BIOSFER: Jurnal Tadris Biologi Vol. 14 No. 2 (2023) 157-167

BIOSFER: JURNAL TADRIS BIOLOGI
p-ISSN: 2086-5945 (print), e-ISSN: 2580-4960 (online), DOI 10.24042/biosfer.v14i2.18414
http://ejournal.radenintan.ac.id/index.php/biosfer/index

How discovery learning effect student's critical thinking in biology based local potential?

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ARTICLE INFO

Article History
Received : 10-07-2023
Accepted : 17-11-2023
Published : 31-12-2023

Keywords:
Critical thinking; discovery learning; local potential.

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ABSTRACT

This study aims to determine how the effect application of discovery learning on students' critical thinking and how the influence of discovery learning on each indicator of critical thinking. This research is quasi-experiment with pretest-posttest control group design. This research was conducted at 3 SMA Pacitan District, there are SMANA Punung, SMAN B Pacitan, and SMAN C Ngadirojo. The population used in this study were all students of class X Science in 3 schools as research object. Data collection techniques in this study were carried out using test techniques. Data analysis technique in this study was carried out through Wilcoxon test while to find out how much students' critical thinking skills increased, N-gain calculations were carried out. The results showed that there were significant differences in influence of local potential-based discovery learning models on critical thinking aspects of interpretation indicators, analyzing and concluding students with Asymp scores. Sig. (2-tailed) < α value (0.000 < 0.05).

Bagaimana discovery learning mempengaruhi berpikir kritis peserta didik dalam pembelajaran biologi berbasis potensi lokal?

ABSTRAK: *Penelitian ini bertujuan untuk mengetahui bagaimana pengaruh penerapan discovery learning terhadap bepikir kritis siswa serta bagaimana pengaruh discovery learning pada tiap indikator berpikir kritis. Penelitin ini merupakan quasi-experimen dengan desain penelitian pretest-posttest control group design. Penelitian ini dilaksanakan di 3 SMAN Kabupaten Pacitan yaitu SMAN A Punung, SMAN B Pacitan, dan SMAN C Ngadirojo. Populasi yang digunakan dalam penelitian ini yaitu seluruh peserta didik kelas X IPA di 3 sekolah yang menjadi objek penelitian. Teknik pengumpulan data dalam penelitian ini yaitu dilakukan menggunakan teknik tes. Teknik analisis data dalam penelitian ini dilakukan melalui uji Wilcoxon sedangkan untuk mengetahui seberapa besar peningkatan keterampilan berpikir kritis peserta didik dilakukan perhitungan N-gain. Hasil penelitian menunjukkan bahwa terdapat perbedaan pengaruh yang signifikan antara model discovery learning berbasis potensi lokal terhadap aspek critical thinking pada indikator interpretasi, menganalisis dan menyimpulkan peserta didik dengan perolehan nilai Asymp. Sig. (2-tailed) < nilai α (0,000 < 0,05).*

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INTRODUCTION

Learning biology is part of educational process which is means to increase strengthening attitudes, knowledge and skills which lead to improvement of life skills. Life skills-oriented education needs to be implemented in Indonesia because content of curriculum tends to only strengthen theoretical-academic aspects, while empirical needs and problems in students' environment are not given enough attention, causing students less able to apply their learning abilities to needs and problems that occur their environment. Implementation of life skills learning places more emphasis on contextual learning, the relationship between real life and environment and experiences of students (Depdikbud, 2007);(Mudaningrat et al., 2022). Life skills that develop in students can obtained through series of activities exploring the natural environment through biology learning. This is because biology is concerned with systematically finding out and understanding nature. In addition, biology learning can be vehicle for students to learn about surrounding environment (Ramdiah et al., 2020).

Biology learning has great potential in utilizing the environment as learning resources (Imtihana & Djukri, 2020), one of which is by studying local potential which is internalized in biology learning. Local potential-based learning will train students to make observations, find various problems and provide solutions related to existing problems (Imtihana & Djukri, 2021) so it will provide positive aspects for students to be logical and critical in dealing a problem. It's because through local potential around the environment which is integrated in biology learning, it allows students to associate material with real-world situations and encourages students to connect knowledge with everyday life applications (Ardan, 2016). Learning process is not only enough to make students master science (knowledge transfer), but also how to use and implement this knowledge to overcome various life problems after joining the community.

Integration of local potential in biology learning can be done through several learning models, one of which is discovery learning (Sunarsih et al., 2020). Discovery learning helps students to analyze the problem and solve it themselves so students learn for themselves because discovery learning emphasizes process or not discovery (Addis et al., 2019). This is in line with the statement of Ramdiah et al. (2020) that biology is a process of discovery. Therefore, based on this statement researcher considers that biology learning process will be effective if using discovery learning so through this learning can maximize student learning outcomes.

Discovery learning is scientific learning model that can improve students' life skills, one of which is critical thinking aspects (Wahyudi et al., 2019);(Iswati & Purwati, 2022);(Nuryana & Mubarok, 2022). Learning through discovery learning can involve students actively in learning process so it can trigger students to improve thinking skills and able to develop theory learned into real life practice (Iswati & Purwati, 2022). Therefore, discovery learning integrated with local potential is seen effective in improving students' thinking skills. Several research results have shown that through the integration of local potential in learning effectively improve students' critical thinking skills (Nurhidayati & Khaeruman, 2020); (Rahmi et al., 2023). This is interesting to study in areas that have a variety of local potentials.

Several studies have proven that students' critical thinking abilities can be improved one of which through discovery learning, such as research conducted by (Iswati & Purwati, 2022);(Rahmawati & Masykuri, 2021);(Chusni et al., 2021) stating that discovery learning proven effective in improving students' critical thinking through learning strategies that are relevant to biology topics used.

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The results of this research were then developed by researchers by integrating local potential as learning strategy through discovery learning to improve students' critical thinking abilities. What differentiates this research from research that has been conducted is that in the syntax of learning through discovery learning, researchers integrate the local potential of the region.

One area that has various local potentials is Pacitan Regency. Pacitan Regency is one of the areas in East Java which geographically has local potential and has the potential to become biology learning resources based on results of several studies conducted such as beaches Muzaki et al. (2019) and karst caves Kurniawan et al. (2018). Based on this background, researchers want to apply biology learning through discovery learning based on local potential of Pacitan Regency to find out how it influences to students' critical thinking. To integrate local potential in biology learning, concrete biology materials relevant to local potential were used in this study, there are Pidakan beach and Song Terus karst cave. Therefore, ecosystem material was chosen in this study because it is considered relevant to local potential of Pacitan Regency which will be integrated. This research was conducted with the aim to find out how the influence application of discovery learning on students' critical thinking and how the influence of discovery learning on each indicator of critical thinking.

METHOD

This research is quasi-experiment, involving the placement (but not random placement) of participants into groups so the determination of class population is not random because there are already provisions from school. The research design used pretest-posttest control group design, where in this design there were two groups, there are experimental group and control group.

This research was conducted at 3 SMA Pacitan District, there are SMAN A Punung, SMAN B Pacitan, and SMAN C Ngadirojo. The selection of these schools was based on the following criteria: (1) having used local potential as learning resources, (2) applying the 2013 curriculum, (3) having an equivalent average value of Biology UNBK. This research was conducted from February to April 2021. The timing of this research was based on schedule for implementing learning on subject of ecosystems which was carried out at the end of the even semester.

Population used in this study were all students of class X Science in 3 schools that were the object of research. While the research sample is follows:

Table 1. Research Sample

Schools	Treatment	Class	Total of Students
SMAN A Punung	Experiment	X IPA 1	16
	Control	X IPA 3	15
SMAN B Pacitan	Experiment	X IPA 1	10
	Control	X IPA 2	13
SMAN C Ngadirojo	Experiment	X IPA 2	22
	Control	X IPA 1	20

Research Data Collection Techniques

Data collection techniques in this study were carried out using test techniques. The test used in this study was in the form of true-false questions containing elements of analysis in accordance with KD 3.10 of the 2013 curriculum on the subject of ecosystems based local potential. In addition to test techniques, research also uses observation techniques which aim to observe the implementation of learning activities carried out by teachers through learning implementation sheets in experimental class and control class. Observations in this study were carried out using unstructured observation. The stages of data collection techniques carried out in this study are follows:

1. Conduct observations at high schools in Pacitan Regency area to determine sample of schools, population size, local potential to be integrated and biology material to be taught

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2. Develop learning tools: syllabus, lesson plan, and other instruments
3. Performing the validity of expert judgment instrument
4. Conduct research instrument trials
5. Estimating validity and reliability of research instruments
6. Give pretest and posttest in each sample class
7. Analyze data

Research Data Analysis Techniques

Data analysis techniques in this study were carried out through descriptive analysis including the presentation of maximum value, minimum value, Mean (M), variance and Standard Deviation (SDi). Then Wilcoxon test was carried out to determine the effect application of discovery learning on students' critical thinking skills in biology material based on local potential. To find out how much students' critical thinking skills have increased, N-gain calculation is carried out which is then interpreted using the classification in table 2.

Table 2. N-Gain Criteria

N-gain Limit	Interpretation
g ≥ 0,7	High
0,3 ≤ g ≤ 0,7	Medium
g ≤ 0,3	Low

(Hake, 1998)

RESULTS AND DISCUSSION

This research was conducted in February-April 2021 at 3 Pacitan Regency State High Schools, there are SMAN APunung, SMAN B Pacitan and SMAN C Ngadirojo. Research implementation includes four stages there are pre-research, initial data collection, implementation of learning activities, and final data collection.

The first stage of research is pre-research. Pre-research activities include observation and validation of research instruments. Observation activities were carried out to obtain information about schools that have utilized local potential in biology learning, class X biology subjects that utilized local potential, and types of local potential used in biology learning.

The second stage in this study was initial data collection which was carried out through pretest activities on students to see the extent of students' initial abilities.

The third stage in this research is implementation of learning activities. Learning activities are carried out in 6 classes in 3 schools with each school using 2 classes including an experimental class that applies control class learning model. Learning activities were carried out for 3 meetings in both experimental class and control class.

The fourth stage in this research is final data collection which is carried out through posttest activities. Results analysis of students' critical thinking skills through discovery learning can be seen in table 3.

Table 3. Results Analysis of Students' Critical Thinking

No	Descriptive Statistics	Experiment		Control	
		Begin	end	Begin	end
1.	Maximum value	90	96	84	92
2.	Minimum value	24	30	36	24
3.	Mean	55,71	66,29	63,44	66,19
4.	Variance	345,232	239,530	171,102	324,496
5.	Standard Deviation	18,580	15,477	13,081	18,014
6.	Sample (N)	48		48	
7.	N-gain	0,38		0,07	

If viewed based on N-gain criteria according to (Hake, 1988), the increase in students' critical thinking skills is in the medium category for experimental class, and low for control class. When viewed from each school, the increase in critical thinking varies both in experimental class and control class. Results analysis of students critical thinking in each school are follows in Table 4.

Based on table 4, it can be seen that the increase occurred in each SMAN in Pacitan Regency area, there are: SMAN Punung was in the medium category for experimental class and low for control class, SMAN B Pacitan was in the medium category for

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experimental class and control class, SMAN C Ngadirojo is in the medium category for experimental class and low for control class.

To find out how much influence the application of discovery learning has on students' critical thinking skills, different test was carried out through Wilcoxon test with the help of IBM SPSS Statistics 23 for windows program. Results of Wilcoxon test on academic life skills in critical thinking aspect of class X students of senior high schools in the Pacitan Regency are follows in Table 5.

Based on table 5, it can be seen that Asymp.Sig. (2-tailed) in experimental class is 0.000 > 0.05, while in control class value is Asymp.Sig. (2-tailed) 0.148 > 0.05. These results indicate that there is significant difference between students who take part in learning using discovery learning model based on local potential (experimental class) and students who do not use discovery learning model (control class) on critical thinking. Results of the different tests on each indicator academic life skill aspect of critical thinking can be seen in Table 6.

Based on table 6, it can be seen that learning through discovery learning models based on local potential has an influence critical thinking on interpretation indicators (0.000), analyzing (0.013) and concluding (0.003) with Asymp.Sig values. (2-tailed) is smaller than 0.05, and has no effect on critical thinking on explaining (0.131) and evaluating (0.092) indicators with Asymp.Sig values. (2-tailed) is greater than 0.05 .

Table 4. Results Analysis of Students' Critical Thinking in Each School

School Identity	Class	Descriptive Statistic					
		Max. value	Min. value	Mean	Variance	Standard Deviation	N-Gain
School A	Experiment (begin)	76	30	48,50	274,933	16,581	0,31
	Experiment (end)	88	36	65,50	199,600	14,128	
	Control (begin)	74	36	58,00	195,429	13,980	0,05
	Control (end)	86	24	55,87	353,410	18,799	
School B	Experiment (begin)	81	54	67,50	77,611	8,810	0,31
	Experiment (end)	82	60	73,90	35,656	5,971	
	Control (begin)	83	64	71,23	34,026	5,833	0,44
	Control (end)	92	71	83,92	33,410	5,780	
School C	Experiment (begin)	90	24	55,59	437,206	20,909	0,30
	Experiment (end)	96	30	63,41	341,491	18,479	
	Control (begin)	84	36	62,45	191,839	13,851	-0,00
	Control (end)	82	30	62,40	206,779	14,380	

According to Handoko et al., (2016), by using discovery learning students will be guided to find problems in the surrounding environment related to the ecosystem that exists in the student's local potential. This will allowstudents to think critically through discovery materials and understand nature systematically to solve a problem in the environment (Yolida et al., 2022).

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Discovery learning has the effect of making students think more critically to solve problems, look for answers to given problems and find their own knowledge concepts (Aprillia et al., 2022) . Students can express all the insights they have so that they can practice improving their critical thinking (Handayani et al., 2022).

Table 5. Results of Wilcoxon test

	Posttest Experiment-Pretest Experiment	Posttest Control-Pretest Control
Z	-4.719[b]	-1.448[b]
Asymp. Sig. (2-tailed)	.000	.148

Critical thinking measured in this study includes indicators explaining, interpreting, analyzing, concluding and evaluating (Aswanti & Isnaeni, 2023);(Sari et al., 2021). Indicators explaining include ability to identify and describe the components that make up Pidakan coastal ecosystem and Song Terus karst cave ecosystem, interpretation indicators include ability to interpret interactions between components in Pidakan coastal ecosystem and Song Terus karst cave ecosystem, analyzing indicators include ability to describe and differentiate the energy flow of Pidakan coastal ecosystem and Song Terus karst cave ecosystem, concluding indicators include ability to infer differences in Pidakan coastal ecosystem and Song Terus karst cave ecosystem, evaluating indicators include ability to assess and provide suggestions on alternative actions against damage in Pidakan coastal ecosystem and Song Terus karst cave ecosystem.

Table 6. Wilcoxon Test Results on Each Indicator of Critical Thinking

Indicator	Result Test	Experiment	Control
explaining	Z	-1,511[b]	-2,232[c]
	Asymp. Sig. (2-tailed)	0,131	0,026
interpreting	Z	-4,485[b]	-4,452[b]
	Asymp. Sig. (2-tailed)	0,000	0,000
analyzing	Z	-2,490[b]	-0,372[b]
	Asymp. Sig. (2-tailed)	0,013	0,710
concluding	Z	-2,968[b]	-0,498[b]
	Asymp. Sig. (2-tailed)	0,003	0,619
evaluating	Z	-1,687[b]	-0,546[c]
	Asymp. Sig. (2-tailed)	0,092	0,585

Wilcoxon Signed Ranks Test
Based on negative ranks.
Based on positive ranks.

Utaminingsih et al. (2021) states that critical thinking can be increased through discovery learning integrated with local potential. This is in accordance with results of this research study that discovery learning based on local potential has influence on academic life skills in aspect of critical thinking (Haka et al., 2020). Rudibyani (2018) states that discovery learning is effective and has high effect size in increasing critical thinking skills. Furthermore, Rudibyani (2018) states that when students learn through active participation in expressing concepts accompanied by research activities, this can improve cognitive skills so students able to develop, perfect and expand ideas about their findings. In addition, through discovery learning, students are required to organize themselves topics studied (Göbel, 2021).

Haka et al., (2021) states that through various activities of gathering information, comparing, categorizing, analyzing, reorganizing and making conclusions about what is learned. In addition, through variety of information related to local potential that is integrated into learning process, students will be motivated to know more about it. So, at the end of lesson, in addition to getting learning concept about the topics studied, students also get knowledge about local potential of the area. Therefore, through learning that makes students learn for themselves through learning experiences to

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organize knowledge, it will affect the achievement of effective learning (Mahmoud, 2014). The absence of influence on all indicators of critical thinking can occur due to the incomplete learning syntax of discovery learning (Pangestuti et al., 2019).

Based on this, it can be concluded that discovery learning based on local potential can affect academic life skills in critical thinking aspect. Life skills are competencies that help person able to function properly in environment where they live so as to enable individuals able to know what to do and how to do it (Saravanakumar, 2020);(Hasan et al., 2023). Life skills help students develop social competence and problem-solving skills to form identity (Saravanakumar, 2020). Discovery learning based on local potential is learning model that can bridge students to develop life skills through exploration, self-monitoring, and knowledge construction (Zhang et al., 2014) so as to facilitate students to develop reasoning processes and improve problem solving Johnson (2019) because learning biology is not only about mastering collection of knowledge but also process of discovery (Ramdiah et al., 2020). Nisa et al. (2020) states that integration of local potential in learning through discovery learning model can increase interest in learning and the abilities of students are more developed when participating in learning.

Through discovery learning based on local potential, students will gain knowledge about local potential of the area so with this knowledge students can develop their life skills with the aim of students being able to develop local potential around them to learn Kurniawati et al. (2017) and also know the values of local wisdom and potential considering values of local potential that are starting to fade and be abandoned Uge et al. (2019) so students will experience internalization of values that can make them character Wilujeng et al. (2017) and increase understanding of local potential values of the region.

This research results in line with similar research that has been conducted previously that discovery learning can improve students' critical thinking skills in biology. It can be seen in Table 7.

Table 7. Comparison of Research Results with Similar Studies

Journal	Results
Similar Research	
Rizhal Hendi Ristanto, Arin Sabrina Ahmad, Ratna Komala (2022)	There is an influence of guided discovery learning on students' critical thinking with p-value of t-test was 0.000 at the significance level of α = 0.05 aspects of drawing conclusions, interpreting, and clarifying or explaining
Sri Utaminingsih, Rihayati, Santoso (2021)	Discovery learning model based on the ethnoscience being effective to improve students critical thinking with a significance level of t-test 0.000 < α = 0,05
Martauli Aritonang, Muhammad Mona Adha, Pargito, & Pramudiyanti (2023)	Discovery-based learning modules are effectively used in the learning process and can improve the critical thinking skills through the t-test before 0.000, which means that there is a significant average difference
Dahlan Abdullah, S. Susilo. R. Romdanih, & S. Sujinah (2022)	The use of discovery learning has an effect on students' critical thinking skills with tcount 2.031 > ttable (1.668). All critical thinking indicator (interpretation, analysis, evaluation, inference and explanation) show in medium category
This Research	
Ezif Rizqi Imtihana & Riani Ken Utami (2023)	There were significant differences in influence of local potential-based discovery learning models on critical thinking aspects of interpretation indicators, analyzing and concluding students with Asymp scores. Sig. (2-tailed) < α value (0.000 < 0.05).

Table 7 shows that results of research had been carried out are the same as similar research previously, that through discovery learning students' critical thinking skills can improve based on the t-test results. This shows that discovery learning can effectively be an alternative learning model in improving students' critical thinking skills. By paying attention to the characteristics of

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material and its suitability for choosing the right material (Tan et al., 2023), discovery learning can be solution to overcome problems in relation to students' thinking abilities (Mulbar et al., 2021).

CONCLUSIONS AND SUGGESTIONS

Based on results and discussion that has been done, the conclusion of this study there are significant differences in influence of local potential-based discovery learning models on critical thinking aspects of interpretation indicators, analyzing and concluding students of class X SMA in Pacitan Regency on ecosystem material with Asymp value acquisition. Sig. (2-tailed) < α value (0.000 < 0.05). This research is study that aims to provide empirical evidence about the influence of discovery learning models based local potential on students' critical thinking skills not only theoretically, so local discovery learning models based local potential can be an alternative to biology learning models used to improve critical thinking aspects.

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