TÜRK FEN EĞİTİMİ DERGİSİ
Yıl 17, Sayı 4, Aralık 2020

Journal of
TURKISH SCIENCE EDUCATION
Volume 17, Issue 4, December 2020

http://www.tused.org

The Correlation between Metacognitive Skills and Cognitive Learning Results of Biology Pre-service Teachers on Different Learnings

Wulandari SAPUTRI[1], Aloysius Duran COREBIMA[2]

[1] Universitas Muhammadiyah Palembang, INDONESIA, ORCID ID: 0000-0002-2097-0384
[2] Universitas Kanjuruhan Malang, INDONESIA, ORCID ID: 0000-0002-2632-9467

Received: 22.04.2019 **Revised:** 09.04.2020 **Accepted:** 02.09.2020

The original language of article is English (v.17, n.4, December 2020, pp.487-503, doi: 10.36681/tused.2020.40)

Reference: Saputri, W., & Corebima, A.D. (2020). The Correlation between Metacognitive Skills and Cognitive Learning Results of Biology Pre-service Teachers on Different Learnings. *Journal of Turkish Science Education,* 17 (4), 487-503.

ABSTRACT

Several previous researches reported that there was a positive correlation between metacognitive skills and cognitive learning results. However, some others reported otherwise. This is believed to be related to the learning model used. This research aimed at revealing the correlation between metacognitive skills and cognitive learning results of pre-service teachers taught by using QASEE and RQA learning models, as well as by using conventional learning, and comparing the regression equations of the three learnings. 107 biology pre-service teachers at Universitas Islam Negeri Raden Fatah Palembang, Indonesia, were involved in this correlational study. Data were obtained by the essay test and were analyzed by simple linear regression analysis. The research result indicates that there is a significant correlation between metacognitive skills and cognitive learning results of the pre-service teachers taught by using the three learnings. It was also found that the regression equations uncovered at the three learnings was parallel and coincide. The contribution of metacognitive skills toward cognitive learning results uncovered in RQA learning model is the highest one among the three learnings preceded by that uncovered in QASEE learning model. This information is beneficial for lecturers in order to use the right learning model to empower pre-service teachers' metacognitive skills and cognitive learning results.

Keywords: Metacognitive skills, cognitive learning results, learning models, pre-service teacher.

INTRODUCTION

Metacognitive skills are defined as the skills to control cognitive processes during the learning process and problem solving behaviour (Veenman, 2012; Veenman et al., 2014). Metacognitive skills are also related to three other skills, namely planning, monitoring, and evaluation skills. Planning skills includes the skills in determining the appropriate strategies and allocating the appropriate resources for the learning process. Monitoring skills are related

Correspondence author e-mail: durancorebima@gmail.com

to the understanding and the performance in the learning process. Evaluation skills refer to the skills of assessing the results and the efficiency of learning (Vrugt & Oort, 2008). The development of these metacognitive skills, in the form of planning, self-monitoring, evaluation (Hrbáčková et al., 2012), and reflection (Martin-Gamez et al., 2016) must be facilitated by the education program of the pre-service teachers in Universities.

Metacognitive skills should be engaged in teacher education because they play a significant role in the academic success of pre-service teachers (Hrbáčková et al., 2012). Pre-service teachers who have good metacognitive skills will be able to perform well on their teacher education. This is because metacognitive skills make the pre-service teachers more flexible in thinking, especially in planning their learning (Chuvgunova & Kostromina, 2016). In addition, metacognitive skills help in the process of problem solving or completion of academic tasks (Tachie, 2019).

However, compared with metacognitive skills, cognitive learning results are given more attention and used as an indicator of learning success in many levels of education, including in Institute of Teachers' Education. Cognitive learning results are something obtained as a result of learning experience by an individual (Bahri & Corebima, 2015). Cognitive learning results are also associated with an individual's cognitive processes which include some levels: remembering, understanding, applying, analyzing, evaluating, and creating (Anderson & Krathwohl, 2001).

Many research results revealed that there is a correlation between metacognitive skills and cognitive learning results. In other words, cognitive learning results will increase when the metacognitive skills increase. This is in line with the research results conducted by Kusuma & Nisa (2018) which reporting that metacognitive skills are found to have a correlation in cognitive learning results with a regression equation Y = 1.2029X–29.395 and a contribution of 81.08%. Moreover, the results of research conducted by Nongtodu & Bhutia (2017) and Onyekuru & Njoku (2015) also showed a positive correlation between metacognitive skills and cognitive learning results. Besides, metacognitive skills as reported by Kristiani et al., (2015) have a bigger contribution towards cognitive learning results as much as 61.93%, compared to the contribution of scientific attitude as much as 9.49%. Furthermore, the research conducted by Siswati & Corebima (2017) found a positive correlation between metacognitive skills and concept gaining. Finally, Akyol et al., (2010) and Ghiasvand (2010) reported that the use of metacognitive strategies had an effect on science learning results.

Metacognitive skill is associated with an increase in cognitive learning results because it makes pre-service teachers more aware of their thinking processes, so that they try their best to complete each task as well as possible (Onyekuru & Njoku, 2015). In addition, it is also because metacognitive skill plays a key role in various cognitive activities such as, understanding, attention, communication, problem solving (Howard, 2004), and memory (Howard, 2004; Ohtani & Hisasaka, 2018).

A pre-service teacher knowing how to learn well will certainly have the confidence in the process of learning and teaching, and most importantly, always become a lifelong learners in order to improve their quality (Demirel et al., 2015; Martin-Gamez et al., 2016). Conversely, pre-service teachers having low metacognitive skills tend to have more hurdles in learning, because they fail to understand their cognitive processes. If this problem is not immediately realized, it will have a negative impact on their future career as a teacher. For example, being unable to choose the best strategy to teach their students (Tachie, 2019). Though being able to choose and use the right strategy is one of the characteristics of an effective teacher (Adu-Gyamfi, 2020). Thus, the development of metacognitive skills becomes very important so that cognitive learning outcomes also increase.

The results of further researches revealed that metacognitive skills and cognitive learning results do not have a direct correlation, but it is influenced by the learning model applied, such as RQA learning model (Bahri & Corebima, 2015), TEQI (Kristiani et al., 2015), guided inquiry (Sari et al., 2018), and constructivist-based learning models (Kusuma & Nisa, 2018). Nevertheless, the survey results conducted by Siswati & Corebima (2017) found that out of 26 learning models used in previous researches in different school level, 5 learning models did not show any significant correlation between metacognitive skills and concept gaining. Those learning models were PBL, E-portfolio with *lesson study*, RQA + TPS, PBL + NHT, and NHT learning models. This is in accordance with findings revealed by Siswati & Corebima (2017) that the regression equations of the correlation between learning variables at different learning models and school levels might be different. Therefore, the right learning models implemented are believed to be essential in supporting the achievement of the desired learning goals.

One of the learning models that has been proven to make a significant contribution toward the correlation between pre-service teachers' metacognitive skills and cognitive learning results is RQA learning model. (Bahri & Corebima, 2015). The syntax of RQA learning model consists of reading, questioning, and answering. In the reading stage, pre-service teachers are directed to make a resume of the reading passage. Then, it is followed by questioning and answering stages where pre-service teachers are directed to make a number of questions and search for the answers to the questions that they have made. Finally, the pre-service teachers present the results of their resumes, questions, and answers in front of the class (Bahri, 2016a; Corebima, 2016; Sumampouw et al., 2016).

In addition to RQA learning model, QASEE learning model is also proven to have a significant contribution. QASEE is a new constructivist based learning model developed by Saputri et al., (2020) whose syntax is adopted from RQA learning model. The syntax of the QASEE learning model consists of questioning, answering, sharing, evaluating, and extending activities. In the questioning and answering stages, pre-service teachers are encouraged to make a number of questions independently based on the reading passage and look for answers to the questions that have been made. At the sharing stage, pre-service teachers are directed to discuss the questions and answers with their group before they present the results of their work in front of the class. Then, at the extending stage, pre-service teachers are facilitated to apply the knowledge gained in the previous three stages to a new context. Finally, at the evaluating stage, pre-service teachers are directed to evaluate the whole learning processes. The overall syntax in the QASEE learning model has been reported having potential to improve the critical thinking skills of pre-service teacher with different academic abilities (Saputri et al., 2020). Furthermore, related research conducted by Amin et al., (2020) revealed that there was a correlation between metacognitive skills and critical thinking skills. Thus, the QASEE learning model is also believed to have the potential to improve metacognitive skills which will then have an impact on improving cognitive learning outcomes.

However, the research investigating the correlation between the two variables using QASEE model has never been conducted. Therefore, its potential still needs to be proven. Based on the description above, it is necessary to conduct a research to reveal the correlation between metacognitive skills and cognitive learning results using QASEE learning model, in comparison with RQA learning model, and conventional learning. In addition, this research was also aimed at revealing the differences in the regression equations of metacognitive skills and cognitive learning results in the three different learnings. The results of this research are expected to be a reference on how lecturers should develop classroom learning facilitating the improvement of metacognitive skills and cognitive learning results.

METHODS

a) Research Design

This research is a correlational research which aims at examining the correlation between metacognitive skills and cognitive learning results in different learnings, namely QASEE and RQA learning models, as well as conventional learning. In this research, the metacognitive skill was used as the predictor variable, while cognitive learning result was the criterion variable.

b) Population, Sample, and Procedure

This research was conducted during one semester at Universitas Islam Negeri Raden Fatah Palembang, Indonesia. The population of this research was all the pre-service teachers of Biology Education Program in the 2017/2018 academic year. The samples of this research were 107 pre-service teachers in the Animal Ecology Course. The samples of this research were randomly selected and spread in three different classes. Each class was taught by using different learnings, namely QASEE (38 pre-service teachers) and RQA (36 pre-service teachers) learning models, as well as conventional learning (33 pre-service teachers).

As already mentioned, this research was carried out in the Animal Ecology Course, related to the learning materials consisting of: animal and environment relationships, animal ecophysiology, animal habitat and ecology, animal diversity, population dynamics, population growth and change, organism interactions, community dynamics, and community structure and composition, energetics and animal ecology applications. The QASEE and RQA classes were taught directly by researchers, because the researchers understand the implementation of the two learning models better. While the conventional class was taught by the lecturer who usually taught the course. The learnings carried out in the three classes are described further.

The learning activities in the QASEE class include: (1) making 4-5 questions related to the animal ecology material to be learned, (2) answering questions that have been made, (3) discussing questions and answers in groups, and then presenting the results of the discussion in front of the class, (4) applying the knowledge that has been obtained from previous activities in different contexts, for example, by playing a role play as a zoo owner who wants to design a zoo for endangered animals, and (5) doing self-reflection on all learning activities that have been be carried out. Activity 1 and activity 2 are carried out independently at home.

The learning activities in the RQA class include: (1) reading and summarizing the learning material, (2) making 4-5 questions, (3) answering questions that have been made. All these activities are carried out at home independently, and the results of summarizing, questioning, and answering that have been made are presented in front of the class to get feedbacks.

The learning activities in the conventional class do not have special treatment like the ones in the QASEE and RQA learning classes. The learning activities include: discussion, presentation, and lecture. Each group of pre-service teachers takes turns in discussing and presenting the learning material during one semester. After the discussion and presentation activities, the lecturers give lectures to explain the learning material.

c) Research Instrument/Data Collection Tools

The data of pre-service teachers' metacognitive skills and cognitive learning results were collected using an integrated essay test supported with a specific rubric. The essay test consisted of 13 question items based on animal ecology material. Due to the limited time of the research preparation, the essay test was only validated by biology learning experts. The

results of the validation indicated that the essay test was valid and could be used for research. The validity of the instrument is mentioned to have an effect on the reliability of the instrument (Ursachi et al., 2015).

The rubric used to measure the pre-service teachers' metacognitive skills was developed by Corebima (2009), consisting of eight scales (0-7). The scoring was also done by using a formula developed by Corebima (2009), namely

$$\frac{y1 + 2x}{3} = y2$$

Description:

y1 = Score of cognitive learning results

y2 = Combination score of cognitive learning results and metacognitive skills

x = Score of metacognitive skills

Meanwhile, the rubric for cognitive learning results in this research adapted from Hart (1994) consisting of 5 scales (0-4). The data of metacognitive skills and cognitive learning results were collected in integrated way before and after the learning process.

d) Data Analysis

The data were analyzed by using simple linear regression to reveal the correlation between pre-service teachers' metacognitive skills and cognitive learning results. After that Anova test was performed on the regression equations to reveal whether or not the regression lines were parallel and coincide, and to reveal which learning model showed the highest correlation between pre-service teachers' metacognitive skills and cognitive learning results. Previously, the assumption tests were also carried out, namely the normality test and the homogeneity test. The data were analyzed by using SPSS 23 for Windows.

FINDINGS

a) The correlation between pre-service teachers' metacognitive skills and cognitive learning results in three different learnings

The QASEE Learning Model

The results of the regression analysis related to the correlation between pre-service teachers' metacognitive skills and cognitive learning results at the implementation of QASEE learning model are presented as follows (Table 1, 2, and 3).

Table 1. *Summary of Anova related to the correlation between metacognitive skills and cognitive learning results at the implementation of QASEE learning model*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	717.370	1	717.370	136.108	0.000[b]
	Residual	189.742	36	5.271		
	Total	907.112	37			

b. Predictors: (Constant), XKMETAQASEE

Table 2. *Regression coefficients of the correlation between metacognitive skills and cognitive learning results at the implementation of QASEE learning model*

	Unstandardized Coefficients		Standardized Coefficients		
	B	**Std. Error**	**Beta**	**T**	**Sig.**
(Constant)	5.894	5.684		1.037	0.307
Metacognitive Skills	1.004	.086	0.889	11.667	0.000

Table 3. *Summary of regression related to the correlation between metacognitive skills and cognitive learning results at the implementation of QASEE learning model*

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	0.889[a]	0.791	0.785	2.29578

a. Predictors: (Constant), XKMETAQASEE

Table 1 shows that there is a significant correlation between pre-service teachers' metacognitive skills and cognitive learning results at the implementation of QASEE learning model. Table 2 shows that the regression equation is Y = 1.004X + 5.894, and the Table 3 shows that the reliability value is 0.791. Thus, it can be concluded that metacognitive skills have a contribution as much as 79.1% toward the increase of pre-service teachers' cognitive learning results, and the remaining 20.9% is probably the contribution of the other factors, other than metacognitive skills.

The RQA Learning Model

The results of the regression analysis of the correlation between pre-service teachers' metacognitive skills and cognitive learning results at the implementation of RQA learning model are presented as follows (Table 4, 5, and 6).

Table 4. *Summary of Anova of the correlation between metacognitive skills and cognitive learning results at the implementation of RQA learning model*

Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	702.379	1	702.379	219.650	0.000[b]
	Residual	108.722	34	3.198		
	Total	811.101	35			

b. Predictors: (Constant), XKMETARQA

Table 5. *Regression coefficients of the correlation between metacognitive skills and cognitive learning results at the implementation of RQA learning model*

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	**Std. Error**	**Beta**		
(Constant)	3.670	4.426		0.829	0.413
Metacognitive Skills	1.024	0.069	0.931	14.821	0.000

Table 6. *Summary of regression of the correlation between metacognitive skills and cognitive learning results at the implementation of RQA learning model*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.931[a]	0.866	0.862	1.78822

a. Predictors: (Constant), XKMETARQA

Table 4 shows that there is a significant correlation between pre-service teachers' metacognitive skills and cognitive learning results at the implementation of RQA learning model. The regression equation found is Y = 1,024X + 3,670 (Table 5), and the reliability value is of 0.866. This can be interpreted that metacognitive skills have a contribution as much as 86.6% toward cognitive learning results, and the remaining 13.4% is probably the contribution of other factors, other than metacognitive skills.

Conventional Learning

The results of the regression analysis of the correlation between pre-service teachers' metacognitive skills and cognitive learning results at the implementation of conventional learning are presented as follows (Table 7, 8, and 9).

Table 7. *Summary of Anova of the correlation between metacognitive skills and cognitive learning results at the implementation of conventional learning*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	714.157	1	714.157	100.431	0.000[b]
	Residual	213.328	30	7.111		
	Total	927.485	31			

b. Predictors: (Constant), XKMETACONV

Table 8. *Regression coefficients of the correlation between metacognitive skills and cognitive learning results at the implementation of conventional learning*

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	-1.221	6.011		-.203	0.840
Metacognitive Skills	1.127	0.112	0.877	10.022	0.000

Table 9. *Summary of regression of the correlation between metacognitive skills and cognitive Learning results at the implementation of conventional learning*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.877[a]	0.770	0.762	2.66663

a. Predictors: (Constant), XKMETACONV

Table 7 shows that there is a significant correlation between pre-service teachers' metacognitive skills and cognitive learning results at the implementation of conventional learning. Then, Table 8 shows that the regression equation is Y = 1,127X-1,221; and the reliability value is 0,770 (Table 9), meaning that metacognitive skills have contribution as

much as 77% toward the increase of cognitive learning results, so the contribution of other factors, other than metacognitive skills is as much as 23 %.

b) Differences in the regression equations of the correlation between pre-service teachers' metacognitive skills and cognitive learning results at the implementation of the three different learnings

The results of Anova test on the regression line equations between metacognitive skills and cognitive learning results in the three different learnings are presented in Table 10. Table 10 shows that the regression line equations between metacognitive skills and cognitive learning results in the three learning models are parallel and coincide. In other words, the increase rate of the pre-service teachers' cognitive learning results due to the effect of metacognitive skills in QASEE, RQA, and conventional learnings is not significantly different. The graph of the regression equations of the three learnings can be seen in Figure 1.

Table 10. *Summary of Anova test on the regression equations of the correlation between metacognitive skills and cognitive learning results in the three different learnings*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5404.336	5	1080.867	211.193	0.000[b]
	b1,b2	5.265259358	2	2.63263	0.514394	0.599
	b1,b2,b3	21.39024216	4	5.347561	1.044869	0.388
	Residual	511.792	100	5.118		
	Total	5916.128	105			

b1, b2, b3 = Parameters that indicate the slope of the regression line

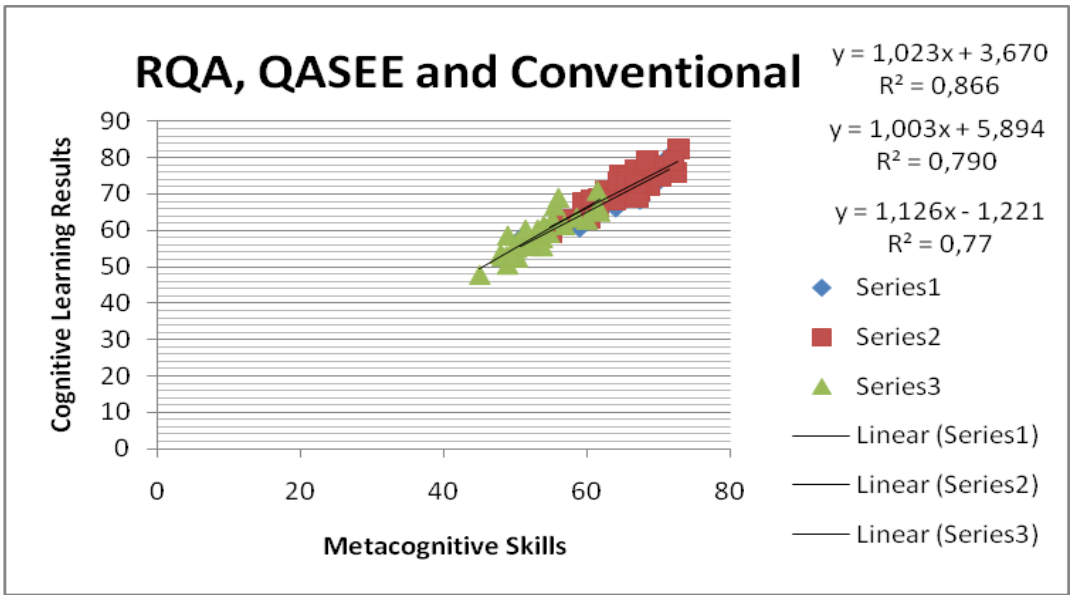

Figure 1. Graph of regression equations in QASEE, RQA, and conventional learning

DISCUSSION

a) The correlation between pre-service Teachers' metacognitive skills and cognitive learning results in the three different learnings

The results of the data analysis show that there is a significant correlation between pre-service teachers' metacognitive skills and cognitive learning results in the three learnings, namely QASEE, RQA, and conventional learnings. This finding is in line with several previous researches conducted by Bahri & Corebima (2015), Kusuma & Nisa (2018), Sari et al., (2018), and Siswati & Corebima, (2017). Kusuma & Nisa (2018) reported that the implementation of constructivism-based learning models was able to facilitate the correlation between pre-service teachers' metacognitive skills and cognitive learning results. Sari et al., (2018) using the guided inquiry learning model also reported similar results. In addition, Bahri & Corebima (2015) through using the implementation of the RQA learning model found that metacognitive skills had a higher contribution (91.38%) than learning motivation (0.51%) towards cognitive learning results. Moreover, Onyekuru & Njoku (2015) also stated that the correlation between metacognitive skills and cognitive learning results can also be facilitated through the application of metacognitive strategies, namely reading from planning, monitoring comprehension while reading, to evaluating reading results.

Metacognitive skills have a contribution toward the increase of the pre-service teachers' cognitive learning results because they are able to direct the pre-service teachers in the learning process. In this case, metacognitive skills play a role as the basis of cognitive activity, so that they are always aware of the most appropriate learning strategies to understand information more successfully (Tachie, 2019). Moreover, metacognitive skills have an effect on the results of pre-service teachers' cognitive learning because they play a role in long-term memory or retention (Bahri, 2016b; Palennari, 2016). The pre-service teachers' awareness of whether they understand particular information encourages them to constantly re-study the learning material, to change the learning strategy, until they finally understand it and able to absorb and store it in their long-term memory. As a result, the pre-service teachers get sufficient cognitive learning results/scores when taking a test.

The significant correlation between pre-service teachers' metacognitive skills and cognitive learning results in this research cannot be separated from the role of the implemented learning model. At the implementation of RQA learning model in this research, metacognitive skills had a contribution of 86.6% towards cognitive learning results. RQA learning model, like the results of the previous research, has been proven to be able to facilitate the correlation between pre-service teachers' metacognitive skills and biology cognitive learning results (Bahri & Corebima, 2015). In the reading activity, the pre-service teachers are indirectly forced to read and create a resume before attending the class. This activity facilitates pre-service teachers to build the initial knowledge of the material to be studied (Bahri, 2016a). Making a resume of the reading material also involves complex thinking activities in that the pre-service teachers must be able to express the main ideas of reading using their own words in their resume, not just copying from the text (Hariyadi et al., 2018). The questions generated from the reading activity and making a resume are the results of complex thinking activities in that the pre-service teachers are required to be aware of what is known and unknown, and then they need to find the answer. Thus, it is normal that the series of these activities have an effect on the increase of the pre-service teachers' involvement and performance in the classroom learning process (Sumampouw et al., 2016), empowerment of metacognitive skills (Bahri & Corebima, 2015; Sumampouw et al., 2016), and also retention of learning material (Palennari, 2016).

Then, at the implementation of QASEE learning model, metacognitive skills had a contribution of 79.1% towards cognitive learning results. QASEE learning model, as already mentioned, is developed to facilitate the pre-service teachers to construct knowledge through a series of syntax, namely questioning, answering, sharing, extending, and evaluating. Each stage of the syntax supports the potential of the QASEE learning model in contributing positively to the correlation between metacognitive skills and cognitive learning results. Several research results including Chin & Osborne (2008), Kaberman & Dori (2009), Song et al., (2017), and Bobby et al., (2007) report the positive benefits of questioning and answering activities. Making own questions after reading a text and answering the mentioned questions can help to improve the learning process in the classroom, while training the metacognitive skills (Chin & Osborne, 2008; Kaberman & Dori, 2009). This activity also encourages pre-service teachers to be more active in the learning activities (Song et al., 2017), so that they get better scores on cognitive learning results (Bobby et al., 2007).

Similarly, the sharing activity also produces the same results. This sharing activity is identical with cooperative learning that has been proven to be able to improve metacognitive skills and cognitive learning results (Anca & Preda, 2012; du Toit & Kotze, 2009). The sharing activity is reported to help pre-service teachers to monitor and evaluate each other's understanding (du Toit & Kotze, 2009). In addition, the sharing activity in small groups, which is conducted after making a number of questions independently, is also reported to be able to improve understanding of a topic, not only of the upper and middle but also the lower academic ability pre-service teachers (Bobby et al., 2007). The sharing activity is also reported to be able to increase the memorizing ability because this activity involves retrieval and rehearsal activities when the pre-service teachers explain their understanding to the peers (Schwartz et al., 2011).

The extending activity in the QASEE learning model is also reported to be an appropriate means for empowering pre-service teachers' metacognitive skills and cognitive learning results, because awareness of their cognitive processes is important in completing the tasks (Ramocki, 2007). Applying the obtained knowledge to a new context, especially related to daily life, can strengthen the understanding of the subject matter (Çepni et al., 2017; Curwen et al., 2010) and improve the transfer of learning (Butler et al., 2017; Çepni et al., 2017), where transfer learning is one of the important learning paradigms for the development of 21st century skills (Saavedra & Opfer, 2015).

The evaluating activity adopted from the PBL learning model also has some positive impacts on learning. Directing pre-service teachers to evaluate the entire learning process can improve self-reflection skills which also contributes to the improvement of the subsequent learning. In this case, self-reflection is also a part of metacognitive activity, so that this activity can indirectly become an effective means to train pre-service teachers' metacognitive skills (Martin-Gamez et al., 2016; Pantiwati & Husamah, 2017) and academic performance (Yusuff, 2015). Thus, the QASEE learning model is not only effective in facilitating the improvement of critical thinking skills (Saputri et al., 2020), but also in improving metacognitive skills and also cognitive learning outcomes.

Meanwhile, at the implementation of conventional learning, the contribution of metacognitive skills towards cognitive learning results is not much different from the contribution related to the QASEE learning model, which is 77%. This is in line with the results of the research conducted by Bahri & Corebima (2015) who found that the conventional learning had a bigger contribution (95.53%) than the PBL integrated with RQA learning model (75.92%), PBL (86.92%), and RQA (91.89%). Bahri & Corebima (2015) believed that the pre-service teachers were not yet accustomed to the implementation of learning models requiring pre-service teachers to perform authentic

tasks, and that they were accustomed to learning in their "comfort zone", i.e. learning dominated by lecturing activities. It is believed that such thing also occurred in this study. The QASEE learning model requires the pre-service teachers to have initial knowledge since they are at home rather than when they are in the classroom. This might be difficult for some pre-service teachers who are accustomed to entering the classroom without having sufficient initial knowledge. Pre-service teachers also seemed unfamiliar with several other activities, such as extending and evaluating.

Although the contribution of conventional learning toward the correlation between metacognitive skills and cognitive learning results is not small, it is not recommended to be implemented in the classroom learning any longer. The conventional learning is not in accordance with the concept of 21st century learning which is active learning and requires the empowerment of metacognitive skills. Moreover, conventional learning is not able to provide real experiences like what the constructivist based learning model is (Koçak Altundağ, 2018; Khalid & Azeem, 2012, Muhlisin et al., 2018, Yanti et al., 2019). The big contributions of the conventional learning toward metacognitive skills could also occur due to the effect of other factors, either internal or external factors, which were not examined in this research. These factors are such as academic ability, gender, age, learning styles, ethnicity, learning time, group work/peers, and learning material (Siswati, 2014; Siswati & Corebima, 2017).

b) Differences in the regression equations of pre-service teachers' metacognitive skills and cognitive learning results in the three different learnings

The results of data analysis show that the regression equation lines of the correlation between metacognitive skills and cognitive learning results in the QASEE, RQA, and conventional learnings are parallel and coincide. It means that the three learnings have the same value of slope and intercept; the increase rate of the pre-service teachers' cognitive learning results due to the effect of metacognitive skills in the three learnings is not significantly different from each other.

These results might be caused by the similarity of the factors affecting the values of slope and intercept in the regression equation of $y = ax + b$ even though the used learning type is different. These factors include the number of samples, lecturer factors, and pre-service teachers' factors. As stated by Guilford (1942) in a research activity, education in particular, one variable can have a correlation with many other variables. The dependent variable/criterion cannot be adequately explained by only one or two predictor variables (Schneider et al., 2010).

In this research the pre-service teachers' factor, especially academic ability, is believed to have the most significant effect on the slope and intercept (Siswati, 2014; Siswati et al., 2016). Differences in academic abilities are reported to determine the selection and use of metacognitive strategies in the learning process. This condition causes the upper academic ability of pre-service teachers to have higher metacognitive skills and tend to be more accomplished than those with lower academic abilities (Ghiasvand, 2010). The pre-service teachers who have high metacognitive skills also tend not to over-confident about the results of their work because they are aware of their weaknesses (Amzil & Stine-Morrow, 2012). This condition makes the pre-service teachers having high metacognitive skills tend to be academically successful (Demirel et al., 2015) even estimated up to 90% of their variability (Hrbáčková et al., 2012).

However, the contribution of metacognitive skills toward cognitive learning results uncovered in RQA learning is the greatest one compared to that is uncovered in QASEE and conventional learnings. RQA is a constructivist based learning model that is intentionally designed to make pre-service teachers better prepared in the classroom learning (Corebima, 2016; Hariyadi et al., 2018). RQA is proven to be able to empower pre-service teachers' metacognitive skills because its syntax directs pre-service teachers to self-assess their own understanding through reading activities, making resumes, making questions, and answering questions independently (Sumampouw et al., 2016). The increase of the pre-service teachers' metacognitive skills eventually improves cognitive learning results (Bahri, 2016a; Bahri & Corebima, 2015) and memorizing ability (Palennari, 2016).

Although not as big as the potential of RQA learning model, QASEE learning model also has the potential to improve pre-service teachers' metacognitive skills and cognitive learning results. The potential effectiveness of the QASEE learning model is inseparable from its syntax which encourages pre-service teachers to be actively involved in learning to construct knowledge both individually and in groups. This is in line with the results of the meta-analysis conducted by Semerci & Batdi (2015) reporting that pre-service teachers will be more academically successful and have good retention when they are given a constructivist learning approach experience. The pre-service teachers taught by using traditional approaches tend to achieve lower learning result scores (Khalid & Azeem, 2012) and lower metacognitive skills score (Muhlisin et al., 2018). However, the pre-service teachers taught by using constructive approaches obtain better learning results and are believed to have more potential to implement the learning gained during their education to their students in the future.

The effectiveness of the QASEE learning model is also related to its syntax that has been developed by considering several metacognitive strategies in order to train metacognitive skills, such as self-questioning, self-testing, self-monitoring, and self-evaluating (Chin & Osborne, 2008) and self-reflection (Martin-Gamez et al., 2016; Pantiwati & Husamah, 2017; Yusuff, 2015). This is in accordance with the statement that metacognitive skill is not a gift (from birth), but it can be empowered by using metacognitive strategies (Kaberman & Dori, 2009). Thus, the QASEE learning model is potential to improve pre-service teachers' metacognitive skills and cognitive learning results so that it is essential that it be induced into the education program of pre-service teachers.

CONCLUSION and RECOMMENDATIONS

Metacognitive skills are the key to academic success. Metacognitive skills can be improved by applying learning models that support pre-service teachers to construct their own knowledge. QASEE as a new constructivist-based learning model is believed to have the potential to facilitate the improvement in the scores of metacognitive skills and cognitive learning results.

The results of this research indicate that there is a significant correlation between metacognitive skills and cognitive learning results of the pre-service teachers taught by using QASEE learning model, with relatively high contributions of 79%. The same correlation was also found in pre-service teachers who were taught by using the RQA learning model and conventional learnings with the contribution of metacognitive skills of 86.6% and 77%. Moreover, the results of post hoc analysis reveal that the regression equations of the three learnings are parallel and coincide and the highest position of contribution is uncovered in the RQA learning model. This indicates that RQA is the most effective learning model in facilitating the empowerment of pre-service teachers' metacognitive skills and cognitive

learning results. Nevertheless, QASEE can still be considered as an alternative learning model that is also have potential to empower metacognitive skills and cognitive learning results. Though the conventional learning could facilitate the correlation between the two variables, this learning model should be abandoned, because conventional learning is not in accordance with the view of constructivism and 21st century learning paradigms.

Therefore, it is recommended that lecturers of institute of education program select and apply the appropriate learning models, including QASEE and RQA, to improve pre-service teachers' metacognitive skills and cognitive learning results. Certainly, the implementation of any learning model, especially QASEE, is expected to be carried out continually, so that the pre-service teachers become more accustomed to its implementation, and it will have a more significant effect on pre-service teachers' metacognitive skills and cognitive learning results.

In addition, Guilford (1942) and Schneider et al., (2010) who say that one criterion variable can be influenced by several predictor variables at once, it is believed that there are also other factors in addition to metacognitive skills or learning models that also influence the improvement of cognitive learning results. The other factors which need to be investigated further through including the academic ability, critical thinking skills, retention, etc. which are analyzed by multiple linear regression.

ACKNOWLEDGEMENT

The researchers would like to thank to the Institute of the Indonesian Endowment Fund for Education (LPDP) in relation with their support for the completion of this research.

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APPENDICES

The Differences of QASEE Learning Model, RQA Learning Model, and Conventional Learning

No	Differences	QASEE Learning Model	RQA Learning Model	Conventional Learning
1	Learning Syntax	QASEE learning model is a new learning model based on constructivism. The activities in the QASEE learning model are pre-service teachers centered. The learning syntax consists of: • Questioning • Answering • Sharing • Extending • Evaluating	RQA learning model is a constructivist-based learning model. This model has been proven having potential to improve pre-service teachers' metacognitive skills and cognitive learning results. The learning activities consist of: • Reading • Questioning • Answering	The conventional learning model in this research is the learning activities that are generally carried out by lecturers without involving certain learning models. The learning activities include: discussions, presentations, and lectures.
2	Lecturer role	In the QASEE learning model, the lecturer directs and motivates pre-service teachers to do the learning activities according to the learning syntax. Including motivating pre-service teachers to evaluate their learning independently through the evaluating activity.	In the RQA learning model, the lecturer directs and motivates pre-service teachers to do the learning activities according to the learning syntax.	In the conventional learning, the lecturer directs and motivates pre-service teachers to do discussions and presentations. After the discussion and presentation activities, the lecturer quite dominantly continues giving explanation about the learning material with lecturing activity.