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Research Article

Empowering Critical Thinking Skills Of The Students Having Different Academic Ability in Biology Learning of Senior High School through PQ4R - TPS Strategy

Henny Setiawati[1], Aloysius Duran Corebima[2]

[1]Biology Department, Faculty of Teacher Training and Educational, University of Muhammadiyah Parepare, Indonesia
[2]Biology Department, Faculty of Mathematics and Natural Science. State University of Malang, Malang, Indonesia

ABSTRACT: Critical thinking skills are the thinking skills that students need to be independent and successful people in the future. The thinking skills are not inherited but it can be obtained through guided practice. This research aimed at comparing the critical thinking skills of students having different academic ability through PQ4R, TPS, and PQ4R-TPS learning strategies. The results of the analysis show that PQ4R - TPS learning strategy is significantly more potential to improve students' critical thinking skills than the other learning strategies. Related to the academic ability, upper academic ability students have higher critical thinking skills than the lower-academic ability students. In addition, the PQ4R-TPS strategy is able to empower the lower academic ability students to achieve the same potential as the upper academic ability students in PQ4R and TPS strategy. This information is valuable for teachers in implementing appropriate learning strategies to improve students' critical thinking skills to be independent learners.

Key Words: academic ability, biology learning, critical thinking, PQ4R, TPS

INTRODUCTION

Critical thinking is a high-order thinking skill that potentially increases students' critical analytical power. The improvement of students' critical analytical power is closely related to the improvement of students' intellectual ability. Therefore, developing the students' critical thinking skills in learning is an effort to improve students' learning results (Arnyana, 2004).

In line with Sadia (2008), the specific purpose of critical thinking empowerment in science education and other disciplines is to improve students' thinking skills and at the same time to prepare them for success in their lives. According to Johnson (2002), critical thinking can be used as a means to solve problems, to make decisions, to seek answers, to enrich the meaning, and to fulfill the desire to know something. Critical thinking skills can help people to make informed decisions based on careful, systematic, logical efforts and to consider many points of views.

Redhana (2013) stated that critical thinking was a useful characteristic in school learning at every level, although critical thinking rarely got the attention from the teachers. Students need to repeatedly practice their thinking skills even though this skill is already part of their way of thinking. Regular prectice that the students do will have an effect on the efficiency and automation of their thinking skills.

The thinking skills are not inherited and are not automatically owned by students. Critical thinking skills are obtained through guided practice. If in the teaching of

critical thinking skills the students have not reached the stage where the students understand and learn to use it, the thinking skills will not be much useful. According to Rosnawati (2012), students' critical thinking skills can be trained through problem-solving in the form of a variety of questions.

Critical thinking skills are skills that can be learned, so that these skills can be taught (Robbins, 2005). Similarly, Eklof (2005) stated that critical thinking skills were a habit and an intellectual skill guiding one to a reliable understanding; this habit was not carried from birth, but it must be learned.

Students in the classroom have different abilities, namely low ability group, medium ability group, and high ability group by using criteria such as intelligence test result, average score of the subjects they take, and objective test result of the subjects learned (Hamalik, 2001). Similarly, according to Arikunto (2003) that in fact there are students having high, moderate, and low ability. Individual differences must be considered and addressed in the learning strategy, so that each student can develop fully and master the learning materials thoroughly. Similarly, according to Corebima (2006), the gap between upper and lower ability students should be considered by educators in learning, so it is expected that the gap is further reduced in both the learning process and the learning results.

Ausubel (1998) suggested that students having high academic ability would achieve better thinking ability than those having low academic ability, because thinking ability was useful as capital in solving problems, and furthermore it affected the students' intellectual level. In addition, Lawrence (1988) stated that students having high academic ability achieved higher thinking better than those of low academic ability. According to Corebima (2005) clever students will be more clever, but less clever students will not be able to align their skills with the clever students because students having academic ability have a higher initial state compared those

having low academic ability.

Academic ability is related to potential. High academic ability students have higher critical thinking skill scores and higher cognitive learning results than those of low academic ability (Muhfahroyin, 2009). Similarly Andayani (2008) found that academic ability had an effect on students' critical thinking ability.

Critical thinking skill empowement can be done through learning strategies implemented. Several studies related to the critical thinking skill empowerment through learning strategies are such as those reported by Lestari et al. (2014), Ariani et al. (2014), Surayya et al. (2014), Daud and Hapsari (2015) who found that learning strategies had an effect on critical thinking skills.

Learning strategies that can be used to enhance students' critical thinking skills include PQ4R (preview, questions, read, reflect, Recite, review) and TPS (Think, Pair, Share) learning strategies. These learning strategies are possible to be integrated due to the similarities of the two learning syntaxes.

PQ4R learning strategy is regarded as one of the strategies having the potential to empower students' critical thinking skills. Related research results as reported by Wahyuningsih (2012), Bibi and Manzoor (2011), as well as Khattack and Khan (2002) show that PQ4R strategy improve students' critical thinking skills. As a student centered learning, PQ4R strategy gives the opportunity to the students to build their own knowledge. Research of Maesah et al. (2012) reported that the application of the PQ4R in learning processes improved students' learning results, as seen from the various indicators of achievement such as achievement test. The same thing is also reported by Wahyuningsih (2012) about the use of PQ4R learning strategy; good and right reading make the students able to take the essence of the reading passage. In this connection, the more essence the students can get from the reading material, the more knowledge they will acquire and will greatly assist them in forming a comprehensive understanding.

TPS learning strategy also potentially improves students' critical thinking skills. The results of research related with this strategy as reported show that TPS learning strategy has the potential to empower the critical thinking (Stuever, 2006; Miranda, 2010), and provides an opportunity for students to hone their thinking ability and finally gives meaningful knowledge to improve students' learning results Widodo (2011). Similarly, Ibe (2009) stated that the procedure of TPS involved students to think independently.

PQ4R-TPS strategy is possible to be implemented in learning. Both of these strategies have the potential to improve students' critical thinking skills because they play a role in empowering effective problem-solving skills. In addition, students gain an understanding of the material presented, ask questions, carry out reading, link the information, create new understandings with their own sentences, evaluate, and make conclusions from their learning results.

By the activities of questioning, reading, reflecting, arguing on issues raised by each group member, summarizing, discussing, and raising cognitive expansion and conflict students are accustomed to use their thinking skills. These thinking skills are the foundation for critical thinking. According to Johnson (2007), critical thinking is a well-directed and clear process used in mental activities such as problem solving, decision making, analyzing assumptions, and the ability to argue in an organized way. The activity of formulating questions uses the related prior knowledge (Logsdon, 2007), which encourages students to think at a higher level (Rogers, 2006).

Based on the above explanation, this research aimed at determining the potential of PQ4R-TPS strategy in empowering the critical thinking skills of students having different academic ability. This information is very valuable for teachers to choose the appropriate learning strategies that not only focus on cognitive learning results but also empower students' critical thinking skills.

METHOD

This study was a quasi-experimental research designed to compare the critical thinking skills of students having different academic ability in the first semester of Class X of senior high school Parepare, Indonesia in 2013 by using a combination of PQ4R-TPS learning strategy, PQ4R strategy, TPS strategy, and conventional learning.

A. Research Sample

The sample in this research represents the population namely the students of senior high schools in Parepare, Indonesia in the first semester of academic year 2013/2014 consisting of 920 students. The sample of the research consisted of 240 students randomly selected and scattered in 4 research classes. Each learning strategy PQ4R, TPS, and PQ4R-TPS was represented by 4 classes. The classes becoming the samples of this research were initially given equality test using the data of placement test in the form of multiple-choice tests on biology material. The test items consisted of 50 items on biology material of senior high school level. The instruments of placement test was valid and reliable. Expert validation consisted of content and construct validity. Content validity is the accuracy of an instrument (content of the instruments), estimated in accordance with the curriculum. Construct validity refers to the appropriateness of the results of the measuring instrument with the ability to be measured. Empirically validated was conducted by trying out the instruments to 40 students of class XI of senior high school in Parepare, Indonesia. The try out was carried out to determine the validity and reliability of the instruments. Reliability of the essay test was also examined. Reliability refers to the degree of test scores, which are free from measurement error or an index that indicates the extent to which a measuring instrument trust worthy or reliable. The instruments of research were valid and reliable. Before and after the treatment, the students were given the essay test (pretest and posttest). The analysis of the equality of the sample classes was done by using analysis of variance (ANOVA) using *SPSS*

20 for Windows. The results of the analysis showed that the whole classses were equivalent.

B. *Instruments and procedures*

Student's critical thinking skills were measured by using cognitive learning test in the form of essay test as many as 15 items, developed by the researcher. The rubric used was the rubric of cognitive learning result adapted from Hart (1994) consisting of 5 scales (0-5). Instruments are validated by experts and empirically validated before it was used. The results of validation and empirical try out showed that the instruments were valid and reliable.

C. *Data analysis*

Hypothesis testing was done after the data was known to be normally and homogeneously distributed. For one semester, the four classes were taught by using different learning strategies, and then the classes were given the final test. The data were then analyzed by using ancova, supported by using SPSS 20.

RESEARCH RESULT

Summary of Ancova test related to students' critical thinking skills is presented in Tabel 1. Based on the result of ancova test on students' critical thinking skill, it can be seen that learning strategy has an effect on students' critical thinking skills ($p < 0.05$).

Table 1. Summary of Ancova Test Result of the Student's critical Thinking Skills

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	28929,297(a)	8	3616,162	205,816	,000
Intercept	2000,933	1	2000,933	113,884	,000
XCritical	1833,988	1	1833,988	104,382	,000
Strategy	4723,643	3	1574,548	89,616	,000
AA	335,522	1	335,522	19,096	,000
STRATEGY * AA	1378,695	3	459,565	26,156	,000
Error	2582,775	147	17,570		
Total	867031,552	156			
Corrected Total	31512,072	155			

Post hoc analysis related to the effect of learning on students' critical thinking skills is presented in Tabel 2. The results of LSD test shows that the mean score of students' critical skills taught by using the combination of PQ4R - TPS learning strategy are significantly higher than that of the students taught by using PQ4R and TPS learning strategies as well as and conventional learning. While the students' critical thinking skills at the PQ4R strategy is not significantly different from that at the TPS strategy.

Tabel2. Summary of post hoc Analysis Result of the learning strategy Effect on critical Thinking Skills

Strategy	XCritical	YCritical	Differences	CriticalCOR	Notation LSD
1=Conventional	54,27	59,80	5,53	62,75	a
3=TPS	54,20	70,63	16,43	73,62	b
2=PQ4R	59,63	75,79	16,16	75,49	b
4=PQ4RTPS	68,98	87,35	18,37	81,41	c

Summary of the results of post hoc test on the interaction of strategy and academic ability is shown in Table 3. The results of post hoc test related to the combination of learning strategy and academic ability show that the combination of PQ4R - TPS strategy is more potential than other strategies in improving the critical thinking skills of high and low academic ability students. The PQ4R-TPS strategy is more potential, especially with the support of the PQ4R strategy than the TPS strategy, which is proved by the potential of the combination of PQ4R-high academic ability is equal with the the potential of PQ4R-TPS-high academic ability. In addition, the PQ4R-TPS strategy has high potential in empowering low academic ability students, which is proved from the fact that PQ4R-TPS strategy is able to empower the low academic ability students, so as to achieve the same potential as the high academic ability students in PQ4R and TPS strategy.

Table 3. Summary of post hoc Test Results of the Interaction of Strategy and academic Ability

Strategy/Learning	Academic Ability	GROUP	XCritical	YCritical	Differences	CriticalCOR	Notation LSD
1 = conventional	1 = high	1	62,60	62,93	0,33	60,84	a
1 = conventional	2 = low	2	45,93	56,67	10,73	64,65	b
3 = TPS	2 = low	6	45,40	59,93	14,53	68,24	c
2 = PQ4R	2 = low	4	50,14	64,84	14,70	70,28	c
3 = TPS	1 = high	5	63,00	81,33	18,33	79,00	d
4 = PQ4RTPS	2 = low	8	59,93	79,64	19,72	79,17	d
2 = PQ4R	1 = high	3	69,12	86,74	17,61	80,70	d e
4 = PQ4RTPS	1 = high	7	78,04	95,06	17,03	83,64	e

DISCUSSION

The findings of this research revealed that the combination of PQ4R - TPS strategy is more potential than other strategies in improving the critical thinking skills of high and low academic ability students. The integration of PQ4R and TPS becoming PQ4R-TPS strategy shows that both strategies complement each other and further maximize the potential of both strategies in empowering critical thinking skills.

The PQ4R-TPS strategy is more potential, especially with the support of the PQ4R strategy than the TPS strategy, as proved by the fact that the critical skills of the high academic ability students in PQ4R are similar to those found in the high academic ability students in PQ4R-TPS. This shows that the PQ4R - TPS strategy is more potential in improving the critical thinking skills with the integration of PQ4R strategy. This is in line with the research by Yani and Handoyo (2013) which reported that the learning using PQ4R also showed an increase in students' critical thinking.

PQ4R strategy has syntax consisting of six steps that gradually direct each student to use their critical thinking skills. Preview stage is the stage of speed reading activity. Speed reading activity by examining important points in reading encourages critical thinking skills. According to Burton (2007), a rapid survey of readings referring to information gathering helps regulate mental compartments in students.

The second stage of the PQ4R strategy is the Question. The students' activity is to create questions for themselves. Bibi and Manzoor (2011) stated that students constructed questions based on their previous surveys. Questioning activities involve students in thinking, and challenging them to think at a higher level (Rogers, 2006).

The Read stage as the third stage is the whole reading activity of a given material. This activity aims to find answers of questions that have been previously built. During reading, students engage in critical thinking processes. According to

Huber (2004), the process of reading helps students to examine their understanding by reaffirming what they learn.

Reflect stage is the second R stage of the PQ4R strategy. Students' activity at this stage is to connect the knowledge that has been built from reading activities with the knowledge that has been previously owned. This activity encourages the empowerment of critical thinking skills. According to Larsen and Williams (1999), thinking processes occur when there is the interaction among readers, text, and understanding.

The Recite stage is the stage of answering the questions that have been proposed. This activity is a phase that involves more senses and increases understanding as well as writes it using information tool such as flow charts and line chart. This activity encourages the empowerment of critical thinking skills. According to Huber (2004), this stage involves students' thinking skills to recap the information that has been understood, and then they formulate concepts, explain the relationship between these concepts, and write back using their own sentences.

Similarly, the fourth R stage is Review, which is the repeating stage by making a summary or formulating the essence of the material that has been read. The most important part of this stage is that students are able to formulate conclusions in response to the questions they have asked (Suprijono, 2011).

Other findings show that PQ4R-TPS strategy is highly potential to empower low academic students, which is proved by the fact that the PQ4R-TPS strategy is able to empower low academic students, so as to achieve the same potential as the high academic ability students in PQ4R and TPS strategy. The activities of questioning, reading, reflection, arguing for the problems posed by each student or group in the PQ4R-TPS learning strategy direct the students to empower their critical thinking skills. Every student, including the low academic ability students, is actively involved in learning. The summarizing and discussing activities are an activity which brings up an expansion and cognitive conflicts to students, making the students accustomed to think critically. These thinking skills are the foundation for critical thinking. According to Johnson (2007), critical thinking is a well-directed and clear process which is used in mental activities, such as problem solving, decision making, analyzing assumptions, and the ability to argue in an organized way.

The findings of this research indicate that low academic ability students are encouraged to improve their learning efforts in order to equalize the high academic ability students. High and low academic ability students in PQ4R-TPS learning strategy are required to be actively involved in the learning process. According to Corebima (2007), certain learning strategies are able to empower the thinking skill of lower academic ability students far greater than those of high academic ability students.

Conclusion

PQ4R-TPS learning strategy is significantly more potential to improve students' critical thinking skills than other learning strategies. Similarly, PQ4R-TPS strategy is more potential, especially with the support of PQ4R strategy compared to the TPS strategy, which is proved by the fact that the potential of the combination of PQ4R-high academic ability is equal to the potential of PQ4R-TPS-high academic ability. In addition, the PQ4R-TPS strategy is highly potential to empower low academic ability students, which is proved by the fact that the PQ4R-TPS strategy is able to empower low academic students, so as to achieve the same potential as the high academic ability students in PQ4R and TPS strategy.

SUGGESTION

PQ4R - TPS learning strategy has the potential to empower the critical thinking skills of different academic ability students, so that it is advisable that teachers implement this learning strategy in order that students have critical thiking skills and be independent.

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