QASEE: A Potential Learning Model to Improve the Critical Thinking Skills of Pre-service Teachers with Different Academic Abilities

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Abstract: Research on critical thinking skills has been frequently carried out, but it has not shown maximum results. This problem is exacerbated by the differences in pre-service teachers' academic abilities. A new learning model that can improve pre-service teachers' critical thinking skills and reduce the gap in critical thinking skills among the upper, middle, and lower academic ability pre-service teachers is needed. This research aims at exploring the potential of the QASEE learning model on the critical thinking skills of different academic ability. This quasi-experimental research involved 107 pre-service teachers of Universitas Islam Negeri Raden Fatah, Indonesia. The research classes were divided into three classes, namely the QASEE class (experimental class), the RQA class (positive control class), and the conventional class (negative control class). Each class was further divided into upper, middle, and lower academic categories. The data were collected using an essay test supported by a critical thinking skill rubric. The data were analyzed by using ANCOVA and followed by LSD test. The research results show that the QASEE (Questioning, Answering, Sharing, Extending, and Evaluating) learning model can improve and equalize the critical thinking skills of pre-service teachers with various academic levels. Thus, the QASEE learning model can be used as a new reference to improve pre-service teachers' critical thinking skills, especially the lower academic ability.

Keywords: *Academic ability, critical thinking skills, learning model, pre-service teachers, teacher education.*

Introduction

As already known, each level of education in many countries equip their students/graduates with the various skills needed to live in the 21 century. One of the 21st century skills which is essential to be possessed is the critical thinking skill. Critical thinking is associated with decision-making efforts related to a matter by reflecting rational and logical thinking (Ennis, 1993). Furthermore, critical thinking skills are broken down into: interpretation, explanation, analysis, inference, evaluation, and self-regulation activities (Facione, 2011). Critical thinking, is also associated with cognitive thinking skills (such as logical thinking, problem solving, etc.), intellectual autonomy (as having ideas, having good reasons to support the ideas, etc.), and the omnipresence of positive and negative aspects (such as considering certain aspects in the decision making process) (Chen, 2017). Moreover, critical thinking is associated with in-depth analysis efforts and non-subjective judgments to make the right decision (D'Alessio et al., 2019). Thus, it can be concluded that critical thinking is a thinking skill that involves cognitive activities by considering logical and objective aspects in order to obtain a reliable conclusion.

In the past five years critical thinking has become one of the most important skills to be developed (Butler et al., 2017; Tican & Deniz, 2019). Recent research shows that critical thinking skills are very important in the workplace. Critical thinking skills are reported to get high points during job interviews because they can be an asset for employees to solve problems and to find appropriate multi-solutions (Pearl et al., 2019). Critical thinking skills are also claimed to be essential in the decision making process because they can reduce the risk of failure and also contribute to the formation of self-regulated workers (Penkauskiene et al., 2019). In addition, critical thinking skills are also reported to have more effects on the decision making process related to real world problems compared to mere intelligence factors (Butler et al., 2017).

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In LPTK (Indonesia: Institute of Teacher's Education), the pre-service teachers who have good critical thinking skills are also believed to be able to overcome the challenges of life and to have successful careers in the 21st century (Kadir, 2017; Tican & Deniz, 2019); as two aspect of critical thinking skills the analyzing and evaluating skills can be used as important tool to develop teachers' professional competence {Formatting Citation}. In addition, critical thinking skills are reported to have a positive contribution toward teacher professional identity, which includes subject matter, didactical, and pedagogical fields (Sheybani & Miri, 2019). Therefore, it is appropriate that the critical thinking skills are used as the main objectives of the teacher education program in many countries (Butler et al., 2017; Lorencova et al., 2019; Sheybani & Miri, 2019).

Interestingly, it is reported that pre-service teachers' critical thinking skills are still at the medium to low levels (Alkharusi, 2019; Cansoy et al., 2018; Sari et al., 2019). Likewise in Indonesia, some researchers report that pre-service teachers' have critical thinking dispositions (As'ari et al., 2017); and critical thinking skills are still underdeveloped (Saefi et al., 2017; Sari et al., 2019), especially in the aspect of inference (Saefi et al., 2017) and self-regulation (Nuraini, 2017). Moreover, there was a research result showing that more than 40% of pre-service teachers are unsure of their own readiness to teach critical thinking skills to their students in the future (Kusaeri & Aditomo, 2019).

This fact indicates that critical thinking skills are apparently still not fully empowered by the teacher education programs in Indonesia. The pre-service teachers who learn by using memorization-oriented learning approaches without involving high-order thinking processes are also believed to apply such learning approaches to their future students (Kusaeri & Aditomo, 2019). If not resolved immediately, this condition is believed to have an impact on the students' critical thinking skills in the future (Furness et al., 2017; Saefi et al., 2017).

In addition to critical thinking, another problem faced in Indonesian education is that the classes in the Institute of Teacher's Education (LPTK) generally consist of pre-service teachers with different academic abilities. The academic ability itself is illustrated with academic performance (D'Alessio et al., 2019) and learning achievement (Fong et al., 2017). Academic ability is believed to be associated with critical thinking skills (Alkharusi, 2019; Permana et al., 2019; Tanujaya et al., 2017). Upper academic ability pre-service teachers generally have sufficient prior knowledge, so that they tend to have better critical thinking skills than the lower academic ability (Mahanal et al., 2019; Zubaidah et al., 2018). Academic ability is even reported to have a bigger contribution toward the improvement of pre-service teachers' critical thinking skills than does the mere mastery of the concepts (Permana et al., 2019).

The difference in academic ability on the one hand is very beneficial, because lower academic ability pre-service teachers can learn from those with high academic ability. On the other hand, the lecturers tend to be reluctant to provide a challenging learning experience because they believe that the lower academic ability pre-service teachers will not be able to complete the tasks. If this belief continues to be maintained, the academic achievement of the lower academic ability will continue to suffer, and they will have difficulty to improve as critical teachers (Permana et al., 2019).

The problems with critical thinking skills and the difference in pre-service teachers' academic ability can be overcome by applying constructivism-based learning (Kusaeri & Aditomo, 2019; Mahanal et al., 2019; Prayogi et al., 2019; Vong & Kaewurai, 2017; Zubaidah et al., 2018). Two constructivism-based learning models believed having potential to improve pre-service teachers' critical thinking skills are the RQA and QASEE learning models. Both of these learning models were selected because they prioritize the importance of self-preperation with the adequate prior knowledge before joining a class. This is in line with Kusaeri & Aditomo (2019) as well as Mahanal et al., (2019) saying that critical thinking skills require sufficient initial knowledge to develop. A more detailed explanation of the RQA and QASEE learning models is described as follows).

RQA (Reading, Questioning, and Answering) learning model has been proven effective to improve pre-service teachers' critical thinking skills (Amin et al., 2020; Thalib et al., 2017). The syntax of the RQA learning model consists of reading, questioning, and answering activities that are primarily developed to make the pre-service teachers better prepared to participate in learning (Thalib et al., 2017). The syntax already contains the aspects needed to foster critical thinking skills. However, there are several aspects of critical thinking that have not been touched by RQA. It is reported that critical thinking skills can be developed through a learning model which is not only active and challenging but also facilitates pre-service teachers to work in groups (Vong & Kaewurai, 2017). Pre-service teachers' critical thinking skills can also be strengthened through self-reflection activities at the end of the learning process (Tican & Taspinar, 2015; ZivkoviĿ, 2016). Besides, (Sandrawati, 2018) stated that group work and social interaction have not been facilitated in the RQA learning model.

A new learning model which is potential and fulfills these critical thinking aspects is QASEE learning model. The QASEE learning model is designed to develop pre-service teachers' thinking skills through constructive experiential learning, which is: (1) thinking about the questions relating to the learning material that has not been understood (Questioning),(2) searching for the answers to questions that have been written independently (Answering),(3) sharing information with group members followed by a presentation to the class (Sharing),(4) strengthening comprehension through knowledge transfer activity (Extending),and (5) doing evaluation independently after a series of learning activities (Evaluating).The five activities are described as follows.

The first stage of the QASEE learning model is the questioning activity. This activity is believed to be associated with critical thinking skills, where the levels of pre-service teacher questions show the levels of their critical thinking skills. It is reported that 38% of the university students very agree and 41% of the university students agree that the activity of making high-level questions, though difficult, helps construct their critical thinking skills (DeWaelsche, 2015). In addition, the questioning activity is also reported as an effective learning method and is favored by university teachers to improve critical thinking skills (Bezanilla et al., 2019).

The second stage of the QASEE learning model is answering activity. The questioning activity together with answering activity are the reading strategies which have been proven effective in practicing to be a critical reader (Akkaya, 2012); when making questions, the pre-service teachers are required to initially read and understand the learning material, analyze it, evaluate it, and then make relevant questions. Likewise, when answering questions, the pre-service teachers are required to be able to choose and pick information that is appropriate and relevant to the context in questions. The questioning and answering activities can be used as a bridge to develop initial knowledge which then can be used to increase involvement in the next learning stage (sharing activity).

The third stage of QASEE learning model is sharing. The sharing activity which is identical with cooperative learning has been proven to be more powerful in improving pre-service teachers' critical thinking skills than the conventional learning (Kim et al., 2013; Vong & Kaewurai, 2017; Zubaidah et al., 2018). This is because the social interaction which facilitates mutual knowledge dialogue among peers provides scaffolding to improve their thinking skills, especially thinking in order to provide logical arguments against the arguments expressed by peers (Vygotsky, 1978). Asking questions and providing arguments to defend each other's opinions ultimately helps to build their reasoning and critical thinking skills (Kusaeri & Aditomo, 2019).

The fourth stage of the QASEE learning model is extending. Extending in this research is described as the activity of applying knowledge that has been obtained in the earlier stages to a new context related to real world problems. This activity can also be used as a tool to measure pre-service teachers' concept gaining (Cepni et al., 2017). This activity is also believed to contribute to the improvement of pre-service teachers' critical thinking. This is in line with the opinion which found that involving pre-service teachers in active learning, challenging their thinking processes, and facilitating cooperation in groups lead to an increase in their critical thinking skills (ZivkoviL, 2016).

The final stage of QASEE learning model is evaluating. Evaluating, especially self-reflection, is theoretically a self-evaluation activity which is essential for maximizing the zone of proximal development (ZPD) (Vygotsky, 1978). Self-reflection activity which is carried out following learning activities has been proven effective in upgrading critical thinking skills (Vong & Kaewurai, 2017). This is because critical thinking and reflective thinking are identical and occur simultaneously, so that the pre-service teachers who are taught reflective thinking will automatically have better critical thinking skills than those who are not (Tican & Taspinar, 2015).

However, the effectiveness of the QASEE learning model in improving the critical thinking skills of pre-service teachers has never been statistically tested. Therefore, this research was conducted to answer the following research questions:

1. Is there any difference in critical thinking skills among the pre-service teachers taught by using the QASEE learning model, RQA learning model, and conventional learning?

2. Is there any difference in critical thinking skills among the upper, middle, and lower academic ability pre-service teachers?

3. Is there any difference in pre-service teachers' critical thinking skills as a result of the interaction between learnings and academic abilities?

It is expected that the results of this research can be used as a reference for the authorities in charge of teacher education program related to curriculum and learning development to promote higher-order thinking skills, especially critical thinking skills, with different academic levels.

Methodology

Research Goal

The main purpose of this research is to investigate the potential of the QASEE learning model on the critical thinking skills of different academic ability. In order to achieve the main objective, it is further divided into three sub-objectives, including: (1) Analyzing differences in critical thinking skills among the pre-service teachers taught by using the QASEE learning model, RQA learning model, and conventional learning, (2) Analyzing differences in critical thinking skills among the upper, middle, and lower academic ability pre-service teachers, dan (3) Analyzing differences in pre-service teachers' critical thinking skills as a result of the interaction between learnings and academic abilities.

Research Design

This research is a quasi-experimental research with pretest-posttest nonequivalent control group design of 3x3 factorial. Learning models and academic abilities were used as the independent variables, and critical thinking skills were used as the dependent variable. The design of this research is presented in Table 1.

Table 1. Quasi-experimental Research Design

Pretest	Groups	Posttest
O1	X1Y1	O2
O3	X1Y2	O4
O5	X1Y3	O6
O7	X2Y1	O8
O9	X2Y2	O10
O11	X2Y3	O12
O13	X3Y1	O14
O15	X3Y2	O16
O17	X3Y3	O18

Description:

O1, 3, 5, 7, 11, 13, 15, 17 = pretest

O2, 4, 6, 8, 10, 12, 14, 16, 18 = posttest

X1 = QASEE learning model

X2 = RQA learning model (positive control)

X3 = conventional learning (negative control)

Y1 = Upper Academic Ability

Y2 = Middle Academic Ability

Y3 = Lower Academic Ability

Sample and Data Collection

The population of this research was the pre-service teachers in the Biology Education Study Program, Universitas Islam Negeri Raden Fatah, Indonesia, in the 2018/2019 academic year, with a total sample of 107 pre-service teachers. The sampling technique used in this research was the convenience sampling technique. This technique was chosen because among the available universities, only the selected university had three parallel classes needed in this research purposes. The three classes were then given different treatment. First class was taught by using QASEE learning model, second class was taught by using RQA learning model, and the third class was taught by using conventional learning. The RQA learning model was used as a comparative learning model in addition to the conventional learning. The RQA learning model served as a positive control which has been proven to improve pre-service teachers' critical thinking skills. Moreover, each class was further divided into three groups based on the academic ability (upper, middle, and lower) of the pre-service teachers based on the results of a placement test.

The pre-service teachers' critical thinking skills were measured by the pretest and posttest using essay tests. The essay test had been validated by the learning experts and was declared valid to be used in this research. A valid instruments lead to a reliable instruments (Ursachi et al., 2015). The answers of the essay test were scored based on the critical thinking skill rubric (Zubaidah et al., 2015), which is modified from Illinois Critical Thinking Essay Test (Finken & Ennis, 1993). The score range in the rubric is 0-5 with the components: (1) focus, (2) supporting reasons and reasoning, (3) organization, (4) conventions and, (5) integration.

Analyzing of Data

The data of the critical thinking skills were then analyzed using analysis of covariance (ANCOVA) related to the effect of learnings, academic abilities, and the interaction between learnings and academic abilities on the critical thinking skills of pre-service teachers. This analysis was carried out to test the pre-determined hypothesis, namely (1) there is a difference in critical thinking skills among the pre-service teachers in the QASEE learning model class, in the RQA learning model class, and in the conventional learning class, (2) there is a difference in critical thinking skills between the upper, middle, and lower academic ability pre-service teachers, (3) there is a difference in critical thinking skills of pre-service teachers related to the interaction between learnings and academic abilities. However, before the data were analyzed, the normality and the homogeneity of the data were tested. The posthoc analysis was carried out by using the LSD test.

Findings

The analysis results related to ANCOVA are presented in Table 2.

Table 2. The Results of ANCOVA related to the critical Thinking Skills

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10402.385[a]	9	1155.821	37.854	.000
Intercept	5173.566	1	5173.566	169.439	.000
Critical Thinking	1434.803	1	1434.803	46.991	.000
Learnings	5415.916	2	2707.958	88.688	.000
Academic Ability (AA)	968.098	2	484.049	15.853	.000
Learnings *AA	599.281	4	149.820	4.907	.001
Error	2961.751	97	30.534		
Total	372906.250	107			
Corrected Total	13364.136	106			

The data in Table 2 show the following information. First, with regard to the source of the learning model, the p-level value is smaller than alpha 0.05, which is 0.000, so that the alternative hypothesis is accepted. This means that there is a difference in the critical thinking skills of pre-service teachers after they are taught by using QASEE learning model, RQA learning model, and conventional learning. But interestingly, the corrected mean score of the critical thinking skills of pre-service teachers who learned by using the QASEE learning model is 12.80% higher than that of the pre-service teachers who learned by using RQA learning model, and 36.93% higher than that of the pre-service teachers who learned by using conventional learning. This can be seen from the results of the LSD test related to the effect of learnings on critical thinking skills presented in Table 3 below.

Table 3. The Results of the LSD Test related to the Effect of Learnings on critical Thinking Skills

No	Learning	XKritis	YKritis	Difference	KritisCor	LSD Notation		
1	QASEE	27.6974	66.9079	39.2105	66.046	a		
2	RQA	26.1806	58.2639	32.0833	58.549		b	
3	Conv	25.6818	47.3485	21.6667	48.232			c

Second, based on Table 2 also, it can be seen that the academic ability has a p-level value of 0,000, which is smaller than alpha 0.05. This indicates that there is a difference in critical thinking skills among the upper, middle, and lower academic ability pre-service teachers. The results of the LSD on Table 4 indicates that the corrected mean score of the upper academic ability is 7.23% higher than that of the middle academic ability pre-service teachers, and 13.72% higher than that of the lower academic ability pre-service teachers.

Table 4. The Results of the LSD Test related to the Effect of academic Ability on critical Thinking Skills

No	Academic Ability	Xkritis	YKritis	Difference	KritisCor	LSD Notation		
1	Upper	28.1081	62.7703	34.6622	61.465	a		
2	Middle	26.2121	57.6515	31.4394	57.316		b	
3	Lower	25.3378	53.4459	28.1081	54.046			c

Third, based on Table 2 also, related to the interaction between learning models and academic abilities, the p-level value obtained is 0,000, which is smaller than alpha 0.05. This means that there is a difference in the effect of the interaction of the two variables on the critical thinking skills of pre-service teachers. The results of the LSD test related are presented in Table 5.

Table 5. The Results of the LSD Test related to the Effects of the Interaction between Learnings and Academic Ability toward critical Thinking Skills

No	Learning	Academic Ability	X Critical	Y Critical	Difference	Critical Cor	LSD Notation			
1	QASEE	Upper	29.4231	69.6154	40.1923	67.499	a			
2	RQA	Upper	27.5	67.0833	39.5833	66.391	a			
3	QASEE	Lower	26.1538	65.1923	39.0385	65.497	a			
4	QASEE	Middle	27.5	65.8333	38.3333	65.141	a			
5	RQA	Middle	25.4167	55.2083	29.7916	56.059		b		
6	RQA	Lower	25.625	52.5	26.875	53.196		b	c	
7	Conv	Middle	25.5556	50	24.4444	50.748			c	
8	Conv	Upper	27.2917	51.0417	23.75	50.504			c	
9	Conv	Lower	24.1667	41.6667	17.5	43.443				d

Several important points can be highlighted from Table 5 as outlined below. First, the highest corrected mean score of critical thinking skills is found at the combination group of the QASEE learning model and upper academic ability. While the lowest corrected mean score of critical thinking skills is found at the combination group of conventional learning and lower academic ability.

Secondly, based on the notations obtained, it appears that the combination group of the QASEE learning model and upper academic ability, QASEE learning model and middle academic ability, as well as QASEE learning model and lower academic ability is not significantly different. This can be interpreted that the QASEE learning model can facilitate the pre-service teachers at various levels of academic ability to improve their critical thinking skills.

Third, based on the notations obtained, the combination group of the RQA learning model and upper academic ability is significantly different from the combination group of RQA learning model and middle academic ability as well as the combination group of RQA learning model and lower academic ability. Even so, the RQA learning model is able to equalize the critical thinking skills between the lower academic ability pre-service teachers and the middle academic ability pre-service teachers. Moreover, the RQA learning model also makes the critical thinking skills of the lower academic ability pre-service teachers equal to the critical thinking skills of the upper and middle academic ability pre-service teachers in the conventional learning.

Fourth, the conventional learning, as presented in Table 3, does not have a positive effect on the pre-service teachers' critical thinking skills at various levels of academic ability. The conventional learning does not only lower the critical thinking skills of the lower academic ability pre-service teachers, but it also has adverse effects on the upper academic ability pre-service teachers.

Thus, it can be concluded that the implementation of certain learning models is more capable of equalizing the achievements among the lower academic ability pre-service teachers, middle academic ability pre-service teachers, and upper academic ability pre-service teachers compared to the conventional learning model. In this case, the most potential learning model to empower the critical thinking skills of different academic ability pre-service teachers is QASEE learning model, followed with the RQA learning model.

Discussion

Learning Models and critical Thinking Skills

The results of ANCOVA analysis indicate that the critical thinking skills of the pre-service teachers taught by using the QASEE learning model, RQA learning model, and conventional learning are significantly different from each other. However, based on the corrected mean scores, the QASEE learning model has the most potential in upgrading the pre-service teachers' critical thinking skills, and then followed by the RQA learning model. This finding is in line with the research results by (Amin et al., 2020; Ichsan et al., 2019; Kwan & Wong, 2015; Mahanal et al., 2019; Prayogi et al., 2019; Sari et al., 2019; Zubaidah et al., 2018) who reported that critical thinking skills could be trained by conditioning individuals in constructivist-based learning environments through the implementation of certain learning models.

The success of the QASEE learning model in improving the pre-service teachers' critical thinking skills is inseparable from its learning syntax, which as mentioned earlier consists of questioning, answering, sharing, extending, and evaluating. The learning syntax has provided space for the pre-service teachers to think through questions, cooperative learning groups, oral presentations, authentic learning activities, and written reflections, which was summarized as an effective activity to improve critical thinking skills in higher education (Bezanilla et al., 2019). The syntax also mediates

pre-service teachers to think independently and practice logical communication, which is believed to be important to become a critical teacher (Kusaeri & Aditomo, 2019). Some of these aspects also appear in the RQA learning model. RQA learning model consisted of reading, summarizing, making questions, and answering questions that have been proven capable of empowering pre-service teachers' critical thinking skills (Amin et al., 2020; Thalib et al., 2017). Therefore, it is natural that the RQA learning model is found to be far more effective in improving the pre-service teachers' critical thinking skills than the conventional learning.

Related to the conventional learning, the pre-service teachers' were actually given a task to do presentations and discussions in groups, too. However, due to the absence of the activity requiring the pre-service teachers to read or make questions and answers before joining a class caused only the groups doing the presentations and only few pre-service teachers mastered the learning materials. While some other pre-service teachers only listened and recorded the results of the discussion delivered by their peers and lecturers. In fact, initial knowledge is essential in developing the critical thinking skills of pre-service teachers (Kusaeri & Aditomo, 2019; Mahanal et al., 2019). As a result, the students' skills in criticizing material/information conveyed by their peers or lecturers were not well developed.

The Effect of academic Ability and critical Thinking Skills

The results of ANCOVA analysis also found that there was a significant difference in critical thinking skills among the upper, middle and lower academic ability pre-service teachers. This finding supports the results of previous research reporting that differences in academic ability can affect the pre-service teachers' ability at criticizing information (D'Alessio et al., 2019; Mahanal et al., 2019; Permana et al., 2019; Zubaidah et al., 2018).

This difference in academic ability is believed to be related to the initial knowledge which then causes the upper academic ability pre-service teachers be easier to identify the accuracy of the information provided (Mahanal et al., 2019; Zubaidah et al., 2018). Conversely, the inadequacy of initial knowledge is reported to be one of the causes of failure in completing assignments given by the lecturers (Mahanal et al., 2019). While the pre-service teachers who did not have enough knowledge tended to have difficulty in making arguments, both for supporting and for refuting others' opinions (Gurkan & Kahraman, 2019; Lin, 2014).

The difference in academic ability is also believed to be related to the use of learning strategies. In this connection the upper academic ability used the learning strategies differently from the lower academic ability (Yip, 2009). This is presumably because the upper academic pre-service teachers have a personal disposition factor and self-regulation ability better than the lower academic ability. Similarly, the lower academic ability used fewer cognitive and metacognitive strategies than the upper academic ability (Ghiasvand, 2010). Whereas cognitive strategy and metacognitive strategy are mentioned as the key for becoming critical thinkers (Kwan & Wong, 2015).

The Effect of the Interaction between Learnings and academic Abilities on critical Thinking Skills

Overall, the results of ANCOVA found that there is a difference in the pre-service teachers' critical thinking skills as a result of the interaction between learnings and academic abilities. The results of post hoc LSD test find four important points which are described in details as follows.

First, the score of critical thinking skills in the combination group between QASEE learning model and the upper academic ability pre-service teachers is the highest among the scores of the other combination groups. This is in line with (Mahanal et al., 2019; Zubaidah et al., 2018) who stated that the problem of low critical thinking skills and differences in academic ability can be overcome by implementing the appropriate learning models and facilitating the pre-service teachers to perform higher order thinking.

Second, the QASEE learning model has the most potential in facilitating the pre-service teachers with different academic abilities (upper, middle, and lower) to improve their critical thinking skills. The QASEE learning model even succeeds in helping the lower academic ability pre-service teachers equalize their achievements with the upper academic ability pre-service teachers who are taught by using the RQA learning model, in terms of critical thinking. The QASEE learning model is superior to the other learning models because its activities not only facilitate pre-service teachers to construct their own knowledge individually, but also in groups with their friends, and it also provide the pre-service teachers the opportunity to do self-reflection. The advantages of the QASEE learning model are described as follows.

Each pre-service teacher constructs their initial knowledge individually through the activities of making questions (questioning phase) and answering questions (answering phase) which are carried out before the class begins. These activities are categorized into reading comprehension strategies that have been proven effective for practicing critical thinking skills (Akkaya, 2012). This is because when making questions and answering questions, all of the upper, middle, and lower academic ability pre-service teachers are encouraged to practice analyzing, assessing, and selecting information needed to complete their assignments. Furthermore, the initial knowledge obtained from these activities can be a good basis to criticize the information conveyed by other peers in the following learning activities (Mahanal et al., 2019). The following learning activity is the sharing phase, where the pre-service teachers construct their

knowledge through group discussions as well as class discussions. In the group discussion, the upper academic ability pre-service teachers play a role as tutors for the middle and the lower academic ability. They can exchange information and assess questions and answers with each other, so that they can benefit from this activity to improve their critical thinking skills (Mahanal et al., 2019; Zubaidah et al., 2018). This is also supported with the research results finding that social dialogue in small groups, which involves pre-service teachers in various cognitive activities, such as explaining, critiquing their ideas, debating, clarifying, and collaboration, can trigger the development of their critical thinking skills (Kim et al., 2013). Meanwhile, the extending phase is more than just group work requiring the pre-service teachers to apply their understanding gained in the three previous activities to a new context. Authentic assignments which are related to real life problems is proven effective in improving pre-service teachers' cognitive involvement which leads to the process of higher order thinking and critical thinking (Cepni et al., 2017; Kim et al., 2013). Finally, the QASEE learning model also helps pre-service teachers understand themselves through evaluating phase. Understanding themselves here means that the pre-service teachers reflect on what they have learned, what supports the learning process and the problems they have in the learning process, as well as the efforts for improvement. This activity will indirectly train the pre-service teachers to do reflective thinking, which is the basis for critical thinking (Tican & Taspinar, 2015; Vong & Kaewurai, 2017). Furthermore, it is even reported to help the lower academic ability pre-service teachers to identify the learning goals and the appropriate learning strategies, which will result to the improvement of pre-service teachers' learning performance (Yang et al., 2016).

Third, although not as potential as the QASEE learning model, the RQA learning model is more effective in empowering the critical thinking skills of the lower academic ability pre-service teachers than the conventional learning. Moreover, the lower academic ability pre-service teachers taught by using the RQA learning model achieved higher critical thinking skills that the upper academic ability pre-service teachers in the conventional learning. Therefore, the RQA learning model can become an alternative learning model to empower pre-service teachers' critical thinking skills in addition to QASEE learning model. This is because the RQA learning model was initially created to overcome the problems of the lack of pre-service teachers' motivation to read the learning material before the class begins. In fact, by reading the learning material before the class begins, the pre-service teachers obtain adequate initial knowledge, which is important to improve the performance of the lower academic ability in criticizing the accuracy of information (Mahanal et al., 2019). In addition, RQA learning model also includes the component of reading strategies which is believed to bridge pre-service teachers to become critical thinkers (Akkaya, 2012). The self-questioning activity in the RQA learning model is also considered as a metacognitive strategy, and the application of metacognitive strategy contributes to the improvement of critical thinking skill levels (Amin et al., 2020; Lai, 2011).

Fourth, related to the conventional learning in this research, the pre-service teachers (the upper, middle, and lower academic ability) obtain the lowest critical thinking skills scores. Moreover, due to the implementation of conventional learning, the critical thinking skills of the upper academic ability pre-service teachers are not significantly different from those of the middle academic ability pre-service teachers, or even equal. This is in line with the report stating that the implementation of conventional learning followed by lower order tasks will enlarge the achievement gaps between the upper academic ability pre-service teachers and the lower academic ability pre-service teachers (Zohar & Dori, 2003). Furthermore, the research by (Wan & Cheng, 2019) found that the lack of involvement of higher order thinking in learning became the main cause on the weak correlation between critical thinking disposition and academic achievement

Thus, based on the points that have been described above, it is logical that the critical thinking skills of the lower academic ability pre-service teachers in the QASEE learning experience the highest increase compared to the other learnings in this research, and then followed by the RQA learning. Therefore, the habit of implementing conventional learning, especially for the teacher education program, should be immediately abandoned. Conventional learning that is not oriented towards the improvement of critical thinking skills can affect the professional competence of pre-service teachers, such as the inability to select and deliver the appropriate concepts to their pre-service teachers (Saefi et al., 2017). Furthermore, the low critical thinking skills can also result in a poor mastery of science development and the inability to create an enjoyable learning climate, and so on (Sheybani & Miri, 2019). Those conditions will eventually have an effect on the development of the critical thinking skills of their students in the future (Furness et al., 2017; Saefi et al., 2017). This is also related to what was reported by Tican & Deniz (2019) that the 21st century learner skills, including the critical thinking skills, were found to be positively correlated with the 21st century teacher skills.

The significance of the findings of this research is that developing the critical thinking skills of pre-service teachers cannot be achieved by implementing conventional learning. Instead, it must be supported by the implementation of particular learning models that also facilitate the development of the critical thinking skills of pre-service teachers having different academic abilities. The QASEE learning model in this research has proven that it can empower the critical thinking skills of both the upper academic ability pre-service teachers and the lower academic ability pre-service teachers.

Conclusion

Based on the findings of this research, it can be concluded that: (1) there a difference in critical thinking skills among the pre-service teachers taught by using the QASEE learning model, RQA learning model, and conventional learning, (2) there is a difference in the improvement of critical thinking skills among the upper, the middle, and the lower academic ability pre-service teachers, and (3) there is a difference in the effects of the interaction between learnings and academic abilities toward critical thinking skills. Related to this interaction, the QASEE learning model was the most successful in equalizing the critical thinking skills of the upper, middle, and the lower academic ability pre-service teachers.

Suggestions

Based on the research findings, there is a need for learning critical thinking skills in the pre-service teacher education programs in the Indonesian. The QASEE learning model can be used as a new reference for curriculum and learning developer in teacher education program to design a learning which can empower pre-service teachers' critical thinking skills. Moreover, it is expected that the lower and middle academic ability pre-service teachers can have better achievements as the upper academic ability pre-service teachers. It is certainly recommended that the QASEE learning model be continually implemented in the classroom learning, in order that the pre-service teachers are accustomed to the various activities in this learning model. In addition, it is expected that the implementation of QASEE learning model has a positive effect on pre-service teachers' critical thinking skills. In fact, it is also possible that the QASEE learning model be used to improve other skills, such as metacognitive skills, questioning skills, and other skills which can be investigated in the following researches.

Similarly, the RQA learning model can also be used as an alternative learning model to improve pre-service teachers' critical thinking skills. On the other hand, the conventional learning is extremely not recommended to be implemented in learning activities in any circumstances as what has been previously discussed.

Finally, if it is possible in the future for teacher education program in Indonesia needs, it is needed to provide special courses to develop the critical thinking skills of pre-service teachers. Pre-service teacher need to understand the importance of critical thinking skills and appropriate strategies for teaching critical thinking skills to their students later (Gashan, 2015). Of course the application of this special course is done by involving the use of appropriate learning models.

Limitations

The limitations of this research are that it uses one university as a population, and 107 pre-service teachers as the research samples. In addition, this research was carried out for only one semester, so that the pre-service teachers seemed to be unfamiliar with the implementation of the QASEE learning model. This can be seen from the score of the critical thinking skills of the pre-service teachers taught by using the QASEE learning model with an average score of less than 70, though it was significantly different from the critical thinking skill score of the pre-service teachers in the RQA learning model and the conventional learning.

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