

The ability of critical thinking and problem solving prospective biology teacher to solve biological Olympiad questions

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Article Information	Abstract
Keyword: Critically thinking; Problem solving; Prospective biology teacher; Biology olympiad Kata Kunci: Berpikir kritis; Memecahkan masalah; Calon guru biologi; Olimpiade biologi History: Received : 07/12/2022 Accepted : 29/01/2023	It takes careful preparation to answer questions with a high difficulty level regarding the trainers' readiness and the student's readiness in the Biology Olympiad Coaching elective course. Critical thinking skills and problem-solving are needed in solving these Olympiad questions. This study aims to analyse biology teacher candidates' critical thinking skills and problem-solving in solving biology Olympiad questions. This study used a quasi-experimental method using the Reading, Questioning, and Answering (RQA) learning model. The dependent variable to be measured is the ability to think critically and solve problems for prospective Biology teacher students. This research was carried out in the even semester of the 2021/2022 academic year in two classes in the Biology Olympiad Development course at IKIP PGRI Pontianak. The research sample was taken in a saturated manner. Before being given to students, all questions were validated by experts and then continued with the research implementation to obtain data. The normality and homogeneity of research data were then tested. Finally, the research hypothesis was tested using one-way ANCOVA. The study results show that the RQA learning model can empower critical thinking skills and solve problems for prospective teacher students. The RQA learning model can be an effective solution to deal with the advancement of 21st century education. Abstrak Dibutuhkan persiapan yang matang untuk menjawab soal dengan tingkat kesulitan yang tinggi, baik dari segi kesiapan pelatih maupun kesiapan siswanya pada mata kuliah pilihan Pembinaan Olimpiade Biologi. Kemampuan berpikir kritis dan pemecahan masalah diperlukan dalam penyelesaian soal olimpiade ini. Penelitian ini bertujuan untuk menganalisis kemampuan berpikir kritis dan pemecahan masalah mahasiswa calon guru biologi dalam menyelesaikan soal olimpiade biologi. Penelitian ini menggunakan metode kuasi eksperimen menggunakan model pembelajaran <i>Reading, Questioning, and Answering</i> (RQA). Variabel terikat yang akan diukur yakni kemampuan berpikir kritis dan pemecahan masalah mahasiswa calon guru Biologi. Penelitian ini dilaksanakan pada semester genap tahun ajaran 2021/2022 di dua kelas pada mata kuliah Pembinaan Olimpiade Biologi IKIP PGRI Pontianak. Sampel penelitian diambil secara jenuh. Sebelum diberikan kepada siswa, seluruh soal telah divalidasi oleh ahli kemudian dilanjutkan dengan pelaksanaan penelitian hingga didapatkan data penelitian. Data penelitian kemudian diuji normalitas dan homogenitasnya dan yang terakhir diuji hipotesis penelitian menggunakan one way ANCOVA. Hasil penelitian menunjukkan jika model pembelajaran RQA dapat memberdayakan kemampuan berpikir kritis dan memecahkan masalah mahasiswa calon guru. Model pembelajaran RQA dapat menjadi salah satu solusi yang efektif untuk menghadapi kemajuan pendidikan abad 21.

A. Introduction

Education is the main spear for a nation. This fact causes the pattern of education today to be different from the pattern of education in the previous era (Nugraha et al., 2021). The 21st century education, which continues to be developed today, is the basis for development in all sectors (Ismiati, 2020; Setiawan et al., 2022). At this time, there were dynamic changes in the economy, transportation, technology, communication, information, and education (Warsita, 2017). Education in the 21st century emphasizes various abilities that student-teacher candidates must master. For prospective students to acquire these skills, it takes prospective teachers who are ready in various aspects, such as having good critical thinking and problem-solving skills.

The Biology Olympiad is one of the projects held by the government every year to develop students' scientific talents and interests. Olympiad selection begins at the school, district/city, provincial and national levels. In the district/city level Olympiad selection, Olympiad participants were high school students selected from all schools in each district/city. The aim of holding the Biology Olympiad is to hone students' abilities in biology, improve the quality of biology learning, and capture excellent seeds in the field of biology.

Holding the Olympics on an ongoing basis will positively affect the learning process because the learning process becomes more creative and innovative (Suryawan et al., 2017; Suryanto et al., 2020). Ideally, educational Olympiad events must be well prepared, especially in compiling questions or questions posed to the participants. According to Ridhana et al. (2021); Astuti et al. (2021); Susanti et al. (2022), the questions compiled must be valid and reliable to measure and train students' thinking and reasoning abilities.

Following the guidelines of the General Administration of Elementary and Secondary Education (2013) for the implementation of the Olympics, the questions for the Biology Olympiad at the district level are prepared by the main group. Asking questions is entirely the responsibility of the Ministry of National Education. Members of the problem-solving team are lecturers and biologists from various universities, as well as students from International Biology Olympiad (IBO) participants who are former Biology Olympiad participants. Furthermore, the team jointly compiled questions for the Biology Olympiad at the district/city, provincial and national levels.

The Olympiad questions are designed to select students who excel in biology and therefore require high and low-difficulty questions. Very

simple problems do not motivate students to increase their problem-solving efforts. Questions with simple criteria must be considered and should not be made into Olympic questions (Arikunto, 2011). This condition makes the Olympic questions a high difficulty level, good discrimination, a valid and effective distractor, valid, and reliable (Nurinda et al., 2014; Muharromah, 2020).

Based on the results of the analysis of the difficulty level of questions for the Biology Olympiad in West Sumatra, Riau, Jambi and Bengkulu in 2018, 1.66% of the questions in the Biology Olympiad were very easy, 1.66% of the questions were classified as simple, and 36.66% of the questions were classified as medium, 40% of the questions are classified as difficult, and 20% of the questions are classified as very difficult. This problem is very difficult if the total is almost balanced (Syarif & Syamsurizal, 2019).

In Pacitan Regency, the District-level Biology National Science Olympiad (OSN) is held consistently. So it needs careful arrangement on the part of the school, for example, ideal directions for prospective Biology OSN members by utilizing questions that have been detailed and whose quality is known. Several secondary schools in Pacitan, Ponorogo and Trenggalek train potential Olympic participants by providing directions using questions from the previous year (Nurinda et al., 2014).

The Biology Olympiad Development Course is one of the elective courses taken by students of the Biology Education Study Program at IKIP PGRI Pontianak. This course aims to prepare prospective teacher students to become Olympiad coaches at the junior and senior high school levels. In the lecture process, student teacher candidates are trained in mastering mature concepts to answer various Olympic selection questions at the junior, high school, and tertiary levels. To answer questions with a high level of difficulty requires careful preparation, both in terms of the trainer's and the student's readiness. This condition requires that Olympic coaches need high thinking skills and routine Olympic questions practice. Critical thinking skills and problem-solving are needed in solving these Olympiad questions.

Critical thinking is the ability to reason, apply, synthesize, and evaluate concepts or information obtained or generated (Zubaidah, 2010). Students need to be able to deal with personal and social problems in their daily lives (Nuryanti et al., 2018). The ability to think critically does not appear but must be trained continuously to become a habit for students (Rahmah et al.,

2021). Besides, problem-solving is the student's ability to combine previously obtained information to solve new problems (Siringoringo et al., 2018; Endang et al., 2021).

To develop prospective biology teachers' critical thinking and problem-solving skills, they need to be trained in the Biology Olympiad Coaching course. The formulation of the problem in this study is: How is the critical thinking ability of prospective biology teacher students in solving biology Olympiad questions? How is the problem-solving ability of prospective biology teacher students in solving biology Olympiad questions? How high are biology teacher candidates' critical thinking and problem-solving ability in solving biology Olympiad questions? Based on the explanation above, this study aims to determine the critical thinking skills of biology teacher candidates in solving biology Olympiad questions, to determine the problem-solving abilities of biology teacher candidate students in solving biology Olympiad questions, to analyze the level of critical thinking ability, and to analyze problem-solving abilities of prospective biology teachers to solve biology Olympiad questions.

B. Material and Method

This study used a quasi-experimental method using the Reading, Questioning, and Answering (RQA) learning model. The dependent variable to be measured is the ability to think critically and solve problems for prospective Biology teacher students. This research was carried out in the even semester

of the 2021/2022 academic year in two classes in the Biology Olympiad Development course at IKIP PGRI Pontianak. The research sample was biology education students selected in a saturated manner. The instrument used to collect the data were pretest and posttest questions consisting of ten essay questions. Before being given to students, all questions were validated by experts and then continued research implementation to obtain pretest and posttest data. The research data then went through a normality test using the Kolmogorov-Smirnov and Shapiro-Wilk, homogeneity test using Levene's Test. Finally, the research hypothesis was tested using one-way ANCOVA.

C. Results and Discussion

The results of the prerequisite test in the form of the normality test using the Kolmogorov-Smirnov and Shapiro-Wilk, and the homogeneity test of the critical thinking ability data using Levene's Test can be seen in Table 1 and Table 2. A summary of the results of the ANCOVA test for the hypothesis test of critical thinking ability is shown in Table 3, and the results of calculating students' ability to solve problems can be seen in Table 4.

The normality and homogeneity test results show if the data's significance is more than 0.05 (See Table 1 and Table 2). Based on these data, the pretest and posttest of critical thinking skills and problem-solving are normally distributed and homogeneous.

Table 1 Data normality test results

Independent variable	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Critical Thinking Ability	.075	50	.200*	.972	50	.279
Problem-solving Ability	.043	50	.200*	.989	50	.918

Table 2 Data homogeneity test results

Independent variable	F	df1	df2	Sig.
Critical Thinking Ability	.498	1	48	.484
Problem-solving Ability	.594	1	48	.445

Table 3 One way ANCOVA test results of critical thinking ability

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3843.257 ^a	2	1921.629	13.427	.000	.364
Intercept	15351.037	1	15351.037	107.260	.000	.695
Pretest	1.632	1	1.632	.011	.915	.000
Class	3835.151	1	3835.151	26.797	.000	.363
Error	6726.663	47	143.120			
Total	306712.000	50				
Corrected Total	10569.920	49				
Corrected Model	3843.257 ^a	2	1921.629	13.427	.000	.364

Table 4 Problem-solving ability

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1007.300 ^a	2	503.650	3.597	.035	.133
Intercept	13760.659	1	13760.659	98.267	.000	.676
Pretest	195.083	1	195.083	1.393	.244	.029
Class	861.090	1	861.090	6.149	.017	.116
Error	6581.580	47	140.034			
Total	264490.000	50				
Corrected Total	7588.880	49				

The summary of the hypothesis test results for prospective teacher students' critical thinking skills in Table 3 shows a significance of 0.000 <0.050 and a problem-solving ability of 0.017 <0.050. Based on the analysis results, the ability to think critically and solve problems for prospective teacher students is influenced by the RQA learning model.

Reading, Questioning, and Answering (RQA) is a newly developed learning model that uses the constructivism theory (Lashari et al., 2017; Maulida & Mayasari, 2019). This learning model begins with reading and understanding what is read, then continues with asking questions and making answers that have been made (Ummiyati et al., 2022). In this study, these activities were carried out during the classroom learning process and to find answers at home. During class, students are asked to read the material to be made because it is in the Biology Olympiad Coaching course. After that, students are asked to make questions following the material for the high school Biology Olympiad with a minimum cognitive level of questions C3, C4, and C5. After creating the questions, students are asked to find answers and present them in class with the lecturer. If there are wrong answers or questions, the lecturer in charge of the Biology Olympiad Development course will be given input and correct answers.

The first stage of this learning model is reading activity. Reading aims to create active student learning so that students become ready to be assigned learning and can improve critical thinking skills (Bustami & Corebima 2017). The ability to think critically is realized through understanding the concept of learning, empowering the mind, which requires students to be active and learn (Putri et al., 2022). Thus the responsibilities given can create a deep understanding of specific topics so that the ability to reason, provide arguments, evaluate, and formulate problems on the topic of discussion is realized through the Reading Questioning Answering (RQA) model (Sudin et al., 2018).

The second activity is asking questions. The activity of asking questions can also empower

students' critical thinking skills (Fitriyah & Ramadani, 2021). When making questions, students actively monitor and evaluate what they have read and understood (Setiawan et al., 2013; Siregar et al., 2017). The question-making stage can also help students convey their thoughts, ideas, and questions (Mayasari, 2014; Putri et al., 2022).

The last stage is answering questions. At this stage, it aims to test the depth of the material obtained and how students maintain their income. The RQA learning model has several advantages when compared to other learning models. Firstly, it can strengthen students' cognition because it empowers the ability to think purposefully. Both increase student motivation because of the interaction between students and students as well as students and teachers. Third, students can become independent learners by asking and answering difficult questions (Darmayanti, 2015).

Reading activities, asking questions, and self-testing in the monitoring process can build students' understanding of the material and integrate it with previous knowledge (Greenstein, 2012). Reading activities can also train students' problem-solving skills because students are trained to map the information they have obtained by making connections with the problems they are facing (Mariyaningsih & Hidayati, 2018).

After reading, students are asked to make and answer questions. At this stage, the ability to solve problems is also needed because the ability to solve problems is an essential ability that students must possess. After all, the main focus of learning is learning to solve existing problems (Widiantie & Lismaya, 2017). Also, at this stage, students practice determining existing problems based on the phenomena they have read about (Bahri, 2016). Students can find problems if students focus on analyzing problems so that students' metacognitive skills and problem-solving can be trained (Zubaidah, 2019). The RQA learning model can also empower students' problem-solving abilities because students try to solve problems so that students try to produce appropriate information, analyze information and realize how necessary it is

to re-examine the results they get (Cahyani & Setyawati, 2016).

D. Conclusion

The results of the study show that there is a significant difference between the critical thinking skills and the problem-solving abilities of prospective teacher students. Based on the analysis results, the ability to think critically and solve problems for prospective teacher students is influenced by the RQA learning model. Based on this explanation, it is concluded that the RQA learning model can effectively deal with the progress of 21st century education. However, wider follow-up is needed so that the benefits obtained from implementing this learning model are more optimal.

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