this study.

Keywords: Problem solving capabilities; Model eliciting activities; Student Independence

1. INTRODUCTION

By seeing that Mathematics is a pattern that grows and develops in life created from thought processes that will create patterns of order, relate between concepts and apply organized concepts in solving everyday problems (Anistyasari and Hidayati, 2022). In mathematics learning, it is not only an orientation to the final result, but rather emphasizes all activities in the ongoing teaching and learning process (Akbarzadeh, Khosravi and Alex, 2022). In turn the student is not only able to solve troubleshooting in mathematics, but must also be able to provide material explanations with mathematical language and able to use its logic, critically, creatively, done systematically and innovatively in solving problems in general (Chamberlin and Moon, 2005). Judging from independence in different learning, in mathematics learning, affective abilities are also needed where the mental processes of students are also something important (Suhendri, 2015). And one of the affective aspects is the independence of learning which is very important for the learning process (Kartika and Hiltrimartin, 2019). So, when entering college students have to make important choices in terms of the field of study they want to be knowledgeable and the college environment in particular is very has differences with context of secondary education.

According to (Blackmore et al., 2021; Faizatuluhmi et al., 2020; Ikawati et al., 2019) says with the presence of students who have seriousness in the learning process have full concentration and high motivation. There is a positive correlation between motivation and achievement, in particular young students with higher Academic intrinsic motivation will have much higher intellectual achievement and performance as well (Eriyanto et al., 2021; Jamaludin et al., 2020; Rahman et al., 2020; Tam et al., 2021; Yulianto et al., 2020). In the Academic context, motivation has been identified as an important predictor for improving Academic achievement (Fatonah et al., 2020; Lim & Yeo, 2021; Tam et al., 2021). In increasing student learning motivation in mathematics learning activities, an educator must be able aims to obtain the best learning model so that all aspects of both cognitive, affective and psychomotor are achieved (Iqrammah & Rijanto, 2019; Listyaningsih et al., 2022; Mashari & Umami, 2019; Sipayung et al., 2021; Solichin et al., 2021; Tam et al., 2021). Is one of the learning that is able to chosen is the MEA. MEA is a learning Models that can be notified in the form of learning methods (Carmona et al., 2022; Chimmalee & Anupan, 2022; Kang, 2022; Passarella, 2022; Saka & Alkan, 2022; Şener & Dede, 2022; Sengil-Akar & Yetkin-Ozdemir, 2022). Some of the principles Meaningful learning requirements contain good concept building, contain evaluations, are real-life based, work together in small groups well, present accurate models (Dzulfikar,

Asikin and Hendikawati, 2012; Azhari and Irfan, 2019). State of The Art on this research activity, that from several understandings that have been listed, so it is pursued that a learning that is currently needed is what makes related to the matter discussed the best learning model that provides an increased influence on the ability to solve mathematical problems because currently it is still generally low. Then Novelty in this study is a modern learning base in terms of independence.

2. RESEARCH METHOD

This study aims to obtain information about the presence or absence of differences in mathematics learning using the Eliciting Activities Model in terms of the level of Independence towards mathematical problem solving ability and if there are differences, which one is best used in mathematics learning. This type of research is an experiment, which is to compare the effectiveness of the Eliciting Activities Model with conventional models in terms of the level of Independence on student learning outcomes in mathematics learning on eigenvalues material. The design can see in **Table 1**.

Table 1. Research Design

Learning Methods (A)	Model Eliciting Activities (A1)	Conventional (A2)
Level of Independence (B)		
Level of Independence (B1)	A1B1	A2B1
Level of Independence (B2)	A1B2	A2B2

The instruments used the test method. A test is a task assigned to an examinee, intending for the participant to show what has been learned or known from a program that has been carried out. The test is a systematic procedure, meaning that the procedure for conducting the test and giving scores on the test results must be clear and specified in detail. The tests in this study were used to gain an understanding of the results of problem-solving skills. The initial process carried out is the sample equality test aimed at determining the independence of each control sample class and experimental class in the Mechanical Engineering D3 Study Program. The initial stage data of the equality test data was taken from the 1st grade UAS of the D3 Mechanical Engineering Study Program students for the 2021/2022 Academic Year.

Then from the test results with a significant degree, then H_0 is accepted if $-t^{(1-\frac{\alpha}{2}, dk)} \leq t_{count} \leq t^{(1-\frac{\alpha}{2}, dk)}$, and α be = 5% dan $dk = (n_1 + n_2) - 2$. Which means that the experimental class is commensurate with the control class. From the calculation of $t_{hitung} = 1.71$ and a significant level of 5 % obtained $t_{table} = 1.71$. So that $-1.96 \leq t_{count} \leq 1.96$, so it refers to the acceptance of H_0 which means the Experimental class is commensurate with the control class.

Then the next step is to test the prerequisites for analysis, namely: Data Distribution Normality Test and Data Distribution Homogeneity Test. Continued with the Hypothesis Test as follows:

Hypothesis test of mathematical problem-solving ability

Anava for Two-Way Classification with Interaction

In this study, the hypothesis test used a variation analysis test for two-way classification with interaction, namely variation analysis:

Table 2. ANAVA for Two-Way Classification with 2 x 2 Factorial Design Interactions

Sources of Diversity	Sum of Squares (JK)	Degrees of Freedom (dk)	Middle Square (RK)	Fcount
Row center value	JKB	r-1	$S_1^2 = \frac{JKB}{r-1}$	$f_1 = \frac{S_1^2}{S_4^2}$
The middle value of the column	JKK	c-1	$S_2^2 = \frac{JKK}{c-1}$	$f_2 = \frac{S_2^2}{S_4^2}$
Interaction	JK(BK)	(r-1)(c-1)	$S_3^2 = \frac{JK(BK)}{(r-1)(c-1)}$	$f_3 = \frac{S_3^2}{S_4^2}$
Error	JKG	rc(n-1)	$S_4^2 = \frac{JKG}{rc(n-1)}$	
Total	JKT	rcn-1		

Information:

$$\begin{aligned}
 \text{JKT} &= \sum_{i=1}^r \sum_{j=1}^c \sum_{k=1}^n (x_{ijk} - \bar{x} \dots)^2 && = \text{sum of squares of the total} \\
 \text{JKB} &= cn \sum_{i=1}^r (\bar{x}_{i\dots} - \bar{x} \dots)^2 && = \text{the sum of squares for the middle of the row.} \\
 \text{JKK} &= rn \sum_{j=1}^c (\bar{x}_{j\dots} - \bar{x} \dots)^2 && = \text{the sum of squares for the middle value of the column.} \\
 \text{JKG} &= \sum_{i=1}^r \sum_{j=1}^c \sum_{k=1}^n (x_{ijk} - \bar{x}_{ij})^2 && = \text{sum of squares}
 \end{aligned}$$

Benferoni Test

There is a analysis continues with the Benferoni method because the number of samples in each treatment is not the same. The Benferoni method was used to test whether there was an average difference in mathematical problem-solving ability between two treatments from the four existing treatments. The next steps are as follows:

Statistical Test

Calculates the absolute price of the difference in the average problem-solving ability score between the compared treatments

$$|\bar{X}_A - \bar{X}_B|$$

Calculating the magnitude

$$SE = \sqrt{D \left(\frac{1}{n_A} + \frac{1}{n_B} \right)}$$

Where D is the middle square (S2) error obtained from the anava table.

Calculating the value of S with the formula:

$$S = \frac{\bar{X}_A - \bar{X}_B}{SE}$$

Compare the price of S with B obtained from the student distribution list with dk = (n-k) and $\alpha = 5\%$ draw conclusions with the criteria if then H0 is rejected (Walpole, 1995).

3. RESULTS AND DISCUSSION

After the sample obtained the results that it is normally distributed and homogeneous, then tested the two-way anava hypothesis with interaction. The hypothesis of differences in mathematical ability in students who have independence and receive learning treatment with the Eliciting Activities Model and learning with conventional methods on eigenvalues material.

Table 3. Anava Divides Two-Way Classification with Factorial Design Interactions 2 X 2

Sources of diversity	Sum of Squares	Degrees of Freedom	Middle Square (RK)	F count	Info
Row Middle Value	8928,14	1	8928,14	101,3582	H0 rejected
Middle Value of Column	2310,40	1	2310,40	26,2292	H0 rejected
Interaction	2502,72	1	2502,72	28,4126	H0 rejected
Error	13741,27	156	88,085		
Total	27482,54	159			

Based on the **Table 3** of analysis of variance for two-way classification with the interaction of factorial design 2x2 obtained:

- a. $F_1 = 101,3582 > F_{table} = 4,08$
 $F_{count} > F_{table}$, so H0 rejected
 The ability skills in college students who use the Eliciting Activities Model with conventional methods.
- b. $F_2 = 26,2292 > F_{table} = 4,08$
 $F_{count} > F_{table}$, so H0 rejected
 So there are differences in the ability to solve mathematical problems between students and a high level of independence and low ability.

- c. $F_3 = 28,4126 > F_{table} = 4,08$
 $F_{count} > F_{table}$, so H_0 rejected
 So on interactions, especially between learning models and others in students Independence on mathematical problem-solving ability.

After being tested using anava 2 x 2, the data results were tested again using the Benferoni determinant test. The full calculation of the ferronic test in **Table 4**.

Table 4. Benferoni Test Results

No.	Test the Difference	Difference (Difference)	Rated S	Rated B	Information
1.	1 – 2	0,31	0,147	1,96	There is no significant difference (significant)
2.	1 – 3	7,03	3,35	1,96	There is a significant difference (significant)
3.	1 – 4	22,54	10,74	1,96	There is a significant difference (significant)
4.	2 – 3	7,34	3,496	1,96	There is a significant difference (significant)
5.	2 – 4	22,85	10,886	1,96	There is a significant difference (significant)
6.	3 – 4	15,51	7,389	1,96	There is a significant difference (significant)

Information:

- a. Treatment 1 (Model Eliciting Activities for students with high independence).
- b. Treatment 2 (Model Eliciting Activities for students with low levels of independence).
- c. Treatment 3 (Conventional method for students with a high level of independence).
- d. Treatment 4 (Conventional method for students with low independence level).

Thus the Eliciting Activities Model for students with a high level of independence with conventional methods for students with a low level of independence there are significant differences. So there is a difference between the treatment of model Eliciting Activities with conventional methods and students with high and low levels of independence. And from the Benferoni test, it can be concluded that the best model is the Eliciting Activities Model for students with a low level of independence. And skills are developed on the basis of understanding while in conventional learning students are only passive recipients of information and skills are developed on the basis of practice. In this case, learning is not just memorization but students are helped to construct knowledge in their minds, so that the knowledge received will last a long time in the minds of students (Aisyah et al., 2018; Akbarzadeh, Khosravi and Alex, 2022). Learning with Model Eliciting Activities also has six main components, namely: constructivism, finding, asking, community learning, modeling, and reflection. With these six components, learning is more diverse and not monotonous. Students are led to find answers to problems and be active in learning. Thus students will not be bored in participating in learning because learning is more fun. Learning is more effective if students learn from themselves, construct knowledge (Guler et al., 2019; Susanti, Fedi and Hutneriana, 2021; Akbarzadeh, Khosravi and Alex, 2022).

In this study, there are several obstacles both in terms of student cooperation and in terms of facilities and infrastructure, including in terms of student cooperation, especially in the learning model With the Eliciting Activities Model, there are some students who still cannot understand about this learning system, for example there are some students who work alone and without collaborating with group members in a team that has been formed. And the obstacle obtained from the Conventional learning model is that many students do not listen to the lecturer's explanation while the teaching and learning process is ongoing (Chamberlin and Moon, 2005; Nurfadilah and Hakim, 2019) In terms of facilities and infrastructure obtained by researchers, there is still a lack of sources of information for students, for example reading resources or guidebooks only relying on modules so that their thinking ability is less extensive because information about the subject matter is limited. Obtained summarized as follows: (1) Students gain the learning process MEA get higher problem-solving skills compared to students who obtain learning with conventional methods/models, (2) Students who have high independence will get higher problem-solving skills from students who have low independence, so an understanding is obtained that there is an influence of independence and learning models on students skills, (3) Students who have high bathiness and get learning with model Eliciting Activities have higher problem-solving abilities compared to other types of learning interactions in the research conducted on this occasion.

4. CONCLUSION

Based on the results of the research that has been carried out, it can be concluded as follows: following conclusions were obtained: 1). Students learning with MEA gain higher problem-solving that the skills of the student are compared with those that acquire the conventional learning process, 2). Students who have high independence will gain higher problem-solving abilities than students who have low independence, so states there is influence of independence and learning methods on students' problem-solving ability skills, 3). Students who have high comfort and get learning with the Eliciting Activities Model have a higher problem-solving ability compared to other types of learning interactions in this study.

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AUTHOR'S CONTRIBUTIONS

The authors discussed the results and contributed to from the start to final manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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