

The Effect of Using Ecology Modules on Communication Skills, Cognitive, and Student Attitudes Through Problem-Based Learning

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Abstract: Learning carried out in lectures really requires a variety of learning resources to improve student abilities for the better. During this time, lectures usually only use learning resources that do not vary much and tend to use only one source, so that student learning outcomes are not maximized. This research was conducted with the aim of improving student learning outcomes for the better, especially in communication skills, cognitive and student attitudes at Bina Bangsa University. The research method used is ADDIE development research starting from the stages of Analysis, Design, Develop, Implementation, and Evaluation. Module development is carried out by measuring its effectiveness on communication skills by means of observation sheets, measuring cognitive abilities with tests, while attitudes are observed with observation sheets. The application of the module in learning is carried out with a quasi-experimental design, then the results are analyzed descriptively with the ANCOVA statistical test using the SPSS application. The results showed that communication skills, cognitive abilities, and student attitudes had improved. Based on statistical tests conducted, there are differences in the achievement of learning outcomes between the control and treatment classes. In the treatment class, the application of problem-based learning modules showed a good improvement in the aspects of communication, cognitive, and student attitudes. However, based on the value of the gain score, the use of problem-based teaching modules on communication skills and student attitudes is in the range of low effectiveness, while in cognitive aspects it is in the range of moderate effectiveness. The use of ecology modules with problem-based learning has an important role, this is because real problem-based learning makes learning more contextual, especially in courses that use environmental problems as the main study.

Keywords: Attitude; Cognitive; Communication; Ecology Module

Introduction

Learning resources sourced from the surrounding environment have a very important role in improving student learning outcomes [1]. Learning resources at both basic and higher education levels are generally in the form of books that become their reference for learning. However, existing books are often not contextual or real learning resources in accommodating student learning in the classroom [2]. Books also usually contain materials whose material novelty value has not changed significantly. Departing from this problem, other types of learning resources to support students' ability to learn are important. One of the learning resources that can accommodate learning well is a lecture module or learning module.

Lecture modules are important in equipping students' communication skills, having a good impact on learning outcomes, and student attitudes, so students who learn from the modules that are compiled have much better abilities than students who do not learn them. Especially if the module is arranged with problems that occur in real life (contextual).

Lecture modules are teaching materials that contain concepts and lecture program units [3]. The module provides students with the opportunity to study independently according to their individual learning pace

[4-5]. The preparation of the module itself is arranged according to learning needs [6], the packaging is attractive and systematic containing material, methods and evaluation for the expected goals [7]. Modules can also be arranged and developed based on constructivist learning theory [8], have advantages in mastering lecture material [9], provide feedback and motivation [10] and solve problems or learning difficulties.

The use of modules in lectures can improve learning outcomes [11], improve communication skills and attitudes [12] so that student grades can be more optimal [13]. Obtaining good grades is because the module can provide a positive and enthusiastic response to learning activities in the classroom [14]. Modules developed in lectures can be developed by adapting to the characteristics of the students, this allows lecture outcomes to be in line with the desired objectives [15].

Modules can also be developed based on contextual or authentic problems raised from problems in their environment, this allows students to study concepts that are close to their own lives. Problem-based modules based on several studies have had a significant effect on students' communication skills [16], influence cognitive learning outcomes [17-18] and their attitudes [19-20]. The problem-based learning module provides opportunities for independent learning in problem solving, being able to find

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out the results of one's own learning and optimal mastery of learning [21]. Modules as learning resources can improve their own learning abilities, substitute for the function of educators which can facilitate their understanding according to their knowledge and age level, have relevance for assessing their own mastery of the material and function as a reference [9].

Research Methods

The module used was developed based on Branch [22] with development based on the ADDIE stages. ADDIE development has stages 1). analyze (Analyze); 2). design (Design); 3). develop (Develop); 4). implement (Implement), and 4). evaluate (Evaluate) with module revisions made at each step. All stages of module development are carried out from beginning to end so that the developed module is tested for effectiveness in learning. The module has also passed a series of feasibility assessments from media experts and material experts so that a module is produced that is suitable for use for student learning. The stages of ADDIE development are as follows (figure 1):

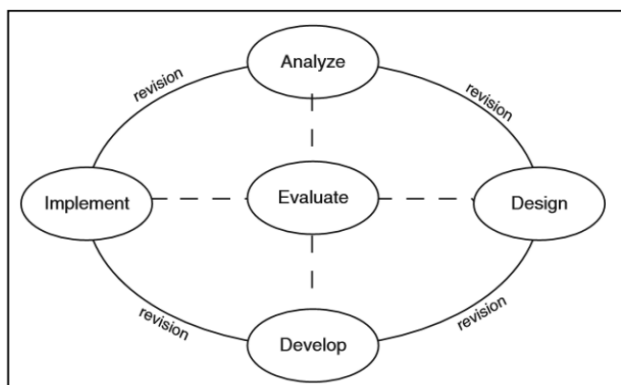


Figure 1. ADDIE Development Stages

Modules that are suitable for use will then be used by Education and Teacher Training Students at Bina Bangsa University in 3rd semester on academic year 2022/2023. A total of 65 students with the following details: Class A, Class B, and Class C. The three selected classes have previously been tested for equality, so that all selected classes have the same abilities. The research design carried out (table 1) is Pretest-Posttest Control Group Design [23] with the following scheme:

Table 1. Research Design

Group	Pretest	Treatment	Posttest
Treatment 1	O1	X1	O2
Treatment 2	O3	X2	O4
Control	O5	X3	O6

Information:

X1 = PBL's module

X2 = PBL

X3 = Non module

O1 = Initial score of treatment 1 class

O2 = Final score of treatment 1 class

O3 = Initial score of treatment 2 class

O4 = Final score of treatment 2 class

O5 = Initial score of control class

O6 = Final score of control class

The effectiveness of the module is also tested, to determine the level it is determined by the gain score value [24], with the following effectiveness assessment criteria (table 2):

Table 2. Gain Score

Gain Score	Criteria
$g \leq 7$	High Effectiveness
$0.3 \leq g \leq 7$	Medium Effectiveness
$g \leq 0.3$	Low Effectiveness

The effectiveness of the module applied in the class was previously tested for equality using the Anova test. After it was equal, a prerequisite test was carried out using the Kolmogorov-Smirnov test and Leven's Test using SPSS to find out normally distributed data in classes with the same variance. if the data is not normally distributed, a non-parametric statistical test is carried out, but if the data is normally distributed and homogeneous then the hypothesis test is carried out using covariance analysis (anakova) with a significance level of 0.05 ($\alpha < 0.05$) using pretest, posttest and sheet score data observation with the SPSS application.

Results and Discussion

Ecology Module Development Research with problem-based using ADDIE model development with the stages of analysis, design, develop, implementation and evaluation. The results of the development produced an ecology module used in lectures that have been tested for feasibility to be used based on the test of material experts and learning media experts at the college level. After obtaining an ecology module that can be used, the module is applied in learning to measure the skills, cognitive, and attitudes of students in semester 3 of Bina Bangsa University.

The application of the module in learning is carried out in 3 different classes, class A (control class) is not given any action, class B (PBL) and class C (PBL's module), in its implementation data acquisition in the class is provided with direct assistance to students, Then the observer observes student activities in ongoing learning.

Average Description of Students' Communication Skills

Data on the average communication skills scores from the pretest, posttest, and average in the three treatment classes are as follows:

Table 3. Average Communication Skills Scores from Pretest, Posttest, and Average

Class		Average	Increase
Control	Pretest	28.63 ± 1.25	2.73
	Posttest	31.36 ± 2.78	
PBL	Pretest	30.62 ± 6.53	6.72
	Posttest	37.33 ± 5.16	
PBL's Module	Pretest	29.59 ± 1.33	11.72
	Posttest	41.32 ± 2.12	

Based on the average results, it can be concluded that the difference in the average posttest scores of the class taught with PBL's modules is higher than PBL class and control class. The average pretest and posttest results

showed an increase in all classes, but the class with the PBL's module had the highest. The diagram of the average pretest and posttest scores of students' communication skills is as follows (figure 2):

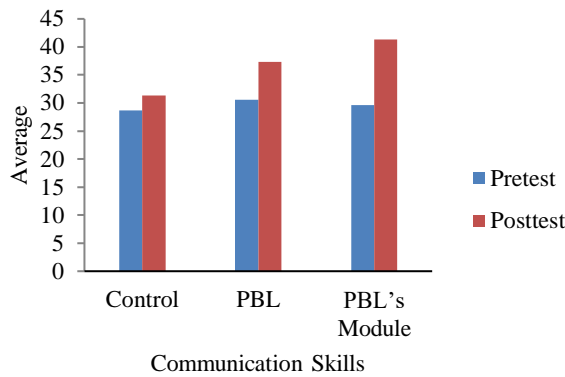


Figure 2. Average Pretest and Posttest Scores of Students' Communication Skills

Average Description of Students' Cognitive Learning Outcomes

Data on the average communication skills scores from the pretest, posttest, and average in the three treatment classes are as follows (table 4):

Table 4. Average Cognitive Learning Outcomes Scores from Pretest, Posttest, and Average

Class		Average	Increase
Control	Pretest	53,36 ± 5,33	16,95
	Posttest	70,31 ± 2,90	
PBL	Pretest	52,23 ± 3,04	19,95
	Posttest	72,19 ± 2,08	
PBL's Module	Pretest	52,86 ± 5,97	25,27
	Posttest	78,13 ± 3,53	

The results of this analysis can be concluded that the difference in the average posttest scores of the class taught with the PBL's module is higher than the PBL class and the control class. The average pretest and posttest results showed an increase in all classes, but the class with the PBL's module had the highest. The diagram of the average pre-test and post-test scores of students' cognitive learning outcomes is as follows (figure 3):

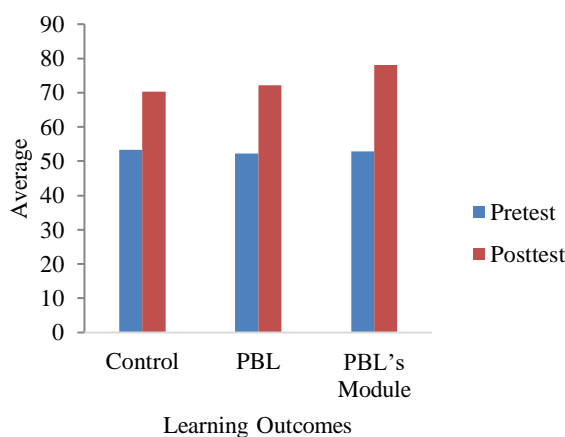


Figure 3. Average Pretest and Posttest Scores of Students' Cognitive Learning Outcomes

Average Description of Students' Attitudes

Data on the average attitude scores from the pretest, posttest, and average in the three treatment classes are as follows (table 5):

Table 5. Average Attitude Scores from Pretest, Posttest, and Average

Class		Average	Increase
Control	Pretest	63.53 ± 2.56	3.09
	Posttest	66.62 ± 3.43	
PBL	Pretest	63.39 ± 2.27	5.63
	Posttest	69.02 ± 3.24	
PBL's Module	Pretest	63.37 ± 2.26	8.99
	Posttest	72.37 ± 4.62	

The results of this analysis can be concluded that the difference in the average posttest scores of the class taught with the PBL's module is higher than the PBL class and the control class. The average pretest and posttest results showed an increase in all classes, but the class with the PBL's module had the highest. The diagram of the average pretest and posttest scores of students' attitude results is as follows (figure 4):

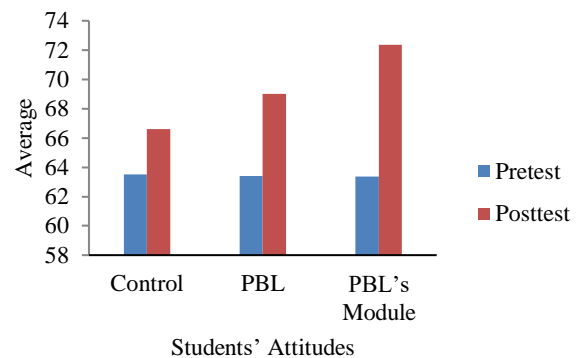


Figure 4. Average Pretest and Posttest Scores on Students' Attitudes

To determine the effectiveness of implementing the module in classroom learning, it is necessary to test stages for normality, homogeneity, and covariance analysis. These three tests will prove that the module developed has effectiveness in improving communication skills, cognitive abilities and student attitudes.

Normality Test

Normality testing was carried out on all existing data, both pretest and posttest results of student's communication skills, cognitive, and attitudes from the three classes. The results of the cognitive learning pretest normality test show that the significance value of the normality test results for the control class, PBL and PBL's module is 0.793; 0.731; and 0.334. The values for all three have values greater than 0.05 so it can be interpreted that the data is normally distributed.

The results of the pretest normality test for learning communication skills show the significance value of the normality test results for the control class, PBL class, and PBL's module class, each with a value of 0.056; 0.738; and 0.539. The values for all three have values greater than 0.05 so it can be interpreted that the data is normally distributed. Likewise, the results of the pretest attitude normality test

show a significance value for the normality test results for the control class, PBL class, and PBL's module class, each with a value of 0.915; 0.132; and 0.818. The values for all three have values greater than 0.05 so it can be interpreted that the data is normally distributed (table 6).

Table 6. Normality Test Results of Pretest Value

Category	Control	PBL	PBL's Module
Pretest of Communication	0.056	0.738	0.539
Pretest of Cognitive	0.793	0.731	0.334
Pretest of Attitude	0.915	0.132	0.818

The cognitive posttest normality test shows the significance value of the normality test results for the control class, PBL class, and PBL's module class, each value is 0.361; 0.795; and 0.359. The values for all three have values greater than 0.05 so it can be interpreted that the data is normally distributed.

The results of the posttest normality test for communication skills show the significance value of the normality test results for the control class, PBL class, and PBL's module class, each value is 0.985; 0.469 and 0.097. The values for all three have values greater than 0.05 so it can be interpreted that the data is normally distributed. The normality test of the posttest scores for aspects of student attitudes shows the significance value of the normality test results for the control class, PBL class, and PBL's module class, each with a value of 0.779; 0.663; and 0.294. The values for all three have values greater than 0.05 so it can be interpreted that the data is normally distributed (table 7).

Table 7. Normality Test Results of Posttest Value

Category	Control	PBL	PBL's Module
Posttest of Communication	0.361	0.795	0.357
Posttest of Cognitive	0.985	0.469	0.097
Posttest of Attitude	0.779	0.633	0.294

Homogeneity Test

Data homogeneity testing was carried out on pretest and posttest data on cognitive learning outcomes, communication skills and student attitudes. The results of the homogeneity of pretest scores for cognitive learning outcomes, communication skills and student attitudes were respectively 0.077; 0.053; and 0.981 is greater than 0.05 ($\alpha > 0.05$). This shows that the pretest data on cognitive learning outcomes, communication skills, and attitudes are homogeneous (table 8).

Table 8. Homogeneity Test Results of Pretest Values

Variable	F	df1	df2	Sig.
Pretest of Cognitive	2.680	2	62	0.077
Pretest of Communication	3.087	2	62	0.053
Pretest of Attitude	0.019	2	62	0.981

The homogeneity test carried out on the posttest scores on cognitive learning outcomes, communication skills and student attitudes obtained a significance value of 0.135, 0.292, and 0.126. The significance values obtained

for all three were greater than 0.05 ($\alpha > 0.05$), so it could be said that the posttest data were homogeneous (table 9).

Table 9. Homogeneity Test Results of Posttest Value

Variable	F	df1	df2	Sig.
Posttest of Cognitive	2.067	2	62	0.135
Posttest of Communication	1.255	2	62	0.292
Posttest of Attitude	2.142	2	62	0.126

Hypothesis Test (Covariance Analysis Test)

Hypothesis testing is carried out to determine the independent variable against the dependent variable. The independent variables in question are PBL learning and PBL's module learning on students' communication skills, cognitive abilities and attitudes.

Hypothesis Test (Covariance Analysis Test) Communication Skills

Hypothesis testing is used to determine the effect of the independent variable (application of PBL learning and PBL's module learning) on the dependent variable, namely communication skills. Hypothesis testing in this study used the covariance analysis test (Anakova), namely communication skills (table 10).

Table 10. Anakova Test for Differences in Achievement of Communication Skills

Anakova Test	F	Sig.
Communication skills	78.133	0.000
Adjusted R Squared= 0,719		

The Anakova test resulted in the calculated F being 78.133 with a significance of 0.000 which is smaller than alpha 0.05 ($\alpha < 0.005$) so it can be concluded that there is a difference in the achievement of communication skills between students in the control and experimental classes. This difference indicates the influence of treatment on students' cognitive learning outcomes. The pretest value turned out to be significant (sig=0.000), this illustrates that the covariance analysis carried out provides meaning. Efforts to carry out statistical control over the pre-test scores can be carried out so that the post-test obtained is purely the result of the influence of the treatment, namely the implementation carried out. The adjusted R squared value of 71.9% for communication skills shows that the problem-based learning model has a contribution of 71.9% to communication skills. The position of each experimental class through the LSD test with a sig level. = 0.05 (table 11).

Table 11. LSD Test Results for Students' Communication Skills

Class	Pretest	Posttest	Increase Notation of BNT
Control	28.63	31.36	2.73% A
PBL	30.61	37.33	6.72% B
PBL's Modul	29.59	41.31	11.72% B

The LSD test carried out can reveal that the achievement of communication skills in the control and PBL classes does not have a significant difference from each other, while students in the module-assisted class have a significant difference from the control class and PBL

class. The results of the LSD test can be concluded that communication skills in the PBL-assisted module class have the highest average of the other two classes.

Hypothesis Test (Covariance Analysis Test) Cognitive

Hypothesis testing is used to determine the effect of the independent variable (application of PBL learning and PBL’s module learning) on the dependent variable, namely cognitive learning outcomes. Hypothesis testing in this study used the covariance analysis test (anakova), namely cognitive learning outcomes (table 12).

Table 12. Anakova Test for Differences in Achievement of Cognitive Learning Outcomes

Anakova Test	f	Sig.
Cognitive Learning Outcomes	44.828	0.000
Adjusted R Squared= 0.576		

The Anakova test shows that the calculated F is 44.828 with a significance of 0.001, which is smaller than alpha 0.05 ($\alpha < 0.05$), so it can be concluded that there is a difference in the achievement of cognitive learning outcomes between students in the control and experimental classes. This difference indicates the influence of treatment on students' cognitive learning outcomes. The pretest value turned out to be significant (sig=0.000), this illustrates that the covariance analysis carried out provides meaning. Efforts to carry out statistical control over the pre-test scores can be carried out so that the post-test obtained is purely the result of the influence of the treatment, namely the implementation carried out. The adjusted R squared value of 57.6% for cognitive learning outcomes shows that the learning model has a contribution of 57.6% to cognitive learning outcomes. The position of each experimental class through the LSD test with a sig level. = 0.05.

Table 13. LSD Test Results for Students’ Cognitive Learning Outcomes

Class	Pretest	Posttest	Increase	Notation of BNT
Control	53.36	70.31	16.95%	a
PBL	52.23	72.19	19.96%	a
PBL’s Modul	52.86	78.13	25.27%	b

The LSD test carried out can show that the achievement of cognitive learning outcomes in the control and PBL classes does not have a significant difference from each other, while students in the module-assisted class have a significant difference from the control class and the PBL class. The results of the LSD test can be concluded that cognitive abilities in the PBL’s module class have the highest average of the other two classes.

Hypothesis Test (Covariance Analysis Test) Attitude

Hypothesis testing is used to determine the effect of the independent variable (application of PBL learning and PBL’s module learning) on the dependent variable, namely student attitudes. Hypothesis testing in this study used the covariance analysis test (anakova), namely student attitudes (table 14).

Table 14. Anakova Test for Differences in Achievement of Attitudes

Anakova Test	F	Sig.
Attitudes	11.335	0.000
Adjusted R Squared= 0.236		

The ANOVA test resulted that the resulting f count was 11.335 with a significance of 0.000 less than alpha 0.05 ($\alpha < 0.05$) so it can be concluded that there is a difference in the achievement of student attitudes between students in the control class and the experiment. This difference indicates the effect of module application on the achievement of student attitudes. The pretest value was significant (sig=0.000), this illustrates that the analysis of covariance carried out provides meaning. Efforts to statistically control the pretest value can be done so that the posttest obtained is purely the result of the effect of the treatment, namely the application carried out. The adjusted R squared value of 23.6% for student attitudes shows that the learning model has a contribution of 23.6% to student attitudes. The position of each experimental class through LSD test with sig level. = 0.05 (table 15).

Table 15. LSD Test Results for Students’ Attitudes

Class	Pretest	Posttest	Increase	Notation of BNT
Control	63.53	66.62	3.09%	a
PBL	63.39	69.02	5.63%	b
PBL’s Modul	63.37	72.36	8.99%	b

The LSD test carried out can reveal that the attitude achievements of students in the control and PBL classes do not have a significant difference from each other, while students in the module-assisted class have a significant difference from the control class and PBL class. The results of the LSD test can be concluded that the student attitude aspect in the PBL’s module class has the highest average compared to the other two classes.

N-Gain Value (Gain Score)

The n-gain value obtained shows the effectiveness of the module on the measured capabilities. The gain score calculation was obtained by calculating the posttest and pretest scores in the three classes that were the subject of the trial, namely the control class, using the PBL and PBL models assisted by modules. In the aspect of communication skills, the gain score in the control class was 0.04, the PBL class was 0.09 and the PBL’s module class was 0.17, all three were in the low category. The class using PBL’s module had the highest gain score compared to the other two classes (table 16).

Table 16. Effectiveness of The Module in Improving Students’ Communication Skills

Class	Gain Score	Criteria
Control	0.04	Low Effectiveness
PBL	0.09	Low Effectiveness
PBL’s Modul	0.17	Low Effectiveness

In the cognitive aspect, the gain score in the control class was 0.36, the PBL class was 0.42 and the PBL’s module class was 0.54. The three gain scores are in the medium category, however the class with PBL’s module

application is higher compared to the other two classes (Table 17).

Table 17. Effectiveness of The Module in Improving Students' Cognitive Learning Outcomes

Class	Gain Score	Criteria
Control	0.36	Medium Effectiveness
PBL	0.42	Medium Effectiveness
PBL's Modul	0.54	Medium Effectiveness

In the attitude aspect, the score gain value in the control, PBL and PBL's module classes respectively is 0.08; 0.15 and 0.24 are all in the low category, however the PBL's module class has the highest value compared to the other two classes, namely the control class and the PBL class (Table 18).

Table 18. Effectiveness of The Module in Improving Students' Attitudes

Class	Gain Score	Criteria
Control	0.08	Low Effectiveness
PBL	0.15	Low Effectiveness
PBL's Modul	0.24	Low Effectiveness

Overall, the effectiveness of the gain score of communication and student behavior gets low effectiveness, while for the effectiveness of cognitive gain is in the medium category.

The use of Advanced Ecology modules can be in lectures based on problems found in lectures to improve the quality of lectures for the better. Modules can be used to accommodate important material or concepts that can be learned contextually [25]. The use of modules in learning biology is more effective because modules provide opportunities for students to improve their learning optimally [26].

Learning using modules can improve learning outcomes [11], skills and attitudes [12]. Problem-based modules can improve learning activities and results optimally because this approach examines authentic problems so as to provide opportunities for investigation [27].

Problem-based learning modules provide opportunities for independent learning in problem solving, can know their own learning outcomes and optimal mastery of learning [21]. Modules as a learning resource can increase the ability to learn on their own, replace the function of educators who can facilitate their understanding according to knowledge and age level, relevance to assess their own mastery of the material and serve as a reference [9].

Conclusion

Lecture modules used in learning to Bina Bangsa University students can improve aspects: communication skills, cognitive abilities, and student attitudes. This is evidenced by the statistical test obtained with a significance of 0.000 less than alpha 0.05 ($\alpha < 0.005$) so that it can be concluded that there are differences in the achievement of communication skills, cognitive, and student attitudes between the control and experimental classes. It's just that

based on the value of the gain score, the use of problem-based teaching modules on communication skills (0.17) and student attitudes (0.24) is in the range < 0.3 which means its effectiveness is low, while in the cognitive aspect (0.54) is in the range of $0.3 \leq g \leq 7$ which is medium effectiveness value.

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