The Effect of Project-Based Learning Methods on Material Understanding and Student Thinking Skills

*Delvi Yanti[1] and Nika Rahma Yanti[2]

[1]*Andalas of University, Department of Agricultural Engineering and Biosystems, Faculty of Agricultural Technology*
[2]*Andalas of University, Department of Agricultural Engineering and Biosystems, Faculty of Agricultural Technology*
**Corresponding author. Email: delviyanti@ae.unand.ac.id*

ABSTRACT

Project-Based Learning Method is a real/complex world problem raised into a learning scenario (students can find their own or projects from industry), student-centered, solved by students in groups. The material studied in the Land and Water Resources Management course is a real-world problem, so the Project-Based Learning method is suitable to apply to this course. This study aims to analyze the material understanding and thinking skills of students using project-based learning methods in the Land and Water Resources Management Course. This type of research is an experiment with a post-test only control group design. The type of data collected is quantitative, namely an assessment of student work. The research was conducted for fifth semester students at the Department of Agricultural and Biosystems Engineering, Faculty of Agricultural Technology, Andalas University. The results of the learning outcomes of lecture participants with the TCL and PBL methods show that there are differences in several parameters that are assessed. The difference occurs in the aspects of planning (problem formulation), implementation (data completeness), implementation (data processing and analysis), and reporting of results (conclusions), with A symp value. Sig (2-tailed) <0.05. The Project-Based Learning (PBL) method can improve students' understanding of material and thinking skills. This can be seen from the aspects in formulating problems and drawing conclusions. In PBL the final achievement is more accurate while TCL is still in the less precise category.

Keywords: Learning Method, Project-Based Learning, 21st Century Skills; Learning Achievement

1. INTRODUCTION

1.1 Background

Land and Water Resources Management Course is one of the elective courses in the Department of Agricultural and Biosystems Engineering but is a compulsory subject for students of the Land and Water Resources Engineering study group. This course has a weight of 2 credits, which is offered in semester V (five).

The Land and Water Resources Management course discusses and learns about the basics related to the concept and scope of the LWRM, land capability and suitability, water availability, water demand, and water balance. This course discusses land and water resources, how to carry out the stages of analysis, and how to represent the results and recommendations needed by users related to land and water resources.

The expected learning objectives are that students can carry out LWRM stages in different places on the earth's surface, including planning the LWRM design from data collection, field surveys, and reporting. Students are expected to think critically to realize the importance of saving the potential of land and water resources, evaluate the condition of land and water resources in an area, including being able to analyze and dare to express ideas and ideas confidently.

Profiles of graduates of the Agricultural and Biosystems Engineering Department of Faculty of Agricultural Technology, Andalas University, are 1) Graduates are expected to can manage natural resources, equipment and handling in agriculture or other relevant fields, 2) Graduates are expected to act as sources of effective solutions, 3) Graduates expected to have shown a professional attitude in carrying out the work.

In line with this, the contribution of the Land and Water Resources Management course to learning outcomes in the curriculum of the study program is the ability to apply knowledge of mathematics,

natural and/or material science, information technology and engineering to gain a thorough understanding of the principles of agricultural engineering, and Biosystems.

To get learning outcomes as expected, the lecturers who support this course already have teaching materials such as power points, diktat, and scientific works. The learning model that has been applied to this course is the conventional learning model or Teacher Centered Learning (TCL) which is carried out by explaining theories, giving assignments both individually and in groups. Then the assessment carried out to measure student learning achievement that has been implemented so far is based on the value of the Mid-Semester Examination (MSE) with a weight of 50%, and the Final Semester Examination (FSE) with a weight of 50%. The assessment weights for MSE or FSE are: Attendance by 10%, Quiz by 20%, Assignments by 20%, and Exam by 50%. The final grades of students got in the Odd semester 2020/2021 are presented in Figure 1.
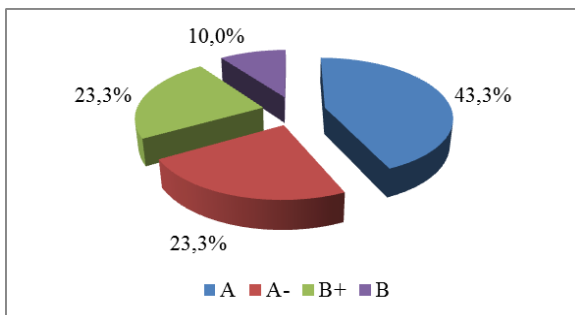
Figure 1 Distribution of Final Grades for Land and Water Resources Management Students on Odd 2020/2021.

Of all participants in the Land and Water Resources Management course (30 people), there was no participant who failed (scores below C), but the maximum score (A) was 23.33%. This shows that the lecture process could not achieve excellent results.

As mentioned above, the learning model that has been applied in this course is the TCL learning model. Kurdi [1] stated that the TCL model makes students passive because they only listen to lectures so that their creativity is not nurtured or even is uncreative. Lecturers mostly carry out teaching and learning activities as lecturing, while students during lectures or listening to lectures are only limited to understanding while taking notes for those who feel they need it. Lecturers become the center of the role in achieving learning outcomes and seem to be the only source of knowledge. This model provides one-way information because what it wants to achieve is how lecturers can teach well so that there is only knowledge transfer.

Based on experience in the previous semester (Odd Semester 2020/2021), the application of the Teacher Centered Learning (TCL) learning method that has been carried out does not give satisfactory results because during lectures, students' expressions look bored and sleepy, and not all students do the independent assignments. This can be seen from the percentage distribution of the final grades got in the previous semester (Figure 1). In achieving maximum learning outcomes, it is necessary to apply Project-Based Learning Methods in this course.

Learning Method Project-Based Learning is a real/complex world problem raised into a learning scenario (students can find their own or projects from industry), student-centered, completed by students in groups [2]. The material to be studied in the Land and Water Resources Management course is a real-world problem, so the Project-Based Learning method is suitable to apply to this course.

1.2 Research Purposes

This study aims to analyze the material understanding and thinking skills of students with project-based learning methods in the Land and Water Resources Management Course.

1.3 Benefits of Research

In the end, the results will provide information on the impact of implementing project-based learning methods on Land and Water Resources Management Courses in particular and as an input in developing teaching and learning strategies as one competency that must be possessed, so that learning objectives can be achieved properly.

2. RESEARCH METHODOLOGY

2.1 Research Setting

This type of research is an experimental design with a post-test only control group design. This design was also chosen because the research to be conducted was not to determine the improvement of conceptual understanding and critical thinking skills, so it did not use pre-test scores. The research design is presented in Table 1 and the hypotheses to be tested in this study are:

H0: There is no difference in the achievement of conventional method learning outcomes with project-based learning methods.

H1: There are differences in the learning outcomes of conventional methods with project-based learning methods

Table 1. Research Design

Class	Treatment	Post-test
Control	X1: treatment of Teacher Centered Learning (TCL) learning model	O1: last observation (post-test) control group
Experiment	X2: treatment of Project-Based Learning (PBL) learning model	O2: last observation (post-test) of the experimental group

Things that are prepared to conduct research on the application of the Project Based Learning method in the Land and Water Resources Management Course, namely:

a) Determining learning materials with the selection of problems.
b) Designing the presentation of the problem to guide students.
c) Determining the time allocation and learning schedule.
d) Organizing study groups.
e) Designing learning resources.
f) Designing a learning environment.
g) Designing the format for assessment of learning processes and outcomes.

2.2 Research Subject

The research was conducted on fifth semester students at the Department of Agricultural and Biosystems Engineering, Faculty of Agricultural Technology, Andalas University

2.3 Performance Indicators/ Data Types

The type of data collected in this study is quantitative, namely an assessment of student work. The data collected in this study include aspects:

a) Planning: Background and problem formulation

b) Implementation: Data/information collection, data completeness, data processing and analysis, and conclusions

c) Reporting results: report systematics, language use, writing/spelling, and display

2.4 Sources, Techniques and Tools for Data Collection, Data Validation and Data Analysis

2.4.1 Data Source

The data collected is primary data collected directly by the researcher.

2.4.2 Data Collection Techniques and Tools

Data collection using observation, presentation, and documentation methods

2.4.3 Data Analysis Technique

The data that has been got will be processed using the SPSS program, namely nonparametric test analysis for independent samples.

2.5 Research Procedure/Flow and Schedule

The research was carried out in the Odd semester of 2021/2022 with the steps for implementing research on the application of Project Based Learning methods:

1. Students are divided into small groups and each group carries out a real project (connecting the problem).

2. Each group is explained the tasks and responsibilities (setting the structure) that must be carried out by the group in practice.

3. Students in each group try their best to identify the problem (visiting the problem) they face according to their knowledge; (a). Identify the problem carefully to find the core of the problem at hand and (b) identify ways to solve the problem.

4. Students in each group seek information from various sources (books, guidelines and other sources) or ask accompanying experts to gain an understanding of the problem (re-visiting the problem).

5. Armed with the information got, students understand each other and understand the problem and find solutions to the problems faced and immediately applied. The lecturer acts as a companion.

6. Each group disseminates its experience in solving problems to other groups to get input and assessment from other groups.

3. RESULTS AND DISCUSSION

3.1 Description of Research Implementation

The beginning of the lecture is filled with lecturer's activities explaining the Semester Learning Plan of Land and Water Resources Management that will be implemented. The discussion discussed lecture materials, source/reference books, lecture methods including preparing project plans along with schedules and the maximum allocation of time that students need in completing projects, assessment and evaluation techniques that must be used.

3.2 Assessment Results of the Application of Learning Methods

The participants of the Land and Water Resources Management lecture are 16 people; the description of the lecture participants based on gender in this study is as shown in Table 2 below.

Table 2. Description of Respondents by Gender

	Amount	Percentage (%)
Male	10	62,5 %
Female	6	37,5 %
Amount	16	100%

Based on Table 2 above, it is known that the largest number of lecture participants based on gender is male, 10 people or 62.5% of the total respondents 16 people. Responses with female sex 6 people or 37.5% of the total respondents.

Gender is one factor that is thought to have a relationship with scientific attitudes and learning outcomes. Scientific attitude reflects the development of scientific thinking and scientific skills possessed by students. According to Zubaidah [3], gender differences affect the psychology and physiology of learners. Tabulation of learning achievement assessment is presented in Tables 3 and 4.

Table 3. Tabulation of Assessment of implementing Teacher Centered Learning (TCL) Methods

No	Aspect	Achievement Value										Average
		Case 1					Case 2					
1	Planning:											
	a. Background	2	1	1	1	2	2	2	2	2	2	2
	b. Formulation of the problem	2	2	2	1	1	2	2	2	2	2	2
2	Implementation:											
	a. Data/information collection	2	1	2	1	2	2	2	2	2	3	2
	b. Completeness of data	3	2	3	2	3	3	3	3	2	3	3
	c. Processing and analysis of data	3	2	3	1	3	3	3	3	2	3	3
	d. Conclusion	2	2	2	1	2	2	2	2	2	2	2
4	Results Reporting:											
	a. Report systematic	1	1	1	1	2	2	2	2	2	2	1
	b. Language use	2	2	3	1	2	3	3	3	2	2	2
	c. Writing/spelling	1	1	1	1	1	2	2	2	2	2	1
	d. Appearance	3	3	3	1	3	3	3	3	2	3	3

Description: right = 3; inaccurate = 2; incorrect = 1

Table 4. Tabulation of Assessment of the Application of Learning Methods Project-Based Learning (PBL)

No	Aspect	Achievement Value										Average
		Case 1					Case 2					
1	Planning:											
	a. Background	1	2	3	3	2	2	3	3	3	3	2
	b. Formulation of the problem	1	3	3	2	1	3	3	3	3	3	3
2	Implementation:											
	a. Data/information collection	2	3	2	2	2	2	3	3	3	3	2
	b. Completness of data	2	3	3	3	1	3	3	3	3	3	3
	c. Processing and analysis of data	2	3	2	2	2	2	3	2	2	2	2
	d. Conclusion	3	3	3	3	3	3	3	3	3	3	3
4	Results Reporting:											
	a. Report systematic	2	3	2	2	2	2	3	3	3	3	2
	b. Language use	2	2	2	2	2	2	2	2	2	2	2
	c. Writing/spelling	1	3	2	2	2	2	3	3	3	3	2
	d. Appearance	2	3	2	2	3	2	3	2	2	3	2

Description: right = 3; inaccurate = 2; incorrect = 1

Table 5. Results of Statistical Analysis of the Application of Learning Methods

Test Statistics[b]

	P1.1	P1.2	P2.1	P2.2	P2.3	P2.4	P3.1	P3.2	P3.3	P3.4
Mann-Whitney U	43.000	8.000	30.500	1.500	23.000	26.000	30.000	50.000	35.000	34.000
Wilcoxon W	98.000	63.000	85.500	56.500	78.000	81.000	85.000	105.000	90.000	89.000
Z	-.608	-3.460	-1.643	-3.953	-2.294	-2.072	-1.780	.000	-1.831	-1.389
Asymp. Sig. (2-tailed)	.543	.001	.100	.000	.022	.038	.075	1.000	.067	.165
Exact Sig. [2*(1-tailed Sig.)]	.631[a]	.001[a]	.143[a]	.000[a]	.043[a]	.075[a]	.143[a]	1.000[a]	.280[a]	.247[a]

a. Not corrected for ties.

b. Grouping Variable: Group

Based on Table 5, it can be seen that the results of the learning outcomes of lecture participants with the TCL and PBL methods there are differences in some of the assessed parameters. The differences occur in aspects of planning (formulation of problems), implementation (completeness of data), implementation (processing and analysis of data), and reporting of results (conclusions). A symp value. Sig (2-tailed) < 0.05, then H0 is rejected, meaning that there is a difference in the learning outcomes of conventional methods (TCL) and project-based learning methods (PBL).

The Project-Based Learning (PBL) method can improve students' understanding of material and thinking skills in the Land and Water Resources Management Course. This can be seen from the aspect of formulating problems and drawing conclusions. In PBL, the last achievement is more accurate, while TCL is still in the less precise category.

According to Mardapi [4], the assessment process which includes collecting evidence about student achievement is not always obtained through tests alone, but can also be collected through observation or self-reports.

The Project-Based Learning (PBL) learning system works on an agreed project theme, then lecture participants find various problems on that theme and then look for solutions to problems through discussion. Real-life situations provide authentic examples to lecture participants that there is over one solution or answer to each problem raised by lecture participants.

Project-Based Learning (PBL) is a learning method that can produce 21st century skills that must be possessed by students. Griffin & Care [5]; Mayasari [6] defines 21st century skills based on four categories. First, individuals must engage in certain ways of thinking, including metacognition, knowing how to decide, engaging in critical thinking, being

innovative, and knowing how to solve problems. Second, have excellent communication skills and be able to work together in a team. Third, using the right tools and having sufficient knowledge to work, as well as having information technology literacy. Fourth, being a good citizen by participating in government, demonstrating social responsibility which includes cultural awareness, competence, and always developing career-related skills.

4. CONCLUSION

The learning method affects the learning achievement of the participants in the Land and Water Resources Management course. The difference in the learning outcomes of lecture participants using the TCL and PBL methods is found in several parameters that are assessed, namely aspects of planning (problem formulation), implementation (data completeness), implementation (data processing and analysis), and reporting of results (conclusions), where the value of A is simple. Sig (2-tailed) < 0.05. The Project-Based Learning (PBL) method can improve students' understanding of material and thinking skills, this can be seen from the aspects in formulating problems and drawing conclusions, in PBL the final achievement is more accurate while TCL is still in the less precise category.

REFERENCES

[1] Kurdi. FN. (2009). Penerapan Student-Centered Learning Dari Teacher-Centered Learning Mata Ajar Ilmu Kesehatan Pada Program Studi Penjaskes. *Forum Kependidikan*, *28*(2), 108–113.

[2] Susanti, Lusi. (2021). Project-Based Learning. Univeritas Andalas [Workshop Peserta workshop Case - Based Method (CBM) dan atau Project - Based Learning (PjBL) serta Outcome - Based Assessment (OBA)].

[3] MZ, Z. A. (2013). Perspektif Gender Dalam Pembelajaran Matematika. *Marwah: Jurnal Perempuan, Agama Dan Jender*, *12*(1), 15. https://doi.org/10.24014/marwah.v12i1.511

[4] Mardapi, D. (2015). Pengukuran, Penilaian, dan Evaluasi pendidikan. Yogyakarta : Nuha Litera.

[5] Griffin, P., & Care, E. (2015). The ATC21S Method. In *Assessment and Teaching of 21st Century Skills*. https://doi.org/10.1007/978-94-017-9395-7_1

[6] Mayasari, T., Kadarohman, A., Rusdiana, D., & Kaniawati, I. (2016). Apakah Model Pembelajaran Problem Based Learning Dan Project Based Learning Mampu Melatihkan Keterampilan Abad 21? *Jurnal Pendidikan Fisika Dan Keilmuan (JPFK)*, *2*(1), 48. https://doi.org/10.25273/jpfk.v2i1.24