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Improving critical thinking of low ability students through TPS and PBL integration in biology learning

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ABSTRACT
Learning needs to develop student's critical thinking because critical thinking is at the core of knowledge construction. Both high and low-ability students should be encouraged to develop critical thinking skills. This research aimed to determine the effect of integrating the Think Pair Share (TPS) and Problem Based Learning (PBL) strategies on closing the critical thinking gap between higher and lower academic skill. The research design is quasi-experimental and was conducted using a pretest-posttest non-equivalent control group design conducted in Kota Metro Lampung in Indonesia. Data on critical thinking skills were obtained by essay tests targeting the ability to formulate problems, argue, deduce, induce, and evaluate. Data were analysed using ANCOVA. It was found that there was an effect of TPS and PBL integration on critical thinking ability. There was no effect of the interaction between learning method and academic ability which led to this increase in critical thinking. TPS and PBL integration were effective in improving the critical thinking of lower-ability students in biology learning by about 24.63%. The researcher suggests that the teachers need to implement TPS and PBL integration in biology learning.

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Introduction

Biology learning should develop students' critical thinking skills as well as imparting knowledge. Through critical thinking, students can solve real-life problems. Critical thinking is a 21st century skill (Baran et al 2022). However, students generally have different characters and academic abilities (Muhfahroyin, 2009) Bene et al (2021) noted that academic performance has long been

associated with successful learning and studying strategies that are governed by cognitive processes. In line with this, (Yusnaeni et al., 2017) states that based on academic ability, there are three groups of students: students with high academic abilities, students with moderate academic abilities, and students with low academic abilities. (Corebima, 2007a); (Corebima, 2007b) advises that educators must consider the gap between high and low academic students in learning; it is hoped that the gap will be smaller, both in the process and in the learning outcomes. To minimise the gap between learning outcomes, teachers must facilitate student learning through methods that empower students with different academic abilities. The *Kota Metro* (City of Metro) is one of the preferred learning destinations for students from Metro city and other regions in Indonesia. This is supported by the number of schools and universities, the teacher-student ratio, and more comprehensive learning facilities compared to other cities. The learning characteristics in the classroom are characterised by teachers empowering students in various aspects of competence and learning objectives, including cognitive, affective, psychomotor, science process skills, and critical thinking. Teachers in schools continue to improve their competencies by practising student-centred learning methods such as cooperative, collaborative, and contextual learning. However, teachers generally do not integrate two or more learning methods.

Learning in City of Metro in general, students have not met the minimum completeness criteria. Even classical completeness only achieved 54%, even though the teacher has analysed learning completeness by paying attention to the aspects of determination, including complexity, carrying capacity (facilities), and student intake (Muhfahroyin, 2008). Teachers in learning have not considered different academic abilities in the classroom. Learning strategies employed by teachers have generally not addressed the gaps between high and low ability students (Muhfahroyin, 2008).

Based on the reality of national education and especially education in City of Metro, efforts are needed to assess learning strategies to improve learning outputs and outcomes. One learning strategy that encourages critical thinking skills, constructivist orientation, and a learning community is cooperative learning (Arends, 2004) (Slavin, 1995). According to (Slavin, 1995) students learn to complete the material and share their thoughts through cooperative learning. Contextual learning and cooperative learning would train students' togetherness in diversity and social skills. (Lord, 2001) noted that cooperative learning will improve students' biological science thinking skills, attitudes, evaluation, social skills, and practical skills. According to Ilkorucu et al (2022) cooperative learning can be effectively used in secondary schools to improve critical thinking skills including the thinking abilities of students with low academic abilities (Corebima, 2007a; 2007b).

Cooperative learning has various types, including Think Pair Share (TPS) and Problem-based Learning (PBL). The Think Pair Share (TPS) strategy in its syntax (step of learning method) provides the opportunity for students to think deeply about the questions posed by the teacher, then discuss these in groups or pairs and finally explain to the whole class (share) (Slavin, 1995); (Arends, 2004). The TPS strategy allows students to make the most of the waiting time to sharpen the logic of thinking. Thinking from the problems or questions given by the teacher will improve students thinking. Questioning can play a central role in developing students' intellectual abilities; questions can guide thinking and test it. (Allen & Tanner, 2002). (Muhfahroyin & Santoso, 2019) stated that syntax modification and integration between learning strategies can improve critical thinking and biology learning outcomes. According to Fuad et al. (2017) and Zubaidah et al. (2017) there are different critical thinking skills in different learning methods and between male and female students.

In the PBL method, students practise critical and systematic thinking, improve cognitive learning outcomes, and improve metacognitive abilities in solving problems (Weissinger, 2004); (Tan, 2007). Through PBL, students can simultaneously analyse obtaining data and test hypotheses based on the data they arrived at (Marra et al., 2014). Learning is accompanied by practice so that it becomes exciting and meaningful, and students gain experience practicing in the context of real-life issues (Agustin, 2013); (Bintang et al., 2020). Such learning patterns can impact students' reflective abilities to problems faced in real life so that students can be a valuable part of their environment (Farisi et al., 2017); (Al-fikry, Yusrizal & Syukri, 2018).

PBL as a learning method can stimulate students to think at higher levels (Mergendoller et al., 2006). In line with that, (Aman, 2019) states that PBL improves critical thinking skills in integrated quality management and information systems. The teacher's role in PBL is to provide teaching materials and help guiding students. Presentation of problems is by the teacher, while problem-solving is carried out by students (Agustin, 2013). Through the knowledge that students have about data collection procedures and compiling a series of questions, then they are lead to critical thinking and problem solving (Lismaya, 2019).

The syntax of TPS and PBL have different emphases. PBL strategies provide opportunities for teachers to facilitate students to solve a problem through group work while TPS focuses on the ability to think individually, discuss with a partner, then share the results of the discussion with other students in the class. The integration of TPS and PBL has high synergy so it would be expected that this approach would improve students' critical thinking. The questions in this research were 1) whether the integration of TPS and PBL can improve the critical thinking skills, 2) whether the integration of TPS and PBL can close the gap in critical thinking skills between higher and lower ability students?

Methods

Research Design

The research design was quasi-experimental that examined the effect of TPS and PBL integration on critical thinking ability, especially for students with low academic ability. The study's design was *a pretest-posttest non-equivalent control group design* and using factorial design 2 x 2. Experimental design and procedures are presented as follows (Table 1 and 2).

Table 1

Factorial Design 2 x 2

Academic Ability (Y)	Method (X)	
	TPS + PBL (X1)	Conventional (X2)
High (Y1)	X1Y1	X2Y1
Low (Y2)	X1Y2	X2Y2

Note. X1Y1 = TPS and PBL integration in higher ability students; X1Y2= TPS and PBL integration in lower ability students; X2Y1= Conventional method in higher ability students; X2Y2= Conventional method in lower ability students.

Table 2

Experimental Procedures of Pretest-Posttest Non-equivalent Control Group Design

Pretest	Group	Posttest
T1	X1Y1	T2
T3	X1Y2	T4
T5	X2Y1	T6
T7	X2Y2	T8

Note. T1, T3, T5, T7 are pretest score; T2, T4, T6, T8 are posttest score; X1 is TPS and PBL Integration method; X2 is conventional method; Y1 is higher ability students; Y2 is lower ability students

Population, Sample, and Procedures

The research was conducted during one semester at senior high schools of Metro Lampung, Indonesia. The population of the research were all the students of Biology in the academic year 2018/2019. The samples of the research consisting of 80 students taken by *simple random sampling* and spread in two different classes. Each class was taught by using different teaching approaches, namely TPS and PBL Integration (40 students) and conventional learning (40 students). The unit being taught was on biodiversity and ecosystems. All of the methods were taught by the biology teacher in all classes. The learnings syntaxes were conducted in the two classes described further below.

The syntaxes in the TPS learning method include: (1) thinking, (2) pairing, (3) sharing. The PBL method has a syntax consisting of five stages of learning, namely: (1) organising students into problems, (2) organising students to learn, (3) assisting independent and group investigations, (4) developing and presenting tasks and exhibitions, 5) analysing and evaluating the problem-solving process.

Based on both TPS and PBL syntaxes above, the researcher integrated the two syntaxes described above. The TPS and PBL Integration has syntaxes: (1) organising students into problems, (2) organising students to learn (in this syntax integrate with 'thinking' and 'pairing"), (3) assisting independent and group investigations, (4) developing and presenting tasks and exhibitions (in this syntax integrate with 'sharing'), 5) analysing and evaluating the problem-solving process.

The learning activities in the conventional class were not given special treatment by the researcher. The learning activities include: lecturing by the teacher, questioning, and answering between the students and the teacher.

The population of this study was students of class X SMA in Metro City in 2019. Sampling was carried out by simple random sampling to determine the school and class as the research location. One class is used for the TPS and PBL (I) integration learning scenario and 1 (one) class for conventional learning (C). Students in the treatment class were taken 50% (20 students) for high academic students and 50% (20 students) for low academic students. Likewise, in the conventional class (C), so that the total sample is 80 students. The grouping of students' academic abilities is based on the SMP (Junior High School) National Examination (UN) scores. The instrument used to measure critical thinking skills in this study was a description test.

The instrument was developed by the researcher, starting from constructing a framework of critical thinking ability, followed by constructing the instrument. After that, the instrument was validated by biology material expert, evaluation expert, and language experts. After the instrument had been validated by the experts, the instrument was piloted on a class that was not involved in the study. Instrument testing was carried out to obtain instrument validity and reliability before it was used in the study. The validity test used Pearson's correlation and the reliability test used Cronbach's Alpha. After the instrument was declared valid and reliable, it was then used to collect research data on the research sample. Data analysis was performed using SPPS version 25 for Windows.

The data collection stage in the study has conducted a pretest, learning observation, and posttest. Data were analysed by using ANCOVA (Montgomery, 2019) and (Winarsunu, 2017). Statistical analysis was performed with a significance level of 0.05 ($p < 0.05$). Before testing the hypothesis, the prerequisite test for normality, and homogeneity of the data were first carried out. The normality test used the One-Sample Kolmogorov-Smirnov test. The homogeneity test used Leven's Test of Equality of Error Variances (Winarsunu, 2017). Test calculations were carried out using the SPSS 25 for Windows programme.

Results

The research data were analysed using assumption tests, namely normality and homogeneity tests. The normality and homogeneity test can be seen in Table 3 and 4. Based on the Table 3 and 4, it

can be stated that the research data are homogeneous. After the assumption test is fulfilled, then the hypothesis is tested with ANCOVA.

The average pretest, posttest, and their category learning outcomes scores can be explained as follows. The average score of the pretest learning outcomes in all groups of research subjects was in the poor category. The groups are the integration of TPS and PBL (I), conventional strategy (C), higher ability (HA), and lower ability (LA). Likewise, with the interaction of integration between TPS and PBL (I) with higher ability (HA), interaction between TPS and PBL (I) integration with lower ability, the interaction of conventional strategies (C) with higher ability (HA), and interaction of conventional methods (C) with lower ability (LA).

Table 3

Normality Test Using One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		80
Normal Parameters[a]	Mean	.0000000
	Std. Deviation	2.28898767
Most Extreme Differences	Absolute	.101
	Positive	.101
	Negative	-.070
Kolmogorov-Smirnov Z		.905
Asymp. Sig. (2-tailed)		.386

Based on Table 3 the data from the research are normally distributed. Furthermore, the data were analysed using the homogeneity test. The results of the homogeneity test can be seen in Table 4. The results of the hypothesis test can be seen in Table 5.

Table 4

The Result of Homogeneity using Levene's Test of Equality of Error Variances

F	df1	df2	Sig.
1.951	3	76	.128

Note. Tests the null hypothesis that the error variance of the dependent variable is equal across groups; a. Design: Intercept + Pretest + Academic Ability + TPS_and_PBL + Academic Ability * TPS_and_PBL

Meanwhile, the mean score of the subject group's posttest critical thinking on the interaction of integration of TPS and PBL (I) with high ability (HA) is in a good category, as well as the interaction between TPS and PBL (I) integration with low ability (LA) is in a good category. The average posttest biology critical thinking ability test scores of the subject group on the interaction of conventional (C) and high ability (HA) strategies was in a good category. Likewise, the interaction between conventional (C) and low ability (LA) strategies is also in the good category. The complete average scores of critical thinking skills in the pretest and posttest can be seen in Table 6 and Figure 1.

Table 5

Summary of Ancova Test Results the Effect of Treatment on Critical Thinking

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	225.721[a]	4	56.430	20.472	.000	.522
Intercept	1670.202	1	1670.202	605.926	.000	.890
Pretest	12.586	1	12.586	4.566	.036	.057
Academic Ability	20.819	1	20.819	7.553	.008	.091
TPS_and_PBL	188.296	1	188.296	68.311	.000	.477
Academic Ability * TPS_and_PBL	13.049	1	13.049	4.734	.033	.059
Error	206.733	75	2.756			
Total	478324.253	80				
Corrected Total	432.454	79				

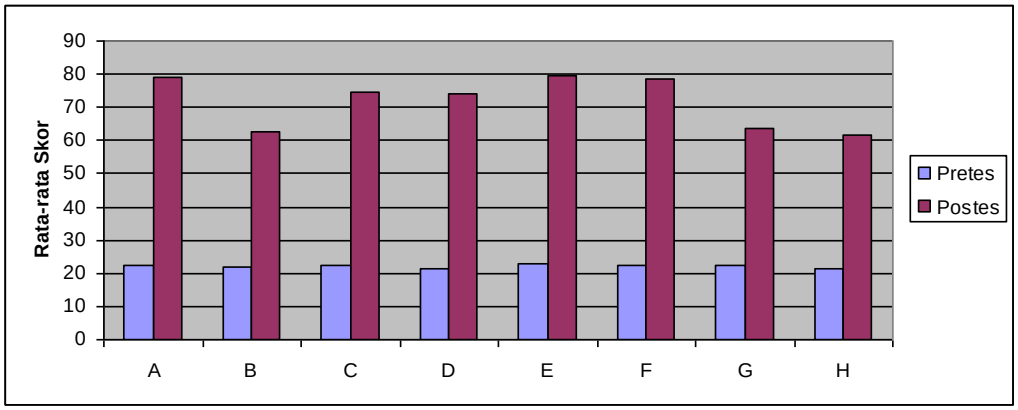
Table 6

The Average of Critical Thinking Score in the Pretest and Posttest

No.	Method	Pretest	Category	Posttest	Category
A	TPS and PBL Integration (I)	35.99	Poor	78.77	Good
B	Conventional (C)	33.88	Poor	75.80	Good
C	Higher Ability (HA)	43.10	Poor	79.73	Good
D	Lower Ability (LA)	28.89	Bad	77.82	Good
E	Interaction I - HA	43.10	Poor	79.73	Good
F	Interaction I - LA	28.89	Bad	77.82	Good
G	Interaction C - HA	42.77	Poor	75.90	Good
H	Interaction C - LA	26.64	Poor	75.71	Good

Figure 1

Average of Critical Thinking Score in the Pretest and Posttest



Note: A = TPS and PBL integration (I); B = Conventional (C); C = Higher Ability (HA); D = Lower Ability (LA)
E = I - HA interaction; F = I - LA Interaction; G = C - HA Interaction; H = C - LA Interaction.

The average score of students' critical thinking skills on integrating TPS and PBL (I) was higher than the conventional strategy (C). TPS and PBL (I) integration have an average critical thinking score of 24.63% higher than the average critical thinking score in conventional strategies (C). A summary of the Ancova test results can be seen in Table 4.

In the analysis of students' academic ability, the p-level was greater than alpha 0.05 ($p > 0.05$) with Sig. 0.55. This result means H0, which stated, "There is no difference in critical thinking skills between high academic and low academic students," is accepted. The research hypothesis states, "There is a difference in critical thinking skills between higher academic and lower academic students," is not accepted.

The analysis of the interaction between learning methods and students' academic abilities showed that the p-level was greater than alpha 0.05 ($p > 0.05$) with Sig. 0.527. This result means that H0, which states, "There is no interaction effect between the integration of TPS and PBL with academic ability on critical thinking skills of biology," is accepted. The research hypothesis states, "There is an interaction effect between the integration of TPS and PBL with academic ability on critical thinking skills," is not accepted. The average critical thinking scores of students from the highest to the lowest is found in the interaction: 1) integration of TPS and PBL (I) and higher ability (HA), 2) integration of TPS and PBL (I), and lower ability (LA), 3) conventional (C) with higher ability (HA), 4) conventional (C) and lower ability (LA). The average score of students 'critical thinking on the interaction of integration of TPS and PBL (I) and higher academic (HA) was 1 % higher than the average score of students' critical thinking skills in the interaction of TPS and PBL (I) integration and lower academic (LA). That is, the average critical thinking score of lower academic students increases closer to higher academic students.

Furthermore, assessed from the comparison between interactions, obtained the following comparisons: interaction between TPS and PBL (I) integration with higher academics obtained an average score higher than the average score of critical thinking on the interaction of integration of TPS and PBL (I) with lower academics. The interaction of the integration of TPS and PBL (I) with higher academic (HA) and lower academic (LA) obtained an average score higher than the average score of critical thinking skills in conventional learning (C) with higher academic (HA) and lower academic (LA). The conventional learning interaction (C) with higher academic (HA) has an average score higher than the average score of critical thinking interaction between conventional strategies (C) and lower academic (LA).

Discussion

The Effect of TPS and PBL Integration on Critical Thinking Skills

The results of this study indicate that learning with the integration method of TPS and PBL has a significant effect on students' critical thinking skills. Students who learn with the TPS and PBL integration methods have an average increase in critical thinking scores higher than students who learn using conventional methods. The increase in critical thinking skills can be seen from the increase in the average score of the pretest compared to the average post-test critical thinking. If it is revealed that the average score is corrected, then the students who learn with the TPS and PBL integration method are higher than those who learn with the conventional method.

This finding is in line with several previous types of research conducted by (Muhfahroyin, 2009) that learning with the TPS method can improve students' critical thinking skills. After the syntax of the TPS and PBL methods is integrated, it turns out that it increases the average critical thinking of lower academic students, closer to the higher academic students. This is supported by the role of PBL being able to improve students' critical thinking skills, which are helpful for solving problems (Munawarah et al., 2018).

In practice, the TPS and PBL integration learning method for students in the class is formed into study groups with 4-5 members. Each group has heterogeneous members, consisting of male and female, various ethnic groups, high, medium, and low academic abilities (Slavin, 1995); (Arends,

2004). Furthermore, (Marni et al., 2020) states that students regardless of gender differences and science clusters needed critical thinking skills. Based on learning context in various groups, there was no need to differentiate gender even though there were differences in the number of a certain gender in one class. All members of the group with different characters come together for effective learning. Group work carried out in the TPS (thinking, pairing, and sharing) scenario was integrated with PBL, which contains solving biological problems. The integration of these two methods has advantages, namely group work in TPS, with the PBL method's strengthening (Muhfahroyin & Santoso, 2019). Strengthening critical thinking is also caused by the habit of students solving problems (Agustin, 2013). Through their knowledge, students learn about data collection procedures and formulate questions that lead to critical thinking and problem solving (Lismaya, 2019). Through PBL, students can perform analysis simultaneously to obtain data and test hypotheses based on the data they got (Marra et al., 2014). Through PBL, the opportunity to interact between students can be facilitated, learning accompanied by practice to be exciting and meaningful. Students gain practical experience in the context of real-life (Agustin, 2013); (Bintang et al., 2020). Continuous learning, mutual interaction between students, and application to analysis can strengthen critical thinking skills.

The effect of TPS and PBL Integration towards Critical Thinking Skills of Lower Ability Students

The average critical thinking score on TPS and PBL integration was higher than by the conventional method. Learning that is carried out by integrating TPS and PBL emphasises critical thinking carried out by students in class, followed by group work to solve problems. Group members work together using activity sheets and other learning facilities to complete the learning material. Furthermore, students help each other to understand the learning material. Each student conducts questioning and answering in groups, tutorials, quizzes, or has a discussion. Group work is carried out by emphasizing the stages of thinking, pairing, and sharing to solve the problems. Good cooperation in groups is shown by the scaffolding of higher academic students to lower academic students. Scaffolding occurs in pairing and sharing so that higher academic students highly facilitate lower academic students. This learning has some perspectives: motivational, social, cognitive, cognitive elaboration, and psychology (Slavin, 1995); (Arends, 2004). The learning process with the integration of TPS and PBL is in accordance with the constructivist learning paradigm. Constructivist learning emphasizes the development of students' ability to solve problems (Nur, 2000). In other words, lower academic students increase very high in critical thinking. The gap of critical thinking between the lower academic students is getting closer to the higher academic students. According to (Muhfahroyin & Santoso, 2019), the integration of appropriate learning methods could improve the quality of learning outcomes and other students' abilities.

In this study, academic ability did not significantly affect students' critical thinking skills. This study indicates that lower academic students obtain an average critical thinking score, which is almost the same as higher academic students. The results of this study are different from (Nasution, 1988), who stated that students with different academic abilities would also have different learning. This study's results are also not in accordance with the results of previous research conducted by (Tindangen, 2006), which states that upper and lower ability students who take the same learning experience different critical thinking skills. The study conducted by these two researchers concluded that upper academic students got higher critical thinking skills than lower academic students. Both of their researches tend to be natural, that in a learning higher academic students will get better learning outcomes than lower academic students.

The average score of students 'critical thinking on the interaction of TPS and PBL (I) integration with higher ability (HA) was only 1% higher than the average score of students' critical thinking skills in the interaction of TPS and PBL (I) integration with lower academics (LA). Further investigations, crosscheck of the mastery learning criteria, the mastery learning can be achieved by both high and low academic students. These findings can be used as a basis for recommendations that to achieve learning completeness, teachers do not have to conduct a remedial teaching programme,

but the teachers can choose learning that empowers higher ability students to scaffold lower ability students. This research is consistent with (Alake & Ogunseemi, 2013) that the students exposed to scaffolding strategy performed significantly better than their counterparts exposed to the traditional method. Scaffolding is significant to help lower ability students in achieving learning results. Thus, the ability to think critically of lower academic students increases and closes higher academic students.

Conclusion and Implications

Conclusion

Based on the results of this research, it can be concluded as follows. 1) There is an effect of learning methods towards critical thinking skills. The average score of students learning with TPS and PBL (I) integration was 24.63% higher than the conventional method (C). 2) There is no difference in the critical thinking skills of higher academic and lower academic students. 3) The average score of students' critical thinking on the interaction of TPS and PBL (I) integration with top academic (HA) is only 1.00% different from the average score of students' critical thinking skills in the interaction of TPS and PBL (I) integration with the lower academic (LA). This minimal difference in critical thinking shows that there is a process of closing lower academic students towards higher academic students in critical thinking caused by TPS and PBL.

Implications

Some suggestions that can be conveyed concerning the results of this study are as follows. 1) The integration of TPS and PBL can improve students' critical thinking skills, therefore researchers suggest that high school biology teachers implement the integration of TPS and PBL in biology learning. 2) All higher and lower ability students can achieve mastery learning; therefore, researchers suggest that teachers have a map of students' academic abilities. This academic ability map is the basis for preparing student study groups in the implementation of TPS and PBL integration so that the scaffolding process runs well.

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Appendix

1. The Differences of TPS and PBL Integration and Conventional Learning Method

No	Differences	TPS and PBL Integration Learning Method	Conventional Learning Method
1.	Syntax	TPS and PBL Learning Method are new learning methods based on constructivism. The activities in the TPS and PBL Learning Method are students centred. The learning syntax consists of: 1. Identifying the problems. 2. Thinking and pairing. 3. Investigating problem-solving. 4. Sharing.	The conventional learning method in this research is the learning activities that are generally carried out by teachers without involving certain learning models. The learning activities include: discussions and lecturing.
2.	Teacher Role	1. Assisting students in identifying the problems. 2. Organizing students to learn (integrate with "thinking" and "pairing"). 3. Assisting group discussions. 4. Organizing student's presentations and exhibitions (in this syntax integrate with 'sharing'). 5. Analysing and evaluating the problem-solving process.	In this research, the conventional learning method is the learning activities in which teachers generally carry out without involving specific learning methods. The learning activities include discussions and lecturing.

2. The Lesson Plan of TPS and PBL Integration

Lesson Plan

A. Identity

- Subject : Biology
- Concept : Biodiversity dan Ecosystem
- Class Level : Grade 10
- Time Allocation : 6 x 45 minutes

B. Basic Competences

1. Explaining the concept of biodiversity and its relation with ecosystems.
2. Explaining the concept of interaction between organisms and their environment in an ecosystem.
3. Presenting examples of interactions between organisms in an ecosystem.
4. Solving an environmental problem.

C. Learning Indicators

After the students finish the learning, they are expected to be able:

1. Explaining the concept of biodiversity and its relationship with ecosystems.
2. Analysing the interactions between organisms and their environment in an ecosystem.
3. Identifying issues and problems in ecosystems.
4. Developing critical thinking skills in solving problems in the environmental issues and biodiversity.

D. Learning Method

1. Model : TPS and PBL Integration
2. Method : Investigation, Cooperative, Discussion, Presentation

E. Learning Media

1. Whiteboard and markers
2. Pictures and diagrams
3. Student's worksheet
4. Laptop and LCD projector

F. Learning Materials

1. Biodiversity
2. Concept and Structure of Ecosystem
3. Interaction between Components of Ecosystem
4. Environmental Problem in Ecosystem

G. Learning Activities

No.	Syntaxes of TPS and PBL Integration	Teacher's Activities	Students' Activities	Time Allocation (minutes)
A	**Introduction**	• The teacher opens the lesson • The teacher introduces the concept of biodiversity and its relationship with the ecosystem by examples • The teacher presents environmental problems and asks students to reflect on them.	• The students participate in the opening of the lesson • The students follow the teacher's explanation • The students reflect the environmental problems	**15**
B	**Main Activities**			
	Meeting 1			
	1. Organizing students into problems,	• The teacher presents a problem that will be solved in groups. • The problem should be contextual. The problem can be found by the students through reading materials.	• The student groups observe and comprehend the problem presented by the teacher. • The students learn to solve the problems found.	30

	2. Organizing students to learn (in this syntax integrate with 'thinking' and 'pairing"),	• The teacher ensures each student comprehends the task in the group • The teacher guides the students to do "thinking" and "pairing"	• The students participate in group to collect data and material to solve the problem • The students do "thinking" and "pairing" activities.	50
	3. Assisting independent and group investigations,	• The teacher monitors student involvement in collecting data/materials during the investigation process.	• The students conduct investigations (gathering data/ references/ materials) for group discussion purposes.	40
	Meeting 2			
	4. Developing and presenting works and exhibitions (in this syntax integrate with "sharing"),	• Opening ceremony for Meeting 2 • The teacher monitors the group discussions and guides the group in preparing their report for presentation "sharing" in the class.	• The students listen to the teacher's introduction in the second meeting. • Groups engage in discussions to arrive at solutions for problem-solving, and the results are presented and shared in class. • The students give presentations in front of the class.	60
	5. Analyse and evaluate the problem-solving process.	• The teacher guides the presentation. • The teacher guides the group to give appreciation. • The teacher guides the group to give feedback to other groups in problem-solving.	• Each group gives a presentation. • Other groups give appreciation to the presenter. • The students groups provide feedback to each other in problem-solving.	60
C	**Closing**	• The teacher and students summarize the learning materials.	• The students make conclusions based on the feedback received during on the class sharing.	15
				270

H. Learning Resources

1. Textbook of Biology for Grade 10
2. Material on Ecosystems and Environmental Issues
3. Video on Biodiversity and Ecosystems

I. Assesment

Essay questions: Critical thinking skills test