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Submission date: 24-Jun-2023 12:54PM (UTC+0900)
Submission ID: 2121718506
File name: COPYEDITING.docx (52.17K)
Word count: 2971
Character count: 17520

Inornatus: Biology Education Journal
Volume 3, Issue 2 (2023): 67 – 74
DOI: 10.30862/inornatus.v3i2.427

Empowering students' critical thinking skills using problem-based learning

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Submitted: 26-05-2023
Accepted: 24-06-2023
Published: 25-06-2023

Abstract: This research aims to ascertain how students' critical thinking skills change after being exposed to Problem-Based Learning (PBL). This study employs a quantitative methodology using quasi-experiments. Non-equivalent control groups were employed in this study. The population included 246 students from seven different classes at IPA SMA Negeri 1 Mamasa, who were all in grade XI. This research used a purposive sample of 36 students from the PBL class and 36 students from the control class. The t-test and the Mann-Whitney test were used to analyze the data in this investigation. The t-test results showed that the students' pretest was different (sig. <0.05), so the posttest t-test also showed a difference (sig. <0.05. The Mann-Whitney N-gain test was used to find out whether PBL had a statistically significant impact. The Mann-Whitney U test found that the students' critical thinking had improved if the significance level (Sig. of N-gain) was less than 0.05. This study provides evidence that PBL may improve students' critical skills.

Keywords: Active learning, critical thinking, PBL, learning

Abstrak: Tujuan dari penelitian ini adalah untuk mengetahui bagaimana perubahan kemampuan berpikir kritis siswa setelah penggunaan dengan Pembelajaran Berbasis Masalah (PBM). Penelitian ini menggunakan metodologi kuantitatif dengan menggunakan kuasi eksperimen. *Non-equivalent control group* adalah desain dalam penelitian ini. 246 siswa dari tujuh kelas yang berbeda di IPA SMA Negeri 1 Mamasa yang semuanya duduk di kelas XI sebagai populasi. Penelitian ini menggunakan sampel purposive sebanyak 36 siswa di kelas PBM dan 36 siswa di kelas kontrol. Uji-t dan uji Mann-Whitney digunakan untuk menganalisis data dalam penyelidikan ini. Hasil uji t menunjukkan bahwa pretest siswa telah berbeda (sig. <0.05) sehingga uji t posttest juga menunjukkan adanya perbedaan (sig. <0.05). Uji Mann-Whitney N-gain digunakan untuk mengetahui apakah PBM memiliki dampak yang signifikan secara statistik. Uji Mann-Whitney U menemukan bahwa pemikiran kritis siswa meningkat jika tingkat signifikansi (Sig. N-gain) kurang dari 0,05. Studi ini memberikan bukti bahwa PBM dapat meningkatkan keterampilan kritis siswa.

Kata kunci: Pembelajaran aktif, berpikir kritis, PBM, pembelajaran

INTRODUCTION

Problem-Based Learning (PBL) is learning that focuses on problem-solving activities. PBL involves giving problems with real-world context, active group collaboration, formulating problems and identifying knowledge gaps, studying and finding related material, and solving problems (Damopolii & Kurniadi, 2019; Salvador et al., 2023; Ssemugenyi, 2023; Wahyuningsih et al., 2023). Students benefit from PBL because it encourages them to think critically, solve issues, and locate and apply relevant learning materials (Chiang & Lee, 2016; Wahyuningsih et al., 2023; Yulianti & Gunawan, 2019).

The educator's role in PBL is that of a facilitator who directs students in the right direction while they work to solve the problem. Furthermore, students' ability to learn with an open, critical, reflective, and active mentality may be enhanced via PBL (Khasanova, 2023; Yuen Lie Lim, 2011). PBL is also meant to foster students' capacity for self-directed learning and interpersonal competence (Abed et al., 2023; Chng et al., 2011). Interpersonal competence and independent learning are formed during students' collaboration to identify important information in learning resources and strategies related to problem solving (Lelasari et al., 2021; Sogen et al., 2018; Zannah et al., 2018). Students are given a problem topic and must discover and determine their own solutions (Damopolii et al., 2021); therefore, applying PBL as a learning model is effective. Students' critical thinking skills are improved because the whole learning process is focused on the students and the teacher's only role is to act as a guide (Alreshidi & Alreshidi, 2023; Anggraeni et al., 2023; Zulyusri et al., 2023).

Based on the results of observations and interviews at SMA Negeri 1 Mamasa, it was found that there was a lack of students' understanding of the material provided. The teacher helps students learn in the classroom by lecturing and having them take notes. This tends to create a dull learning environment and makes students less interested in learning. The use of ineffective learning models is one of the causes of students' lack of ability to think critically, because the learning process is more focused on working on problems without thoroughly exploring the concept to save time in the learning process. Critical thinking skills (CTs) are a reference for improving student achievement (Damopolii et al., 2022; Iftiah et al., 2023; Nusantari et al., 2021).

Through participation in PBL, students may strengthen their ability to think critically. Students interested in learning and learning, as well as challenges from the real world, may benefit from PBL, which is one kind of education that may stimulate CTs. In addition, the average level of CTs among students whose education is based on PBL is considered to be in the developing category (Al-Fikry et al., 2018). It indicates that this model has the benefit of changing students' CTs because they, as passive recipients of information, can change to active recipients of information, capable of being independent and capable of solving problems.

PBL has been proven in a number of studies to have an influence on the CTs of learners. In their review, Razak et al. (2022) said that PBL produces an atmosphere for learning in which the instructor works as a facilitator of student learning activities, which has an effect on the CTs of the students. In their meta-analysis, Ramdani et al. (2023) indicate that PBL has an influence on students' CTs while they are learning about biology. However, further study is required to identify the effect that this learning has. According to the findings of Manuaba et al. (2022), PBL is a viable alternative to traditional learning, which fails to foster higher levels of CTs. According to the findings of their study, PBL is superior to traditional methods of education in terms of its ability to develop students' capacity for CTs.

The purpose of this research is to examine how the implementation of PBL has affected the students' CTs at SMA Negeri 1 Mamasa

METHOD

The methodology for this study is quasi-experimental. Although this design includes a control group, it is not capable of controlling all of the external factors that may have an impact on the results of the tests that are conducted. The Non-equivalent Control Group Design is the kind of research design that was used in this study. The participants in this study were all students enrolled in class XI at SMA Negeri 1 Mamasa. Purposive sampling was utilized to collect data for this research, and the sample was made up of students from two different classes: XI IPA 1 (Experimental), which total of 36 participants; XI IPA 3 (control), which total of 36 participants.

Both before and after participation in the intervention, students' CTs were evaluated. A test in the form of an essay with ten different questions was used in this investigation. PBL is the foundation for developing learning aids such as worksheets and lessons for students. The statistical t-test and the Mann-Whitney U test were used in this investigation with the assistance of the SPSS 20.0 program for Windows. The data for the N-Gain, also known as the normalized gain, is derived from a comparison of the difference in scores acquired during the pretest and the posttest. The calculation of the average value of N-Gain is done to evaluate the improvement in the students' analytical capabilities.

RESULTS AND DISCUSSION

The research was conducted at SMA Negeri 1 Mamasa, Mamasa Regency, West Sulawesi Province, with the study population being all students of class XI.

Table 1. Mean, SD, gain, and gain

Data	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
n	36	36	36	36
mean	66.83	81.42	61.33	74.56
SD	5.69	2.882	5.248	4.901
Gain	14.59		13.25	
n-gain	0.44		0.34	

The data in Table 1 shows that students in the experimental and control classes have an average pretest above 60, but after learning, the experimental class exceeds a score of 80 and the control less than 80. Both groups' N-gain levels are in the middle range, but the experimental group's N-gain is higher than the control group's.

Table 2. Normality of data

Variable	Class	Statistic	Kolmogorov-Smirnov[a]	
			df	Sig.
Critical thinking	Pretest PBL	0.109	36	0.200
	Posttest PBL	0.117	36	0.200
	N-gain PBL	0.098	36	0.200
	Pre-test convensional	0.119	36	0.200
	Posttest convensional	0.137	36	0.087
	N-gain convensional	0.177	36	0.006

Based on Table 2, it can be said that there is only one group of data that does not show normality, namely the control class N-gain data. The results of this analysis indicate that the calculation of the difference in N-gain in the two classes uses Mann Whitney, while the pre and post use the t-test.

Table 3. Homogeneity and t-test results of pretest and posttest

Data		Homogeneity		t-test for equality of means		
		F	Sig.	t	df	Sig.
Pretest	Equal variances assumed	0.093	0.762	4.263	70	0.000
	Equal variances not assumed			4.263	69.548	0.000
Posttes	Equal variances assumed	12.030	0.001	7.278	70	0.000
	Equal variances not assumed			7.278	56.864	0.000

The data from the pretest are homogeneous, whereas the data from the posttest are not. In addition, the sig value for the posttest utilizes the value from the column not assumed: Equal variances. The t test results indicated that the students' CTs differed substantially from the beginning of the course, and the posttest confirmed this. Due to the fact that students' CTs differed before they were launched, the subsequent examination utilized the N-gain value.

Table 4. Mann Whitney of N-gain

Class		N	Mean Rank	Sum of Ranks	z	Sig.
N-gain	1.00	36	41.97	1511.00	-2.22	0.026
	2.00	36	31.03	1117.00		
	Total	72				

The Mann-Whitney test found a statistically significant difference between the percentage of students in the experimental group who showed an increase in CTs and those in the control group. These results show that PBL does have an effect on the way high school students think.

The learning initiatives in the experimental class are devised using PBL principles. In PBL-based students workbooks, problems serve as the central focus of learning. The problems demonstrated in learning exist in ordinary life (Mandasari et al., 2021; Nusantari et

al., 2020). The same sentiment was expressed by Birgili (2015), who stated that he utilized commonplace problems in his research. Researchers find PBL better than traditional learning because students may apply their own experiences to tackle real-world issues.

The findings of this research indicate that the pretest average of the experimental class before being given treatment was 66.83 and after students were given treatment using the PBL model the students experienced an increase of 81.42 (N-gain 0.44). That's why there is an influence from the application of using PBL. While the average pretest score for the control class was 61.33 and the posttest score was 74.56 using conventional learning where there was only a slight increase from the pretest score to the posttest score (N-gain 0.34). This demonstrates that there is a distinction between the CTs of students in PBL classes and those in non-PBL classes. According to Lukitasari et al. (2019), there is a distinction between the CTs of students who engage in PBL and those who engage in conventional learning.

The findings of the study demonstrate that project-based learning has an influence on the CTs of students. Students who participate in PBL have better CTs than students who do not participate in PBL. PBL influences the CTs of students because it encourages students to actively engage in the process of problem-solving and because it may assist in drawing students' attention to the content provided throughout the process of teaching and learning. This PBL has an effect on students' CTs because it helps students develop their CTs and problem-solving abilities and trains their independence (Ramlawati et al., 2017; Yomaki et al., 2023). In this study, PBL was successful in enhancing students' CTs. PBL has created learning environments that attract students and enhance CTs.

CONCLUSION

Based on the implementation of PBL to class XI IPA SMA Negeri 1 Mamasa students' CTs, the researchers concluded that there was an effect on students' CTs. The Sig. of N-gain is less than 0.05 based on the results of the Mann-Whitney test, indicating that students' CTs has improved.

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