Effect of metacognition and self-efficacy on scientific achievement by prospective science teachers of Madura through student creativity

Effect of metacognition and self-efficacy on scientific achievement by prospective science teachers of Madura through student creativity

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Abstract. The low student achievement is influenced by several factors, including metacognition, self-efficacy, and creativity in learning. This study aims to determine how much effect of metacognition and self-efficacy toward scientific achievement through student creativity of prospective science teachers of Madura. The research was carried out on all student in Natural Science Education Study Program, University of Trunojoyo Madura with a total population of 390 students. This study is Ex Post Facto, data of metacognition, self-efficacy, and student creativity collected through questionnaires and scientific achievement using documentation. Data were analyzed using SEM analysis techniques. The results showed that regulation of metacognition and self-efficacy positive and significant impact on the student creativity with each estimated value γ_{11}=0.265 and = γ_{12} = 0.356 positively with $\alpha = 0.05$, > p = 0.01, and student creativity has positive and significant effect on scientific achievement with the value β_{21} = 3.109. Metacognition knowledge and self-efficacy does not directly influence student achievement, but through regulation of metacognition and self-efficacy through student creativity together shown to result in a significant and positive effect on scientific achievement of prospective science teachers of Madura.

1. Introduction

Natural science has an important role in the life and advancement of science and technology. Natural science is a way of thinking in order to establish patterns of thought, structural, objective, and rational skills [1]. In learning something, learners are invited to self-regulate and solve problems that emerge [2]. This self-regulatory mechanism requires confidence to make quick and accurate decisions [3-6]. Student scientific achievement is significantly influenced by fast and correct decisions [7][8]. Therefore, science is one of the main subjects in schools, both in elementary schools, middle schools and higher education.

Students research different natural phenomena at the university level and combine them with natural science principles, rules, and hypotheses to solve different problems by using a range of thought skills, such as logical thinking skills, problem solving skills, collaborative skills, imagination and innovation skills, and communication skills [9][10][2]. The problem-solving method is also carried out by metacognition and making the right choices with self-confidence [11][12].

Basic science is one of the courses in the Natural Science Education Study Program of Trunojoyo Madura University (UTM), which focuses on problems and alternative problem solving. The use of biological, physical, and chemical sciences is combined by problems explored in basic science [13][1]. For example, when studying pollution, the subject under study may be in the form of observations of

multidisciplinary information that are used to study issues from the context, causes, forms, consequences for the environment as a whole that may mutually reinforce and support one another. Thus, it takes thought skills and imagination to solve a problem in order to maximize learning achievement.

Thinking skills used for analyze, evaluate, compare, create (appropriate with cognitive levels of HOTS). Creativity used for solve a problem with appear new alternative solution or furnish/complete oldest solution as way for anticipate, prevent, ward off so that the problem can be solved. With the support self-efficacy to students for convince themselves and self-optimism can solve problem that faced. Through natural science learning, students can improve their scientific achievement, but because many problems/factors that effect on the learning process, many students said that natural science is different lesson, they don't have interest in learning of natural science, so they have low scientific achievement. This is in line with the outcomes of interviews with several UTM natural science education lecturers that showed that when learning took place, there were still students who were considered able to solve the problems given, but they could not do it when the replay took place. This is the cause of low scientific achievement among students.

At Trunojoyo Madura University (UTM), lecture trends in science education are also still geared towards cognitive learning outcomes and have not attempted to motivate the metacognitive skills of Madura's student science teacher candidates. In several courses in UTM science education, the results of researchers' observations of teachers showed that 65 percent of lecturers had not yet empowered metacognition in lectures by applying effective models, techniques, and methods of learning. The implications that occurs is the scientific achievement of student science teacher candidates in Madura appears to be poor and they do not have the confidence to become independent learners. Candidate students of Madura science teacher were not able to control, track, regulate their cognitive abilities through metacognition. Metacognition empowerment needs to be done so that students can solve the problems faced independently, promote self-confidence, and increase learning achievement.

The low scientific achievement of students, influenced by many factors. According to Tatar, et al. [14] factors that affect student achievement can be classified into internal factors and external factors. In line with this, according to Lin, et al., [11] outlines the factors that affect the learning achievement can be classified into two, namely: (1) internal factors, namely factor that comes from within the individual, which includes factors of the physiological and psychological factors, and (2) external factors, i.e. factors that come from outside of the individual, which includes social factors and non-social factors. Given the considerable number of variables that affect student's scientific achievement, both within and from outside of the students, as well as the limited number of researchers in a variety of things such as time and ability, so researchers restrict this research, which only observe factors that comes from within the individual, especially psychological factors, that are metacognition, self-efficacy, and student creativity.

The success of students in solving the problem, among others, relies heavily on the consciousness of what students know and how to do it. Metacognition is a word that relates to what is known about themselves as an individual who learns and how he controls and adjusts the behavior. Students need to be aware of its advantages and disadvantages that they have. According to Lai [15] metacognition is a form of the ability to see himself that what he does can be controlled optimally. With this ability is possible someone has high ability in solving problems which in turn will impact on improving scientific achievement, because in every step that he did always emerges the question "what do I do?", "why am I doing this?", "what can help me in solving this problem?". This is in line with a study have done by Nurdin [4] and Yasir [16] obtained results that learning with PMKM Model (foster metacognitive skills) have an impact on the achievement of mastery learning (at least 85% of students scored 6.5 and above). In line with research conducted by Bandura [3] about some students who have different ability in natural sciences, the results of that research show self-efficacy predicted correctly in natural sciences lessons. This research concluded that students who low scientific achievement possibility caused by lack of ability that they already have ability but lack of self-efficacy to optimize their abilities.

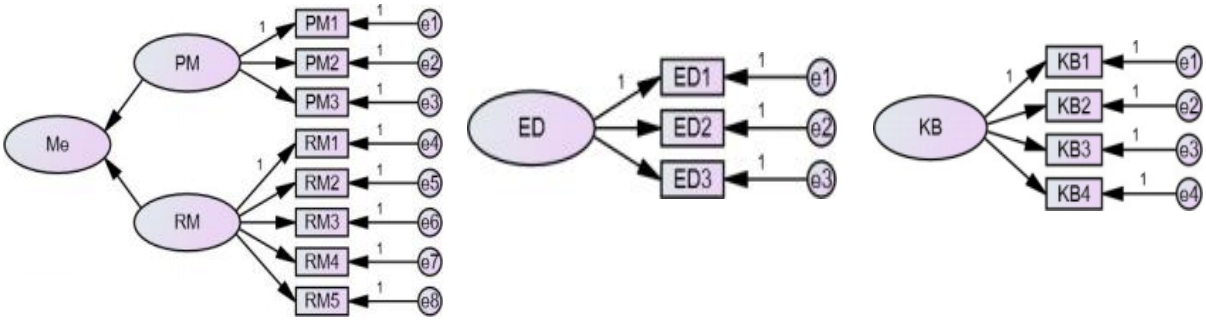
Based on the background outlined above that, there are still among the students when learning takes place is considered to solve the given problem, but when the replay takes place, they can no longer do it. The low student achievement is influenced by several factors, including metacognition, self-efficacy, and creativity in learning. This study was conducted to determine how much effect of metacognition

and self-efficacy toward scientific achievement through student creativity of prospective science teachers of Madura. Metacognition skills trained with make journal of study, self-efficacy seemed when students did presentation their work in front of class with various creation, and then student creativity in the form of present summary as the results of discussion with poster, mind map, and power point. Scientific achievement is the results of basic natural sciences learning in last examination.

2. Method

This research is ex post facto aimed at know how to influence metacognition and self-efficacy on student's scientific achievement through student creativity. The population in this study were all students of prospective natural science teachers of Madura who was educated in Natural Science Education Study Program, University of Trunojoyo for a total of 390 students. The sampling technique is done by proportional random sampling technique with the amount of 30% of the total population as a condition for SEM analysis. Collecting data on metacognition and self-efficacy and creativity of study done by giving questionnaires to a sample. While data on student's scientific achievement obtained using methods documentation. Metacognition instrument consists of 30 items covering dimension statement knowledge of metacognition and regulation of metacognition, self-efficacy instrument consists of a 21-point statement with adapted dimensions from Bandura [3], while student creativity instrument consists of 29 items with dimensions statement fluency, flexibility, originality, and elaboration. Data were analyzed by using descriptive statistics and inferential statistical techniques SEM analysis techniques using IBM SPSS and AMOS program.

Each variable used in this study are prepared instruments for data retrieval. After obtaining the construct of metacognition variables, then given a dimensional model design for variable metacognition (**Figure 1 (a)**). Variables metacognition denoted by X1 is as latent variables and the corresponding items in the questionnaire are denoted by Me_i was as manifest variables metacognition. Similarly, self-efficacy variables, after obtaining the construct of self-efficacy variable is then given a dimensional model design for self-efficacy variables. Self-efficacy variables are denoted by X2 is a latent variable and the corresponding items in the questionnaire are denoted by ED_1 is manifest as self-efficacy variables. And for student creativity variables denoted by Y1 is as latent variables and the corresponding items in the questionnaire are denoted by KB_1 is a student creativity manifest variable. The design dimensional models for these variables can be seen in **Figure 1**.



(a) (b) (c)

Figure 1. The design of a dimensional models for variables (a) metacognition, (b) self-efficacy, and (c) student creativity

The research's instrument was developed to be valid and reliable therefore instruments that have been developed tested validity and reliability. Test the validity of which will be used is the construct validity and internal consistency test. Construct validity is the validity of the type that indicates the extent to which a measuring tool to uncover a theoretical construct that was about measuring. Construct validity is done by experts who had done a lot of research on issues related to science research. Validity is intended to determine whether the statements can reveal about metacognition, self-efficacy, and student creativity of the sample studied, whether the sentence was not inflicting a double interpretation, if the phrase is used in accordance with the rules of writing is good and true, and if the phrase used to

use words that are easily understood by the study sample. The instrument was developed also must have the reliability; the instrument produces the same size if used on other similar samples [17]. Reliability instrument on the show with a number called the coefficient of reliability. Reliability coefficient was analyzed by using the formula alpha-Cronbach. The higher the coefficient of reliability means higher reliability of an assay. The value of coefficient of reliability ranged from 0.00 to 1.00. When coefficient of reliability is getting close to 1.00 then this means that there is consistency of measurement results more perfect [18].

SEM analysis examines two models, the measurement and structural model. Measurement model or models of CFA (Confirmatory Factor Analysis) describes the operationalization of research variables into measurable indicators are expressed in terms of the path diagram or specific mathematical equations. While structural model prediction or hypothesis to explain the relationship between caused variable to variable results. Measurement and structural models in this study are presented in **Figure 2.** More, wherein: X1 and X2 are respectively metacognition and student self-efficacy; Y1 and Y2 respectively is creativity and science learning achievement of students.

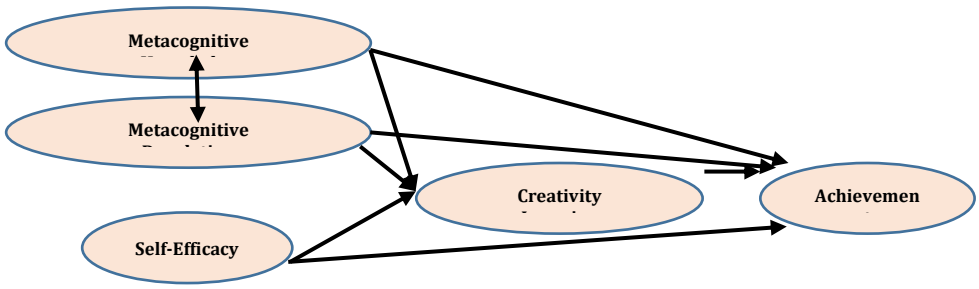


Figure 2. Structural model of functional relationships between constructs

Structural equation based on the description and structural model of functional relationships between the constructs in **Figure 2.** which has been formed by the theory is as follows:

$$Y_1 = f(X_{1.1}, X_{1.2}, X_2) \quad (1)$$

$$Y_2 = f(X_{1.1}, X_{1.2}, X_2, Y_1) \quad (2)$$

The model in **Figure 2.** can be made in the form of models of science known as structural equation modelling (SEM):

$$Y_1 = \gamma_{11}X_{11} + \gamma_{12}X_{12} + \gamma_{13}X_2 + \varepsilon_1 \quad (3)$$

$$Y_2 = \gamma_{21}X_{11} + \gamma_{22}X_{12} + \gamma_{23}X_2 + \beta_{21}Y_1 + \varepsilon_2 \quad (4)$$

Where: $X_{1.1}$ = Knowledge of metacognition, $X_{1.2}$ = Regulation of metacognition, X_2 = Self-efficacy, Y_1 = Student creativity, Y_2 = Scientific achievement, γ_{11} = Coefficient of direct influence $X_{1.1}$ to Y_1, γ_{12} = Coefficient of direct influence $X_{1.2}$ to Y_1, γ_{13} = Coefficient of direct influence X_2 to Y_1, γ_{21} = Coefficient of direct influence $X_{1.1}$ to Y_2, γ_{22} = Coefficient of direct influence $X_{1.2}$ to Y_2, γ_{23} = Coefficient of direct influence X_2 to Y_2, β_{21} = Coefficient of direct influence Y_1 to Y_2, ε_1 and ε_2 are error facto[13][19].

3. Results and Discussion

The following proposed measurement properties of the instrument. The properties in question are the measurement of the suitability of the model, the significance of the coefficient weighting factors and the evaluation of the reliability of the construct.

3.1 Construct of Metacognition

The results of the analysis as in **Table 1.** that the test results meaningfulness of each coefficient weighting factors metacognitive knowledge showed significant entirely at the 5% significance level. It implies that each indicator has sufficient validity and reliability in measuring latent variables metacognitive knowledge. According to the construct validity, the estimation results indicate that the construct of metacognitive knowledge (X1.1) is significant with a level of reliability of 0.811 > 0.70. Similarly, metacognition regulatory analysis result as in **Table 1.** that the significance of test results to

the respective weighting coefficients regulatory factors metacognition (X1.2) are all significant at the 5% significance level and the level of reliability of 0.717 > 0.70. It implies that each indicator has sufficient validity and reliability in measuring latent variables regulation of metacognition.

Table 1. Results of the analysis of convergent validity and reliability for metacognition variable

			Estimate	S.E.	C.R.	P	Cronbach alpha
PM1	←	PM	0,884	0,104	8,509	0,01	0,811
PM2	←	PM	0,897	0,101	8,927	0,01	
PM3	←	PM	1.000				
RM1	←	RM	1.000				
RM2	←	RM	0,364	0,067	5,429	0,01	0,717
RM3	←	RM	0,280	0,064	4,404	0,01	
RM4	←	RM	0,463	0,067	6,864	0,01	
RM5	←	RM	0,459	0,072	6,401	0,01	

Referring to the results of testing of models, both overall model fit test or individually and considering the weighting coefficient and the reliability factor construct obtained [18] it can be concluded, measurement model of metacognition is acceptable. The variable of metacognition is un-dimensional, precise and consistent can be measured and described metacognitive knowledge and regulation of metacognition.

3.2 Construct of Self-Efficacy

The results of test the significance of each weighting coefficients entirely self-efficacy factors showed significant at the 5% significance level. It implies that each indicator has sufficient validity and reliability in self-efficacy measure latent variables

Table 2. Results of the analysis of convergent validity and reliability for self-efficacy variable

			Estimate	S.E.	C.R.	P	Cronbach alpha
ED1	←	Efficacy	0,698	0,055	12,765	0,01	0,875
ED2	←	Efficacy	0,944	0,073	12,893	0,01	
ED3	←	Efficacy	1,000				

According to the construct validity, the estimation results indicate that the construct of self-efficacy (X2) significantly with the level of reliability (Cronbach alpha) 0.875 > 0.70. Referring to the results of testing of models, both overall model fit test or individually and considering the weighting coefficient and the reliability factor construct obtained it can be concluded, self-efficacy measurement model can be accepted. That is, self-efficacy variables, are un-dimensional, precise and consistent can be measured and described by three indicators.

3.3 Construct of student creativity

The results of test the significance of each weighting coefficients entirely student creativity factors showed significant at the 5% significance level. It implies that each indicator has sufficient validity and reliability.

Table 3. Results of the analysis of convergent validity and reliability for student creativity variable

			Estimate	S.E.	C.R.	P	Cronbach alpha
KB1	←	Creativity	1,000				0,894
KB2	←	Creativity	1,629	0,210	7,745	0,01	
KB3	←	Creativity	3,669	0,445	8,253	0,01	
KB4	←	Creativity	1,658	0,204	8,144	0,01	

According to the construct validity, the estimation results indicate that the construct of student creativity (Y1) is significant with a level of reliability (Cronbach alpha) for 0894 > 0.70. Referring to the results of testing of models, both overall model fit test or individually and considering the weighting

coefficient factor and reliability construct obtained it can be concluded, creativity measurement model to learn science is acceptable. That is, student creativity variables, is un-dimensional, precise and consistent can be measured and described by four indicators.

After each variable is declared valid and reliable, here after in this section will describe the research data obtained through questionnaires and science learning outcomes by using instruments developed. Variables described are four variables studied were achievement (Y2), student creativity (Y1), metacognition (X1), and self-efficacy (X2).

Table 4. Results of descriptive analysis for each variable

	Metacognition	**Self-efficacy**	**Student creativity**	**Scientific achievement**
Mean	77,03	54,03	66,28	85,69
Std. Error of Mean	0,53	0,54	0,61	0,82
Median	78,00	55,00	67,00	87,00
Mode	78	56	70	100
Std. Deviation	7,04	7,11	8,18	10,89
Variance	49,64	50,6	66,92	118,63
Minimum	58	34	42	54
Maximum	93	70	87	100
Sum	13635	9564	11732	15168

From these results, it was presented in frequency distribution list with four categories, the tendency of the spread of the frequency distribution of awareness metacognition score as in **Table 5.**

Table 5. Distribution of frequencies, percentages, and categories for metacognition variable (X1)

Interval	**Category**	**Frequency**	**Percent (%)**
35−54	Very bad	0	0
54−64	Bad	3	2
64−84	Good	138	78
84−100	Very good	36	20
Total		177	100

From Table 5, it can be seen that student metacognition of prospective science teachers of Madura are more dominant in good categories, that is by 78% compared with the other categories that bad categories by 2%, 20% for very good categories and 0% for very bad categories. Furthermore, the results of descriptive analysis tendency to spread the distribution of self-efficacy score can be seen in Table 6.

Table 6. Distribution of frequencies, percentages, and categories for self-efficacy variable (X2)

Interval	**Category**	**Frequency**	**Percent (%)**
30−40	Very low	6	4
40−50	Low	41	23
50−60	High	89	50
60−70	Very high	41	23
Total		177	100

Based on Table 6, It is obtained a description that student self-efficacy is more dominant at the high category in the amount of 50% compared with the other categories that category is very high and the low of 23%, and the very low category 4%. Furthermore, the results of descriptive analysis of the distribution of scores student creativity tendency to spread can be seen in **Table 7.**

Table 7. Distribution of frequencies, percentages, and categories for student creativity variable (Y1)

Interval	Category	Frequency	Percent (%)
30−45	Very low	1	1
45−60	Low	33	19
60−75	High	114	64
75−90	Very high	29	16
Total		177	100

Based on **Table 7.**, obtained a description that student creativity of prospective science teachers of Madura is more dominant in high category in the amount of 64% compared with other categories that category is very high of 16%, the low category 19%, and very low category 1%. Furthermore, the results of descriptive analysis tendency to spread the distribution of scientific achievements score can be seen in **Table 8**. And based on **Table 8.**, obtained a description that scientific achievement of prospective science teachers of Madura is more dominant in the category is very high at 44% compared with the other categories, that is 27% (high) and 29% (low), and 1% (very low).

Table 8. Distribution of frequencies, percentages, and categories for scientific achievement (Y2)

Interval	Category	Frequency	Percent (%)
50−60	Very low	1	1
70−80	Low	50	28
80−90	High	48	27
90−100	Very high	78	44
Total		177	100

For the purposes of verification of models and hypothesis testing, SEM has a variety of assumptions as to the multivariate statistical methods. Checking the assumptions required in the SEM as follows: (1) the feasibility of the sample size, has previously been described that the sample in this study declared eligible for further analysis, (2) linearity. In SEM assumed causality and linear. The nature of causality is guaranteed by theoretical arguments in model development. Furthermore, SEM assumes a linear relationship between indicators and latent variables and between latent variables that are required in the covariance matrix.

To see linearity use chart analysis [20]. The results of the analysis of the chart as it shows that all indicators adrift linear latent variable composite score and each variable can be said to be mutually linear adrift. Therefore, the assumption of linearity between indicators of the latent variables and between variables research has been fulfilled. (3) The normality of the dependent variables.

To see the estimates used univariate normality skewness and kurtosis, and used for multivariate normality multivariate kurtosis coefficient Mardia. By using a significance level of 0.05, an indicator or otherwise normally distributed variables when the critical ratio of skewness or kurtosis is within the interval (-2.58). If this assumption is not fulfilled, the transformation of the data or use the procedures robust to non-normality. Results of univariate and multivariate examination there are no data that is not normal, but its multivariate shows that there are some in the multivariate non-normal data. This has been stated by [20] that the variables observed in social science almost never normally distributed.

Furthermore, the transformation of the variable that contains the outlier, but the data still fails to show the transformation of multivariate normality and more difficult in the "interpretation" rather than the original data [20]. Despite the apparent abnormalities in the data, but still decided to use the maximum likelihood estimation, because this technique is quite strong against the violation of normality multicollinearity. Full multicollinearity assumptions do not occur in SEM, but the correlation between the independent variables can be modeled explicitly in the SEM. Multicollinearity complete will result in the singular covariance matrix and will decrease the reliability of estimates of SEM. multicollinearity examination conducted by the Pearson correlation (*r*). If the correlation coefficient $r \geq 0.85$, then multicollinearity highly regarded and seen as problematic empirical under identify. If multicollinearities occur between variables, then it is best done by [20] is studying the occurrence multicollinearities and remove or eliminate one of the variables in the model are mutually collinear.

The results of analysis data showed that multicollinearity (effect on singularity) can ensured because the matrix of correlation toward indicator, overall have coefficient of correlation r < 0,85. Based on the final CFA, each construct builds a complete model of structural equation. The results of the analysis are presented in **Figure 3.** that are final model and **Table 9.** which is the final stage of estimation parameter model.

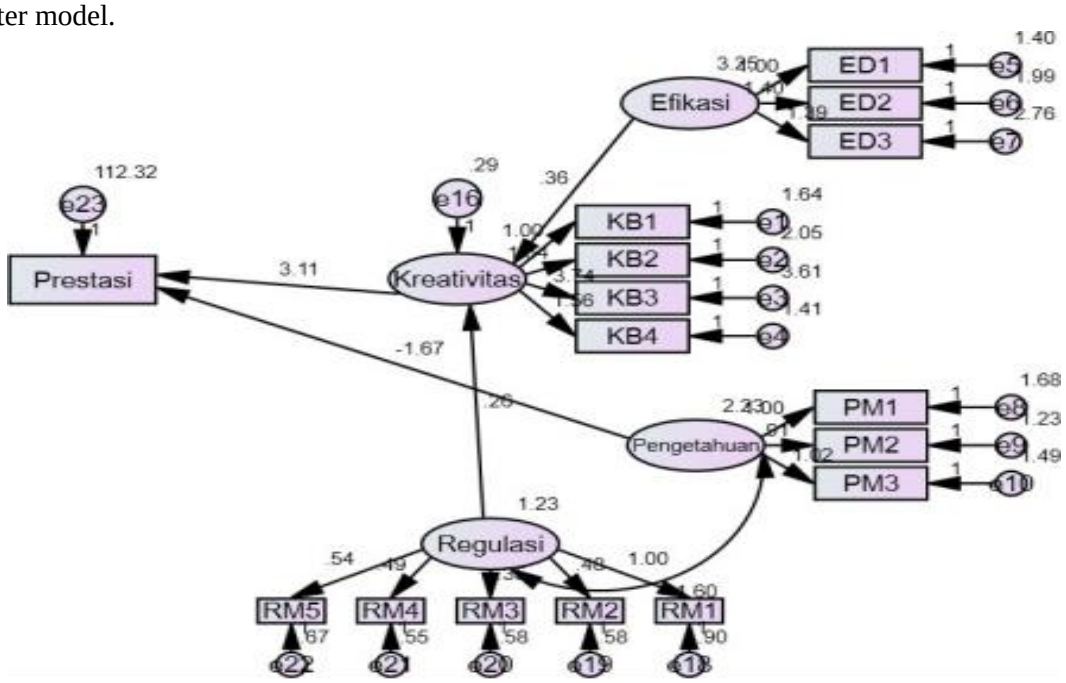


Figure 3. Final stage of structural model between variables effect

Table 9. Final stage of regression model

			Estimate	S.E.	C.R.	P
Creativity	←	Regulation	0,265	0,079	3,350	0,01
Creativity	←	Efficacy	0,356	0,059	5,996	0,01
Achievement	←	Creativity	3,109	1,287	2,416	0,016
Achievement	←	Knowledge	-1,673	0,871	-1,921	0,055

Based on the analysis, the results of research hypothesis testing are expressed in statistical hypothesis, discussion as follows:

3.4 The direct effect of the regulatory metacognition (X1.2) to student creativity (Y1)

Statistical hypothesis which will tested are: H_0: $\gamma_{11}= 0$ against H_1: $\gamma_{11}\neq 0$, where H_1 stated that there is a direct positive effect and significance of the regulatory metacognition (X1.2) to creativity (Y1) at the 0.01 significance level. As shown in **Table 9.** estimation results obtained were positive $\gamma_{11} = 0{,}265$ with $p = 0.01 < \alpha = 0.05$ were significant. This means that at a significance level of 0.05 there is a positive and significant effect of metacognition (X1) to creativity (Y1).

There are positive relationship and significance relationship between regulate of metacognition to student creativity at this study seemed when learning process in class, students training in make journal of basic natural science's learning. Students must write their development in study when join basic natural science's class weekly, that accommodate information about topic of the lesson, note of topic that already understand or not yet, alternative strategy to study for solve the problems. With this method, lecture indirectly train regulation of metacognition's students. Student creativity can be seen in the process when they make journal. They can make journal with colorful pen, add some pictures, with various type of paper, and other. They can make journal whatever they like.

Learning journals are used as recorders of metacognitive and experiential/metacognitive knowledge. This is evident from the guiding questions in the learning journal as shown in **Figure 4. A.** Students can create answers to questions from learning journals according to their knowledge and

experience. One of the learning journal questions is "*how do you understand learning material (pollution)*?" The answer given by students is "*I will make a summary of a pollution mind map*". Mind maps made by students become diverse according to their individual creativity. Creativity is meant in the form of mind maps, relationships between concepts, concept layouts, coloring, and others. This of course cannot be separated from the concept of pollution in the form of the definition of pollution; type of pollution; characteristics of each type of pollution; examples and applications of each type of pollution. In making the mind map creation shown in **Figure 4. B.** students need to identify declarative, procedural, conditional knowledge as well as planning, managing information management, monitoring understanding, correction and evaluation strategies.

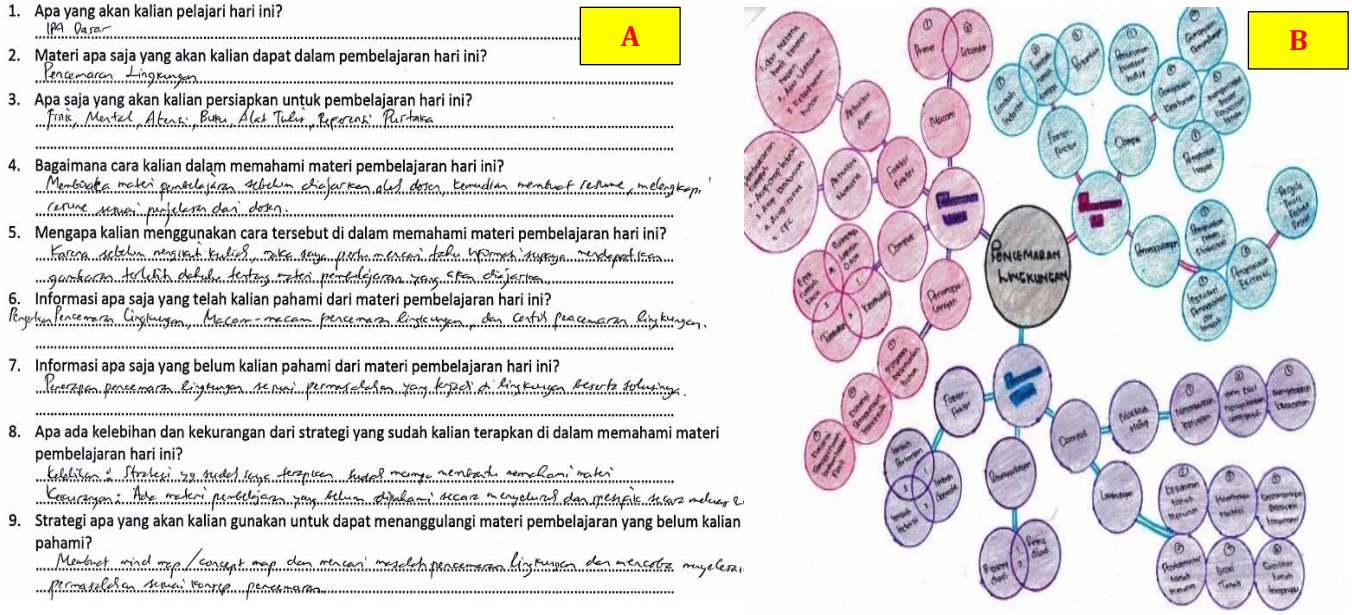


Figure 4. Learning journal interactions (A) with mind maps (B)

The results are in line with the results of research conducted [5] which said metacognition is strongly positively correlated with creativity. The acceptance of this result also means that these findings support to those dictated by [12], that the creative thinking contains aspects of cognitive skills and metacognitive, identify problems, develop questions, identify data relevant and irrelevant, productive, result in a lot of ideas, different ideas/product or new idea and load disposition is to be open, willing to take a position, act quickly, the view that something is part of the whole complex, utilizing the way of thinking of others is critical, and attitude sensitive to the feelings of others.

Meanwhile, [5] reveals that creativity or creative thinking is a cognitive process to generate new ideas useful. Creativity as cognitive processes, creativity is not free from the influence of cognitive abilities, especially metacognition. Declarative knowledge can improve creativity with provided information that is factual and procedural knowledge affect creativity by providing clues to the thinking strategies. Metacognition capability that one can control his cognitive abilities through declarative knowledge, procedural, and conditional and apply them to plan, monitor, and evaluate the cognitive activity that can generate good cognitive abilities, which in turn also affect creative behavior. Based on the research results are positive and significant relationship or there is a significant influence significant between metacognition and creativity in line with Miranda's study [21].

3.5 The direct effect of the self-efficacy (X2) to student creativity (Y1)

Statistical hypothesis to be tested are: H_0: $\gamma_{12} = 0$ against H_1: $\gamma_{12} \neq 0$, where H_1 stated that there is a direct positive effect and significance of the pattern of self-efficacy (X2) to creativity (Y2) at significance level of 0.05. As shown in **Table 9.** be obtained estimation results are positive $\gamma_{12} = 0.356$ to $p = 0.01 < \alpha =$

0.05, which means significant. This means that the significance level there is a positive and effect of self-efficacy (X2) to creativity (Y1).

Creativity is formed from various encouragement from within the individual (intrinsic motivation) and encouragement from the outside or environmental (extrinsic motivation). Encouragement in order to realize the potential of a person to grow and become mature, the urge to express and activate all capacity someone is motivated primer for creativity when individuals form new relationships with their environment Creativity not only requires intelligence, but also need to be supported by high self-efficacy [6]. High self-efficacy will encourage people to devote attention to the activities carried out, so that he will be more knowledgeable in their fields. If the student has a high creativity in natural science learning activities, it can be foreseen that students will have a curiosity greater understanding all the problems that exist in natural science lessons. Students tend to be diligent search for information in the study of natural science is broad and deep. Students will act creatively to face the tasks of teaching natural science is good and right [22]. And self-efficacy in this study seemed when students present their summary of content/lesson and journal of study in class with various creation [23].

These results were confirmed by research conducted by [6] which stated that the efficacy of self-learners causes learners will be able to plan actions, to show new behavior, responds with an active and creative and able to provide solutions or solving life problems being experienced by learners as well as the tasks assigned by the lecturer. Based on the research results are positive and significant relationship or there is a significant effect between self-efficacy and creativity.

3.6 The direct effect of the knowledge metacognition (X1.1) to scientific achievement (Y2)

Statistical hypothesis to be tested are: H_0: $\beta_{21} = 0$ against H_1: $\beta_{21} \neq 0$, where H_1 stated that there is a direct positive effect and significance of metacognition (X1.1) on achievement IPA (Y2) at significance level of 0.05. As the results of the analysis addressed the metacognition knowledge that the direct effect on scientific achievement gain estimation results were negative. So, it can be concluded that there is no direct effect metacognition on scientific achievement.

3.7 The direct effect of the self-efficacy (X2) to scientific achievement (Y2)

Statistical hypothesis to be tested are: H_0: $\beta_{22} = 0$ against H_1: $\beta_{22} \neq 0$, where H_1 stated that there is a direct positive influence and significant of self-efficacy (X2) on scientific achievement (Y2) at significance level of 0.05. As the result of direct analysis that the direct effect of self-efficacy on student achievement gain estimation results are negative. So, it can be concluded that there is no direct effect of self-efficacy on student achievement.

3. 8 The direct effect of the student creativity (Y1) to scientific achievement (Y2)

Statistical hypothesis to be tested are: H_0: $\beta_{23} = 0$ against H_1: $\beta_{23} \neq 0$, where H_1 stated that there is a direct positive influence and significance of student creativity (Y1) of the scientific achievement (Y2) at significance level of 0.05. As shown in **Table 9.** was obtained estimation results are positive $\beta 23 = 3.109$ with $p = 0.016 < \alpha = 0.05$, which means significant. This means that H_1 is accepted at significance level of 0.05. So, there is a positive and significant effect of student creativity (Y1) to the scientific achievement (Y2) at significance level of 0.05.

The results are consistent with the opinion [7] which states that the more creative a person the more it will have the characteristics of creative cognitive and affective. Learning achievement is the result of action with regard to cognitive. So, the creativity of students a significant impact on student achievement. The results of this study indicate that in order to improve the achievement of students the creativity of students need to be considered. Results of analysis further concerning indirect prediction (mediators) can be seen in **Table 10.**

Table 10. The indirect effect between variables

	Regulation	Knowledge	Efficacy	Creativity
Creativity	0	0	0	0
Achievement	0,83	0	0,181	0

Statistical hypothesis to be tested the effect of regulatory metacognition through student creativity to scientific achievement are: H_0: $\beta_{21}\gamma_{11} = 0$ against H_1: $\beta_{21}\gamma_{11} \neq 0$, where H_1 stated that there is a positive and significant effect on the regulation of metacognition (X1.2) through creativity (Y1) to the scientific achievement (Y2) at significance level of 0.05. As shown in **Table 10.** the estimation results obtained $\beta_{21}\gamma_{11} = 0.83$ positively with $p = 0.024 < \alpha = 0.05$ that significance. This means that H_1 is accepted at significance level of 0.05. So, there is a positive and significant effect of regulation of metacognition (X1.2) through student creativity (Y1) to scientific achievement (Y2) at significance level of 0.05. Means that the student creativity of strengthening the effect of metacognition on scientific achievement. Besides it, statistical hypothesis to be tested the effect of self-efficacy through student creativity to scientific achievement are: H_0: $\beta_{22}\gamma_{12} = 0$ against H_1: $\beta_{22}\gamma_{12} \neq 0$ where H_1 stated that there is a positive and significant effect of self-efficacy (X2) through student creativity (Y1) to the scientific achievement (Y2) at significance level of 0.05. As shown in **Table 10.** the estimation results obtained were $\beta_{22}\gamma_{12} = 0.181$ positively with $p = 0, 012 < \alpha = 0.05$ that significance. This means that H_1 are acceptable at significance level of 0.05. So, there is a positive and significant effect of self-efficacy (X2) through student creativity (Y1) to the scientific achievement (Y2) at significance level of 0.05. This means that student creativity strengthens self-efficacy's effect on scientific achievement. So based on two results, regulation of metacognition and self-efficacy through student creativity together shown to result in a significant and positive effect on scientific achievement of prospective science teachers of Madura

4 Conclusion

Based on the analysis of research data, some conclusions from the results of this study were (1) the regulation of metacognition and self-efficacy positive and significant effect on the creativity of the students' prospective science teachers of Madura, (2) student creativity have positive and significant effect on scientific achievement of prospective science teachers of Madura, (3) knowledge of metacognition and self-efficacy haven't direct effect on student achievement, (4) the regulation of metacognition and self-efficacy through learning creativity together show the results of their positive and significant effect on scientific achievement of student's prospective science teachers of Madura.

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