The correlation regression equations between metacognitive skills and concept gaining of science and biology of Indonesian students

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Abstract. In the field of education metacognitive skills can be used as predictors of students' concept gaining. There have been many researches on the correlation between metacognitive skills and concept gaining both at the elementary school level and high school levels. Several further researches were also conducted to uncover the factors that influenced the regression lines of the correlation. However, to date the actual factors affecting the coefficient value of the slope and intercept of the regression equations on the correlation between metacognitive skills and concept gaining have not been revealed. This research aimed at investigating the factors affecting the slope coefficient and intercept of the regression equation of the correlation between metacognitive skills and concept gaining of students in different educational levels implementing of one learning model. The design of this research was a correlational research in order to investigate the correlation between metacognitive skills as the predictor and the concept gaining as the criterion. Among the 27 regression equations related to the correlation between metacognitive skills and concept gaining of the students undergoing various learning models, that have been analyzed, 77.50% of them are parallel, and only 22.50% of them are intersected. Although there were some intersecting lines, the percentage of parallel lines was bigger. Several factors (education level, class level, academic ability, and learning models) which had been predicted to affect the slope coefficient as well as the intercept were finally proved to be non-affecting factors, because both parallel regression lines and intersecting regression lines were still found in the various conditions compared. This research revealed two factors affecting the slope coefficient and the intercept. These factors are the presence of shared variables that affect the value of X and Y and the measurement error. Further researches related to these factors are necessary to be carried out to uncover more accurate results.
Keywords: concept gaining; intercept; metacognitive skills; regression equation; slope

1. Introduction
Flavel defined metacognition as cognition about cognition or a model of cognition according to Nelson [1, 2]. Metacognition is knowledge about ourselves and to think how to think [3]. Brick, MacIntyre, and Campbell explained that the benefits of metacognition for someone was to empower his understanding and attention during his activities. It can be interpreted that with good metacognitive skills, students can control their activities including the activities in the learning process [4]. Metacognitive skills can enable learners to transfer what they have learned from one particular context to the other context or from the previous tasks to the new ones.

Students' academic achievement is an important part Acknowledgment the education. Cognitive skills include recall or recognition of knowledge and the development of intellectual abilities and skills [3]. When someone starts to monitor their basic awareness, it means that she or he has used her or his metacognitive abilities. Wang et al. and Veenman and Elshout explained that metacognition was a strong predictor in learning [5, 6]. It means that metacognitive skills can give a contribution in learning and affect students' intellectual ability. In his further research it was explained that the implication of learners' metacognition empowerment would reduce their cognitive limitations.

Several research findings explain that metacognition can be taught [7]. The empowerment of students' metacognitive skills can be carried out in various ways, one of which is by the implementation of learning strategies. The learning strategies which are proved to be able to empower students' metacognitive skills are Reading Questioning and Answering (RQA), Think Pair Share (TPS), Reciprocal Teaching (RT), Problem Based Learning (PBL) and some other learning strategies. Besides, those learning strategies can also improve students' concept gaining. Therefore, there are a lot of research in the field of education examining those two things. Learning models were chosen because based on previous research it has been proven able to improve metacognitive skills and concept gaining of the students.

Several researches related to metacognitive skills are often associated with the cognitive abilities [8 - 10]. Young and Fry revealed that there was a correlation between metacognitive awareness (using MAI questionnaire) and academic achievement [10]. Other researches which are also still related to the correlation between metacognitive skills and cognitive ability are the researches which aim at revealing the differences of the regression equation of the correlation between metacognitive skills and cognitive ability. Some previous researches that have been conducted for such purposes are Siswati, Kristiani, Siswati, et al., and Buku, et al [11-14].

The researches investigating the differences of the regression equation of the correlation between metacognitive skills and concept gaining have been conducted too in relation to the same level of academic ability or of different levels of academic ability. The researches were also conducted in relation to similar learning models or different learning models [11]. The research was only conducted on one level of education, which was senior high school, and at the same class level (class XI). There was a tendency formed when the regression lines were compared. The tendency was, for example, that the regression lines of the correlation between metacognitive skills and concept gaining being compared were parallel. However, the researches investigating the differences of the regression equations in different classes or at different levels of education (for example between Junior High Schools and Senior High Schools) have never been conducted.

In addition to revealing the differences in the regression equation, the previous researches also examined the factors affecting the slope coefficient and intercept of the regression equations formed [13, 15]. These factors are revealed with the purpose of explaining why there was a tendency on the regression lines compared. The factors which are considered to have some effects in the previous researches were, for example, learning models used in the learning activities, the education level, the class level, and even the academic ability.

Based on previous researches, especially those related to the factors affecting the slope coefficient and intercept, this study attempts to find the factors affecting the slope coefficient and intercept of a regression equation. The research was conducted in various research conditions, for example, comparing among different levels of education, different academic abilities, different class levels, and different learning models. In order to achieve the objectives in this study, some other future researches are still needed. One of the efforts that could be done was by analyzing several or various correlational researches that have been carried out before. In this connection, the difference of all the regression equations related to the various correlational researches will be analyzed. Thus, it is expected that this study can reveal the possible factors having the greatest possibility to affect the slope coefficient and the intercept of the regression equation of the correlation between metacognitive skills and concept gaining.

2. Method

The design of this study was a correlational design. This study was conducted on the basis of some new researches carried out in the academic year 2015/2016, as well as those researches carried out before. The data of those new researches carried out in the academic year 2015/2016. Those researches were conducted for the purpose of writing a thesis or dissertations. The population of this study was the students of class VII and class VIII of junior high schools in Malang and the students of class X and class XI of Senior High School in Malang, Indonesia. Fourteen classes were used as the samples of this study and were divided into two kinds of education levels, namely the junior high school and the senior high school. The total sample was 458 students. Each class was taught using one learning model. The learning models implemented were Think Pair Share (TPS), Reading Questioning and Answering (RQA), TPS + RQA, Reciprocal Teaching (RT), TPS + RT, Problem Based Learning (PBL), and PBL + RQA. There were fourteen regression lines obtained in this new research.

The data from the previous researches were obtained from the research by Siswati et al. [13]. The research was conducted for one semester of the academic year 2013/2014. The population in this research was class XI students of senior high schools in Malang, Indonesia. Thirteen classes taken as the samples of this research were divided into two types of academic ability, seven classes of students having high academic ability and six classes of students having low academic ability. The total samples of the research were 326 students. Each class was taught by using one learning model. The learning models implemented were Jigsaw, Think Pair Share (TPS), Cooperative Script (CS), Reciprocal Teaching (RT), Problem Based Learning (PBL), Thinking Empowerment by Questioning (TEQ), and Thinking Empowerment by Questioning Integrated with Think Pair Share (TEQ + TPS). The previous researchers have found thirteen regression lines formed.

The whole samples in this study were 784 students, and there were 27 regression lines related, 14 regression lines from the new research and 13 regression lines from the previous researches. The hypothesis testing used was simple linear regression analysis. Simple linear regression analysis is also eventually useful to know the regression equation of the correlation between students' metacognitive skills and concept gaining in each learning model. The hypothesis testing began with the prerequisite test, namely the normality test, homogeneity, and linearity test of the data. After the regression equation of the correlation between students' metacognitive skills and concept gaining was known, the Anova test on the regression equations was performed to determine the parallelism and coincidence of the regression lines formed; it also revealed the factors which possibly affected the regression equation of the correlation between metacognitive skills and concept gaining.

3. Results

3.1 The correlation between students' metacognitive skills and their concept gaining in each learning model

The results of data analysis related to the correlation between students' metacognitive skills and their concept gaining in each learning strategy are presented in Table 1.

Table 1. Summary of the ANOVA Test related to the Correlation between Students' metacognitive Skills and Concept Gaining

Anova	1	2	3	4	5	6	7
F	67.243	16,277	16.361	43.107	5.350	80.008	66.776
Sig.	0.000	0.002	0.000	0.000	0.049	0.000	0.000

Anova	8	9	10	11	12	13
F	58.324	71.661	202.801	23.621	88.365	10.876
Sig.	0.000	0.000	0.000	0.000	0.000	0.004

Anova	14	15	16	17	18	19	20
F	10.801	8.713	95.195	39.773	173.131	88.295	316.526

Sig.	0.003	0.006	0.000	0.000	0.000	0.000	0.000

Anova	**21**	**22**	**23**	**24**	**25**	**26**	**27**
F	19.738	38.259	83.312	9.086	8.828	21.005	173.927
Sig.	0.000	0.000	0.000	0.005	0.006	0.000	0.000

1.	Class XI Jigsaw (high)	15.	Class VIII TPS
2.	Class XI TPS (high)	16.	Class X TPS
3.	Class XI CS (high)	17.	Class XI TPS
4.	Class XI RT (high)	18.	Class X RQA
5.	Class XI PBL (high)	19.	Class X TPS
6.	Class XI TEQ (high)	20.	Class X RQA+TPS
7.	Class XI TEQ+TPS (high)	21.	Class X RT
8.	Class XI Jigsaw (low)	22.	Class X TPS
9.	Class XI TPS (low)	23.	Class X RT+TPS
10.	Class XI CS (low)	24.	Class X PBL
11.	Class XI RT (low)	25.	Class X RQA
12.	Class XI TEQ (low)	26.	Class X RQA+PBL
13.	Class XI TEQ+TPS (low)	27.	Class XI PBL
14.	Class VII TPS		

The results of the data analysis in Table 1 show that there is a correlation between students' metacognitive skills and their concept gaining in each class. This is demonstrated by the significant value of less than 0.05. Thus, it is obvious that there is a correlation between the metacognitive skills and concept gaining of both the junior high school students and senior high school students.

3.2 Anova Test of the Regression Equations of the Correlation between metacognitive Skills and Concept Gaining of the Students in the twenty seven different Learnings
The Results of the analysis of variance related to correlation regression equations between metacognitive skills and concept gaining in the twenty seven different learnings are illustrated in Table 2.

Tabel 2. Summary of the ANOVA Test Result of the twenty seven Regression Equations of the Correlation between metacognitive Skills and Concept Gaining among junior and senior high School Students

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	130773,3	53	2467,421	45,91825	0,000
	b1,b2,b3,b4,b5	3902,784	1	3902,784	72,63008	0,000
	b1,b2,b3,b4,b5,b6,b7	42948,72	27	1590,693	29,60251	0,000
	Residual	39226,61	730	53,73509		
	Total	169999,9	783			

In order to obtain a clearer picture of the results of the regression equation difference of the 27 regression lines, the post hoc test was performed. Regression line of metacognitive skills and concept gaining can be seen in Figure 1.

In addition, to reveal the factors affecting the slope coefficient and the intercept of the regression equation of the correlation between metacognitive skills and concept gaining, the results of the analysis are grouped based on the same or different models, the same or different levels of education, the same or different class levels, and the same or different level of academic ability. The analysis was

done by looking at the regression lines formed, whether they are parallel and coincide, parallel not coincide or even intersect.
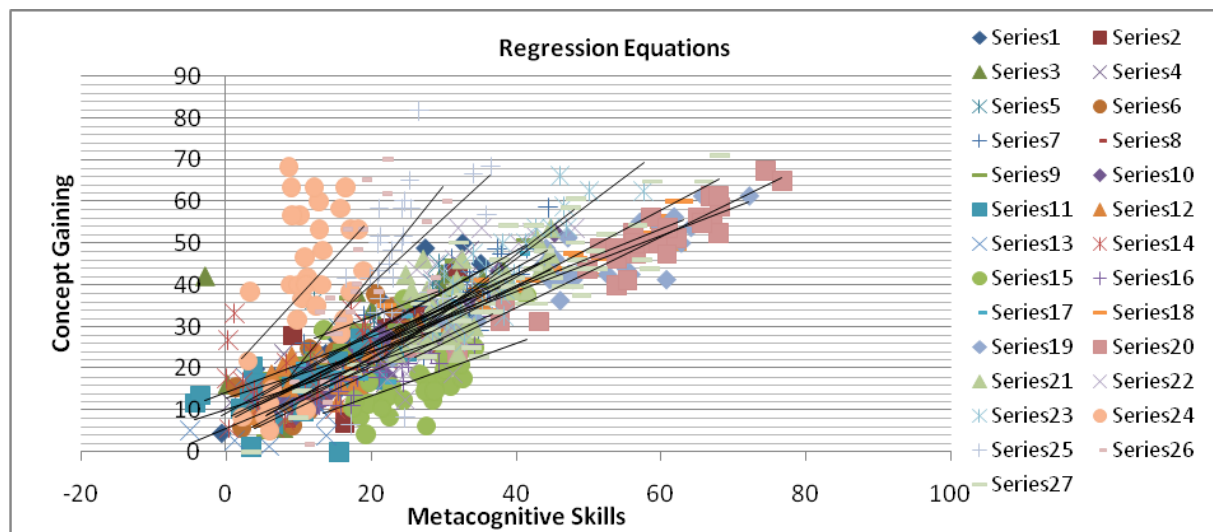

Figure 1. 27 Regression Line of Metacognitive Skills and Concept Gaining at The Implementation of Learning Models

There are some informations uncovered based on the analysis results of the parallelism and coincidence.

1. At the same level of education, the lines being compared are found to be parallel and coincide as much as 44%, parallel and not coincide as much as 33.34%, and intersect as much as 22.66%. At the different levels of education, it is also found that the lines being compared are parallel and coincide as much as 32%, parallel and not coincide as much as 46%, and intersect as much as 22%.

2. At the same level of class, the lines being compared are found to be parallel and coincide as much as 54%, parallel and not coincide as much as 28%, and intersect as much as 18%. Similarly, at different levels of class, the lines being compared are also found to be parallel and coincide as much as 34%, parallel and not coincide as much as 38.67%, and intersect as much as 27.33%.

3. Similarly, at the same academic ability, the lines being compared are found to be parallel and coincide as much as 75%, parallel and not coincide as much as 19.44%, and intersect as much as 5.56%. At the different academic ability, the lines being compared are found to be parallel and coincide as much as 59.53%, parallel and not coincide as much as 30.95%, and intersect as much as 9.52%.

4. At the same learning model, the regression lines being compared are found to be parallel and coincide as much as 28.2%, parallel and not coincide as much as 46.16%, and intersect as much as 25.64%. While at the different learning models, the regression lines being compared are found to be parallel and coincide as much as 44.58%, parallel and not coincide as much as 36.75%, and intersect as much as 18.67%.

Based on the four informations uncovered, it is obvious that related to levels of education, levels of class, academic ability and learning model, there are always regression lines which are parallel and coincide, parallel but not coincide, as well as intersect. These results revealed that levels of education, levels of class, academic ability and the learning model are not the factors affecting the slope coefficient or intercept.

4. Discussion

4.1 The Correlation between Students' metacognitive Skills and Concept Gaining

The results of the data analysis reveal that students' metacognitive skills have a correlation with concept gaining in each class studied. This information is in line with several previous researches, such as Zen stating that metacognitive skills have a correlation with learning results of elementary school students at the implementation of problem Based Learning (PBL) [16]. Moreover, Basith revealed that there was a correlation between metacognitive skills and learning results of elementary school students in Jigsaw learning model [17]. Another research by Arifin revealed that metacognitive skills had a correlation with learning results of senior high school students at the implementation of Reciprocal Teaching (RT) learning model [18]. Fauziyah revealed that metacognitive skills had a correlation with learning results of senior high school students in Think Pair Share (TPS) learning model, and Ardila also revealed that metacognitive skills had a correlation with learning results of senior high school students at the implementation of Thinking Empowering by Questioning (TEQ) [19-20]. Siswati and Corebima stated that there was a correlation between metacognitive skills and learning results of senior high school students and junior high school students in TPS learning model [15].

Hassan and Ahmed explained that students who had metacognitive knowledge development and metacognitive skill organization and able to use their metacognition, they would be able to control their academic abilities [21]. Efklides stated that the metacognitive skills of a person could be used to control his cognition [22]. Metacognitive processes such as planning, monitoring, reviewing, and evaluating and metacognitive experience is the central to adopt and initiate cognitive strategies. It is further explained that metacognition can increase the level of conscious control [23].

In relation to teaching metacognition to the learners, teachers require an understanding of metacognition. The knowledge of metacognition aims to help students achieving the learning objectives [24]. Teachers should initially understand the difference between metacognitive skills and learning strategies. Teachers can show the strategies implemented to students in the classroom, as well as the reason for the strategy to be implemented in the classroom.

4.2 Differences of the Regression Equations of the Correlation between Students' metacognitive Skills and Concept Gaining

In addition to simple linier regression, an ANOVA test is also performed on the regression equations of the regression lines (27 regression lines). The results of the analysis show that the 27 lines being compared are intersecting. To reveal the lines that cause the intersecting, the ANOVA test is performed on the regression equations of every two regression lines. The results of the analysis show that most of the regression lines being compared are generally parallel. This can be seen from the percentage of the parallel lines as much as 77.50%. In details, the percentage of the parallel and coincide lines is 42.17% and the percentage of the parallel and not coincide lines is 35.33%. While the percentage of regression lines which are intersect is only 22. 50%.

Based on the further analysis related to ANOVA test about the difference of regression equations of every two regression lines it is clearly seen that, the intersecting lines are generally found between regression line of some learning strategies. Those intersecting lines are generally found between regression line in relation to TPS learning strategy implemented in class X with other 8 learning strategies implemented in class VII, VIII, X, and XI; in relation to RT + TPS learning strategy implemented in class X with other 15 learning strategies implemented in class VII, VIII, X, and XI; in relation to RQA + PBL learning strategy implemented in class X with almost all other learning strategies implemented in class VII, VIII, X, and XI. Therefore it can be stated that there is a particular factor in the classes that have an effect on the value of the slope coefficient (slope) and the intercept, so that the value of the slope coefficient as well as the intercept value being compared is different from one another.

Related to the phenomena that there are parallel as well as intersecting regression lines it is due to the factors that affect it. In the previous researches, the factors thought to be correlated with the results are such as learning model implemented in the class, teachers' way of teaching, students' learning styles, academic ability, gender, school level, and ethnicity [15], The factors mentioned by Siswati and

Corebima are related to the external factors affecting the value of the slope coefficient and the value of intercept [15]. Kirchner explained that some of the factors that might affect the value of the slope coefficient and the value of the intercept were 1) errors during the measurement, which might occur related to a variety of things, such as during collection of data in the research, 2) the effect of shared variables on the X and Y, 3) the existence of the constrained variations on the X or Y, or both, 4) the serial correlation of the data [25].

In the classes where the regression lines are proved to be intersecting, several other factors were also observed by the researchers that might affect the slope coefficient as well as the intercept. In class X where the RT integrated with TPS learning strategy was implemented, teachers had difficulties in managing time during the learning process. In relation to the poor time management, Kirchner has mentioned that there was a certain cause that could affect the variables x and y together [25]. If the difficulty of time management occurs repeatedly during the research, it can affect the results obtained both in relation to x variable (metacognitive skills) and y variable (students' concept gaining). The effects which impact on the x and y variables can be stated as one of the factors affecting the slope coefficient and intercept.

In addition, teachers have difficulty in assessing students' assignments. The students' assignments tend to be more than the classes that implement the learning process by using a single learning model (not combination of learning models). It gives an impact on the empowerment of students' metacognitive skills and so it also affects students' concept gaining. Kirchner has said that the error in relation to the measurement could have an effect on the value of the slope coefficient and intercept [25].

On the learning using the integration of PBL and RQA learning model, it was also proven that there was a regression line intersected with the related regression line in other classes that used other learning models. The causes of the intersecting regression lines between PBL integrated with RQA learning model and several other learning models are that the learning indicators were not entirely achieved, partly because the students were too active to ask, especially since a lot of students asked about something outside the scope of the materials. Efklides explained that metacognition included monitoring and control functions [22]. The monitoring function included metacognitive knowledge and metacognitive experience, while the control function included metacognitive skills. It was further explained that metacognitive skills had a correlation with the control of one's awareness. These controls included the controls on using strategies, time allocation, and orientation, planning, organizing cognitive process and evaluating the results. Efklides and Petkaki described two metacognitive decisions associated in the form of difficulty in the prediction of awareness and estimation of the time required for completion of a problem [26]. Thus, when there was such a question, teachers should deftly direct the students back on the learning material being studied. The questions outside the scope of the learning material often frequently occur in the classroom, and almost at every meeting.

As what has been mentioned previously by Kirchner, one of the factors that may affect the slope coefficient and intercept is error during the measurement [25]. The measurements were performed using the research instruments, which are an instrument for measuring the metacognitive skills and the instrument to measure the concept gaining. The measurement instruments have been tested for the validity and reliability, so that in this case the instrument is not a factor supposed to influence the slope coefficient and intercept. The factors still associated with the instrument which are thought to have an effect is the way the researcher perform the measurement. The inconsistencies of the researcher during the measurement process related to the use of these instruments can affect the results of the assessment obtained. In this research, it can cause errors during the measurement.

4.3 Factors affecting the slope Coefficient and Intercept of the Correlation between Students' metacognitive Skills and Student's Concept Gaining
Based on the elaboration that has been stated in the previous discussion, it is clear that the factors affecting the slope coefficient and intercept on the research analyzed are related to an error of the measurement due to the inconsistency of the measurer in using the research instruments. Besides, there was shared variables that had an impact on the values of x and y. This is caused the learning indicators

were not entirely achieved, partly because the students were too active to ask, especially since a lot of students asked about something outside the scope of the materials. Thus, the factors that were initially supposed to affect the slope coefficient and intercept in this research (level of education, academic ability, grade level, and learning models) were, in fact, not the factors affecting the slope coefficient and intercept. Based on the analysis, it was proven that parallel and intersecting regression lines were found on each of these conditions).

5. Conclusion

Based on the results of this research, there are some conclusions described further.

1. There is a correlation between the metacognitive skills and concept gaining of students. Therefore, it can be concluded that, on various conditions, when investigating the correlation between metacognitive skills and concept gaining, it can be assured of getting the same result, which is a significant correlation between the two variables.
2. Among the 27 regression equations related to the correlation between metacognitive skills and concept gaining of the students undergoing various learning models, that have been analyzed, 77.50% of them are parallel, and only 22.50% of them are intersected. Therefore it can be concluded that the regression equations of the correlation between metacognitive skills and concept gaining will must always be parallel on any conditions. If there are regression equations intersected, there should be a particular factor that needs to be revealed causing the regression equations intersect.
3. The factors that have previously been thought to have an effect (the learning model, levels of education, grade level, and academic ability) are proved to be not the factors that affect the slope coefficient and the intercept of the regression equation of the correlation between metacognitive skills and concept gaining.
4. In this study one factor affecting the slope coefficients and intercept related to the regression equation of the correlation between metacognitive skills and concept gaining are the inconsistency in using the measuring instruments that cased errors in measurement, as well as the existence of the shared variables that have an impact on the value of x and y. The learning indicators were not entirely achieved, partly because the students were too active to ask, especially since a lot of students asked about something outside the scope of the materials.

Further studies are needed to uncover other factors more which can affect the slope coefficient and intercept related to the regression equation of the correlation between metacognitive skills and concept gaining, so the regression lines related to intersecting.

Acknowledgment

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