Development of Project Based Learning Model in Object Oriented Programming (OOP) Learning in Polytechnic

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ABSTRACT

This research is to investigate the design, validity, practicality, and effectiveness of the Project Based Learning Model in the context of Object Oriented Programming Learning at Polytechnic. This study is categorised as research and development (R&D), employing a learning methodology that is derived from the ADDIE paradigm (Analysis, Design, Develop, Implementation, and Evaluation). Methods of data collection including the utilisation of observation and questionnaires. The data analysis methodologies employed include validity analysis, reliability analysis, practicality analysis, and effectiveness analysis. The study yielded the following results: (1) the Project Based Learning Model in Object Oriented Programming Learning encompasses the design of a Learning Model, the identification of Course Learning Outcomes (CPMK), the determination of Learning Outcome

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Indicators, the selection of Learning Materials, the development of Semester Learning Plans (RPS), the creation of Learning Modules, the formulation of Student Task Plans (RTM), and the establishment of Learning Outcome Assessment Rubrics. (2) The Project Based Learning Model in Object Oriented Programming Learning has a validity of 0.84, meeting the criteria for being highly valid. (3) The practicality of implementing the Project Based Learning Model in Object Oriented Programming Learning is rated at 3.38, falling under the very practical category. Additionally, the lecturer's responses to this learning model are also highly practical, with a rating of 3.44. (4) The effectiveness of the Project Based Learning Model in Object Oriented Programming Learning is rated as high based on student learning test results. Furthermore, students' responses to this learning model are highly effective, with a rating of 3.31. Hence, it can be inferred that the Project Based Learning Model in Object Oriented Programming (OOP) Learning fulfils the requirements of being legitimate, practical, and efficacious for usage at the Polytechnic.

1. INTRODUCTION

In the third millennium, education is facing increasingly complex and demanding requirements, leading to a greater need for knowledge in several sectors. Survival in the competition is contingent upon possessing competence. Competition in the field of education is also unavoidable. Particularly the implementation of advanced technology and a personalised approach. Information and Communication Technology (ICT) systems offer a broad, rapid, and efficient means of distributing information to different regions of the world [1]. The advancement of information technology is closely aligned with the progress of theoretical and practical aspects of student learning activities, as well as the development of communication technology.

Politeknik Lembaga Pendidikan dan Pengembangan Profesi Indonesia (LP3I), also known as Politeknik LP3I Makassar, is a vocational education institution that aims to produce graduates who are prepared for employment and entrepreneurship. Its vision includes enhancing the quality of teaching and learning services, as well as consistently maintaining high standards of education.

According to [2], the project-based learning model is a response to the shortcomings of traditional learning models. These traditional models are condemned for their failure to cater to diverse learning styles and for not offering opportunities to apply acquired knowledge in real-life scenarios. Additionally, it derives inspiration from the project-based learning methodology employed in technical and professional education. This methodology immerses students in scenarios that closely resemble those they would encounter in professional settings, allowing them to effectively apply the knowledge they have acquired through meaningful real-world projects.

The educational institution LP3I Makassar Polytechnic has implemented a curriculum that consists of 30% theoretical learning and 70% practical learning. The emphasis on practical application above theoretical knowledge is a defining feature of vocational education. The purpose of this hands-on exercise is to enhance students' programming abilities and enable them to apply the knowledge acquired during lectures to real-world scenarios [3]. Enhancement of students' practical abilities is achieved through hands-on learning in computer laboratories, specifically in application development [4]. This involves challenging students to design basic or intermediate programmes utilising the programming languages covered in the course. This programme will facilitate students' comprehension of programming principles and enable them to implement them in practical scenarios.

There are several justifications for using Project Based Learning as the most suitable instructional approach to address the aforementioned issues. Project Based Learning (PjBL) is an educational approach that centres around students engaging in projects that necessitate the resolution of intricate difficulties and have direct applicability to real-life situations [5,6]. The project-based learning model often prioritises active learning [7].

Research studies and initial observations indicate that there is a need for further development of learning tools in the form of RPS. Additionally, the implementation of the Project

Based Learning Model is necessary in order to enhance the learning outcomes of Polytechnic students in object oriented programming [8,9]. Hence, the researcher aims to create a learning model based on projects for the purpose of teaching Object Oriented Programming (OOP) at the Polytechnic, as described in the dissertation titled "Development of a Project Based Learning Model in Object Oriented Programming (OOP) Learning at the Polytechnic". The objective of the project is to develop a Project Based Learning model for teaching object oriented programming at the Polytechnic. The aim is to create a valid and effective Project Based Learning model specifically designed for object oriented programming instruction at the Polytechnic. To develop a Project Based Learning framework for the practical application of object oriented programming at the Polytechnic. To develop a Project Based Learning framework for teaching object oriented programming that enhances student creativity at the Polytechnic.

2. METHODS

Research and development method. Research and development is a research method used to produce certain products, and test the practicality of these products. The results of certain products are used in research that is needs analysis and to test the feasibility of these products so that they can be used by students in object oriented programming learning, research is needed to test the effectiveness of these products according to [10]. This research produces a Project Based Learning Model on Object Oriented Programming (OOP) Learning. The learning device development model with the Project Based Learning approach used in this study refers to the ADDIE model used to develop learning instructional designs and learning models. The ADDIE model development stages consist of 5 stages, namely: (1) model needs analysis; (2) model design; (3) model development; (4) model implementation; and (5) evaluation [11]. The subjects in this study were Polytechnic lecturers and students, as well as those needed including small group trials, limited trials, and as many field trials. This is done in order to get statistically significant results.

Fig. 1 is a development procedure diagram that illustrates the stages involved in the development of the project-based learning model for object-oriented programming learning. The stages include needs analysis, model design, implementation, evaluation, and revision.

3. RESULTS AND DISCUSSION

3.1 Research Results

The results and studies in this study are based on previous studies that are relevant and related to this research. The discussion in this chapter is adjusted to the objectives of the first research carried out Efforts to design/realise models, devices and instruments. Before being tested, all instruments and guidelines for learning models, as well as learning devices have been validated by experts & practitioners according to their expertise. After the validation stage, the activities carried out were small group trials, limited group trials and field trials.

3.2 Needs Analysis Stage

The initial step taken in this stage is to analyse the needs in accordance with the results of the development model that has been carried out.

The results of the initial needs analysis assessment of learning can be seen in Fig. 2.

3.3 Results of Student Needs Analysis

Lecturers provide project-based independent and group assignments, obtained an overall average score of 49.17%.

3.4 Learning Implementation

According to the results of the study, the results of the assessment of the implementation of Object oriented programming learning were obtained with an average score of 54.57%.

3.5 Design Stage

In this case, the first research objective is developed and discussed, namely: Produce PjBL Model Design on OOP Learning.

The preparation of the PjBL model design on OOP learning is realised in the learning model book described in Table 2.

3.6 Stages of Development

In this stage, the second research objective is stated and discussed, namely: Produce a valid Project Based Learning Model on Object oriented programming learning.
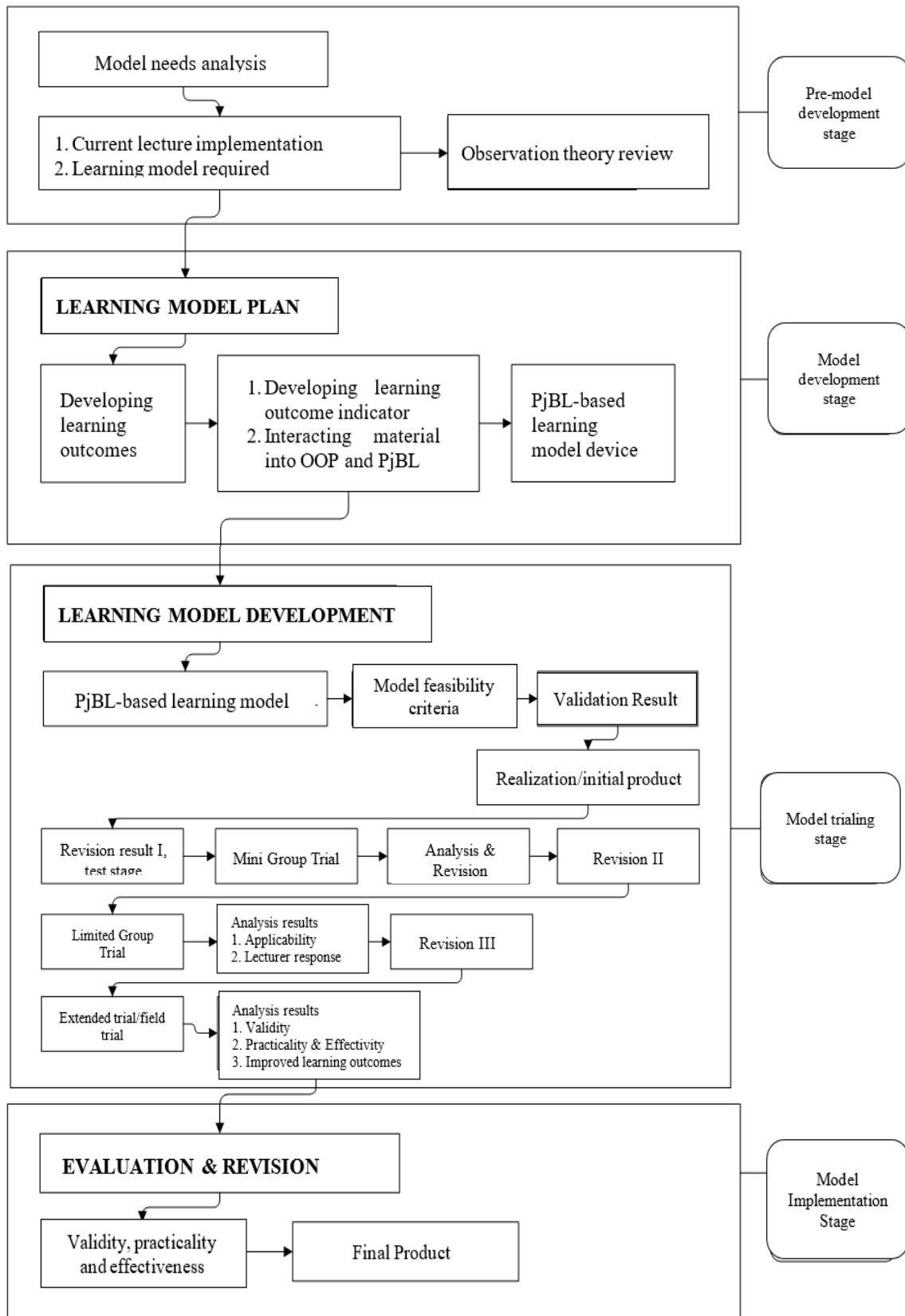
Fig. 1. Development procedure

Table 1. Results of initial needs analysis assessment of learning

No	Aspect	Average (%)
1.	Analysis of student needs in learning Object oriented programming	49,17
2.	Analysis of learning implementation	54,57

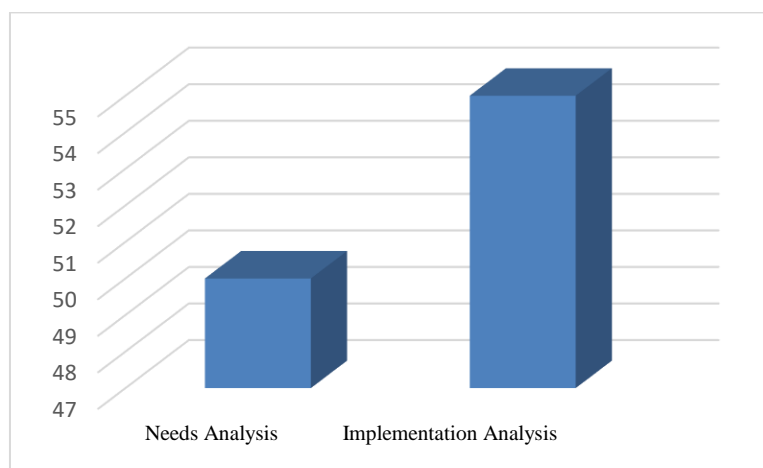*Source: Results of Data Processing, 2023 Page 131 & 158*

Fig. 2. Results of the initial needs analysis assessment of learning

Table 2. Main components of the learning model book

Components	Description
Chapter I	Introduction
Chapter II	Literature Review
Chapter III	PjBL Model Design on PBO Learning
Chapter IV	Implementation of the PjBL Model in OOP learning
Chapter V	Evaluation and development of the PjBL model in OOP learning.

Based on the aforementioned criteria, the average value of the instrument assessment exceeds 0.8, indicating that the research instrument possesses excellent validity.

Instrument reliability is considered dependable when the percentage of agreements (PA) with the criteria for the instrument sheet is equal to or more than 0.70. Regarding Table 3 it can be asserted that all instruments are dependable. Therefore, the instrument can be utilized to gather data regarding the accuracy, feasibility, and efficiency of the PjBl model.

3.7 Stage of Evaluating and Revising the Model

Once the learning model, along with the accompanying tools, has been developed and deemed suitable for testing, the subsequent phase involves evaluating the model. Assessment of the field trial model.

Field Trial refers to a controlled experiment conducted in a natural environment to test the effectiveness or performance of a product or process.

The field trial took place at the Informatics Management study course at LP3I Makassar Polytechnic. It involved one exemplary lecturer, three observing professors, and a group of 30 students who were under observation.

During the Field Trial, three specific subjects were taught, including Introduction to Programming, Programming Activities, and Condition Operators. The Field Trial implementation is displayed in Table 4.

After going through the improvement process, the final product of the Project Based Learning Model on Object oriented programming learning was created. The parts of the revised product can be described as follows.

Table 3. Summary of instrument feasibility

No	Instruments	Coef. validity V		Coef. Reliability (r) Cronbach's Alpha	
		Va	Criteria	PA	Criteria
1	Instrument validation sheet for the validity of the learning model	0,85	Very Valid	0,84	Very High
2	Learning model book validity instrument validation sheet	0,84	Very Valid	0,77	High
3	Learning module book validity instrument validation sheet	0,83	Very Valid	0,75	High
4	PJBL learning model design instrument validation sheet	0,84	Very Valid	0,77	High
5	Instrument validation sheet Test instrument assessment	0,87	Very Valid	0,84	Very High
6	Learning model user response instrument validation sheet	0,84	Very Valid	0,75	Very High
7	Instrument validation sheet of programming operation guide	0,86	Very Valid	0,84	Very High
8	Learning model effectiveness instrument validation sheet	0,85	Very Valid	0,77	High
9	Learning model implementation observation instrument validation sheet	0,85	Very Valid	0,84	Very High
10	Validation sheet of validity instrument Semester learning plan (RPS)	0,86	Very Valid	0,84	Very High

Source: Data Processing Results, 2023, Pages 133 and 138

Table 4. Field trial implementation

Meeting to-	Times	RPS (Pages)	Material
1	03/04/2023	2	Introduction to Programming
2	04/04/2023	2	Introduction to Programming
3	05/04/2023	3	Programming Activity
4	06/04/2023	3	Programming Activity
5	07/04/2023	5	Condition Operator
6	10/04/2023	5	Operator Condition
7	11/04/2023		Examination of Learning Outcomes

3.8 Learning Model

The results of the validation that has been carried out to the validity of the learning model obtained various suggestions and responses from the validator. The results of improvements and the final product of the Project Based Learning Model Book on Object oriented programming learning can be seen as follows.

3.9 Instrument Development

3.9.1 Learning model validation results

The results of the validation of the Learning Model on the cover aspect obtained an average of 0.86 with very valid criteria. the aspect of the contents of the guide obtained an average of 0.85 with very valid criteria.

Fig. 3. Final product of learning model book

Table 5. Learning Model Validation Results

No	Aspect	Average V	Category
1.	Introduction	0,86	Very Valid
2.	Contents of the guide	0,85	Very Valid
3.	Presentation	0,88	Very Valid
4.	Language	0,83	Very Valid
Average V		0,85	Very Valid

Source: Results of Data Processing, 2023 Page 144

Table 6. Learning device validation results

No	Aspect	Average V	Category
1.	Cover feasibility	0,86	Very Valid
2.	Feasibility of model book content	0,83	Very Valid
Average V		0,85	Very Valid

Reference: Data Processing Results, 2023, Pages 147 and 149

Table 7. Validation results for the PJBL model book

No	Learning Tools	Average V	Category
1.	Semester Learning Plan (RPS)	0,85	Very Valid
2.	Learning Module	0,85	Very Valid
3.	Student Task Plan (RTM)	0,83	Very Valid
4.	Learning Outcome Assessment Rubric	0,86	Very Valid
Average V		0,84	Very Valid

Source: Data Processing Results, 2023, Pages 147 and 149

3.9.2 Results of validation of learning tools

The validation of the RPS learning device yielded an average score of 0.85, meeting the criterion for high validity. The Learning Module achieved a mean score of 0.85, demonstrating high validity based on rigorous standards. The Student Task Plan (RTM) achieved a mean score of 0.83, demonstrating highly valid criteria. The Learning Outcomes Assessment Rubric achieved an average score of 0.86, indicating very valid criteria. The validation of Learning Devices yielded an overall average score of 0.84, indicating a high level of validity according to the criteria used.

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average score of 0.86, indicating very valid criteria. The validation of Learning Devices yielded an overall average score of 0.84, indicating a high level of validity according to the criteria used.

The results of the Model Book Validation in the aspect of cover feasibility obtained an average of 0.86 with very valid criteria. While the feasibility aspect of the model book content obtained an average of 0.83 with very valid criteria. Based on the results of the validation of the model book, the overall average assessed was 0.84 and was in the Very Valid criteria.

3.10 Data Analysis

3.10.1 Analysis of the practicality of the learning model

In this stage, the third research objective is stated and discussed, namely: Knowing the practicality of the Project Based Learning Model in Object oriented programming learning.

3.10.2 Learning model practicability analysis

The overall observation of the implementation of the learning model in the field trial obtained an average score of 3.38 with the category implemented very practically.

3.10.3 Analysis of lecturer's response to the learning model

The results of the data analysis of the lecturer's response to the Project Based Learning Model on Object oriented programming learning in Table 9 obtained an average value on the validation aspect of 3.33 with a very practical category. In the reliability aspect, the average value is 3.50 with the practical category. In the objectivity aspect, the average value is 3.44 with a very practical category. While in the aspect of practicality, the average value is 3.50 with a very practical category. Thus the overall average of each aspect of the lecturer's response to the

Project Based Learning Model on Object oriented programming learning obtained an average value of 3.44 with a very good category.

3.10.4 Analysis of the effectiveness of the learning model

Field Trial Knowledge Test Results. Object-oriented programming knowledge test data in the Field Trial was obtained from the final test of learning completeness using the Project Based Learning Model in Object oriented programming learning. The score value data results are the results tested on 30 students.

Based on the results of descriptive analysis of knowledge test data in the Field Trial, the average value is 80.2. The minimum score obtained was 70.00 and the maximum score obtained was 89.00. Furthermore, to determine the percentage of learning outcomes, the learning outcomes test data are grouped into 4 categories.

Therefore, the student learning outcomes in the Field Trial are classified as high.

3.11 Student Response

3.11.1 Student response to model implementation

3.11.1.1 Improvement of student learning outcomes

The effectiveness test of the Project Based Learning Model in Object oriented programming learning was conducted on students of the Informatics and Computer Management study programme at LP3I Makassar Polytechnic with a total of 30 student respondents. The effectiveness test was carried out by giving a pre-test and post-test to see if there was an increase in student learning outcomes by using the Project Based Learning model in Object oriented programming learning.

Table 8. Validation results for the PjBL model book

No	Aspect	Average V	Category
1.	Cover feasibility	0,86	Very Valid
2.	Feasibility of model book content	0,83	Very Valid
Average V		0,85	Very Valid

Source: Data Processing Results, 2023 Page 152

Table 9. Results of the learning model implementation analysis on the field group trial

|	Components	Modul 1		Modul 2		Average
		P1	P2	P1	P2	
	SYNTAKS					
	Establishment of learning model syntax	3,33	3,40	3,33	3,33	3.35
	Introduction	3,27	3,33	3,47	3,20	3.32
	Core activities	3,40	3,47	3,40	3,27	3.39
	Closing the lesson	3,27	3,40	3,33	3,33	3.33
	Average					3,35
	Social System					
	Discuss the material	3,33	3,33	3,27	3,33	3.32
	Q&A	3,27	3,33	3,33	3,40	3.33
	Guiding Modules	3,27	3,33	3,20	3,33	3,32
	Guiding Assignment	3,33	3,40	3,40	3,33	3.37
	Average					3,33
C.	Reaction Principle					
	Motivator	3,33	3,47	3,33	3,40	3.38
	Orientation	3,40	3,40	3,47	3,40	3.42
	Leader	3.33	3,33	3,47	3,33	3.37
	Innovative	3,47	3,33	3,40	3,40	3.40
	Share	3,40	3,40	3,40	3,47	3.42
	Average					3,40
	D.Support System					
	Learning Tools	3,47	3,47	3,33	3,47	3.44
	Learning aids	3,40	3,47	3,40	3,40	3.42
	Average					3,43
	Overall Average					3,38

.*Source: Data Processing Results (2023) Page 157*
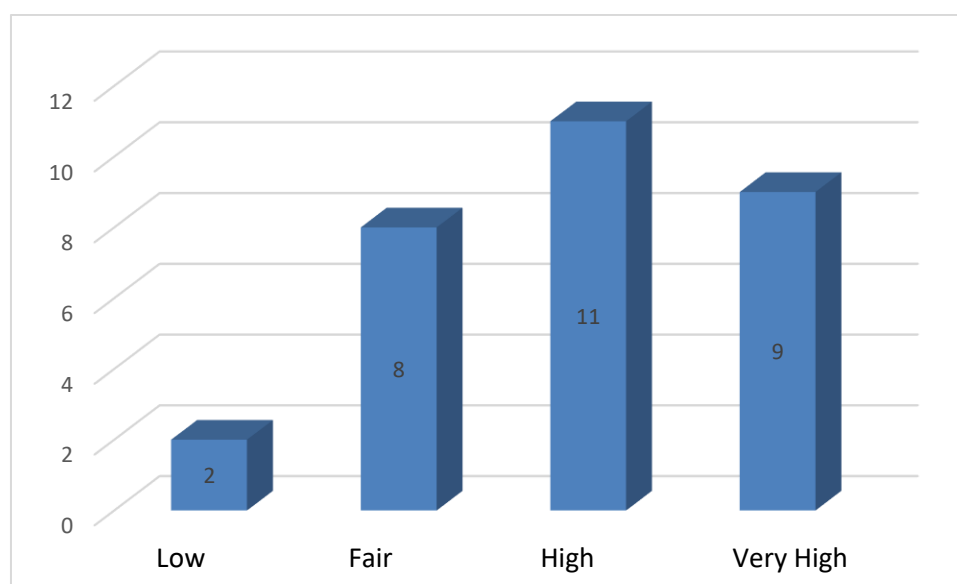
Fig. 4. Displays the outcomes of the Student Knowledge Test in the Field

Table 10. Statistical score of knowledge test results on field trial

Description	Statistical Value
Test Subject	30
Average	86,63
Range	25,00
Minimum	72,00
Maximum	97.00
Mean	85,166
Std.Deviation	7,09095
Variance	50,282

Source: SPSS Data Analysis Results (2023) Page 161

Table 11. Frequency distribution of student knowledge test results in the field trial

Category	Interval	Frequency	Percentage (%)
Very High	87– Above	9	30,00
High	82 – 86	11	36,67
Fair	77 – 81	8	26,67
Low	Under – 76	2	6,67
		30	100

Table 12. Student response to the field group trial

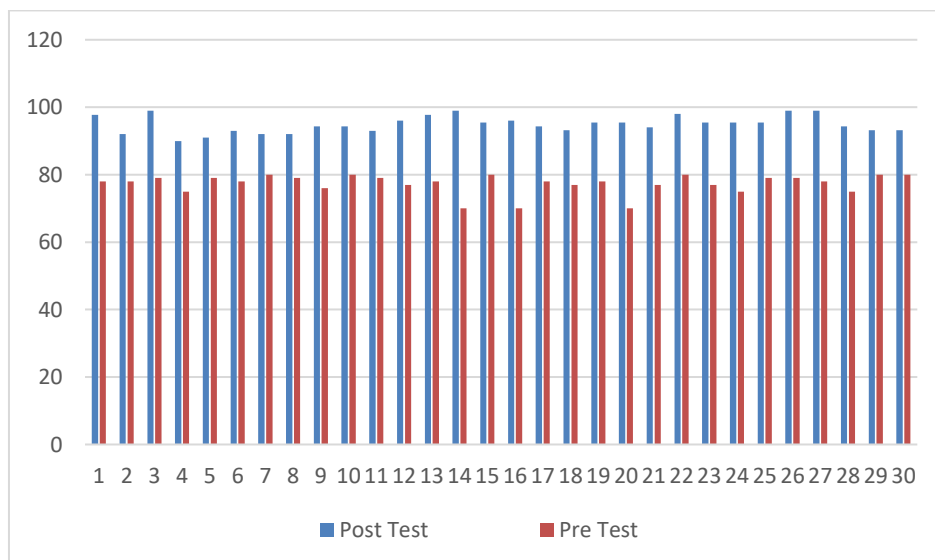| Aspect	Average	Students' Respond
Interest in the learning process	3,20	Effective
Ease of learning process	3,38	Highly Effective
Quality of Lecturer During Learning	3,33	Highly Effective
Learning Activities	3,32	Highly Effective
Overall Average	3,31	Highly Effective

Source: Data Processing Results (2023) Page 171

Fig. 5. Effectiveness test of pre test and post test of student learning outcomes page 179

The results of the PreTest and PostTest Effectiveness Test of Student Learning Outcomes can be seen in Fig. 5.

Based on Fig. 5 of the effectiveness test results, the average value of the pretest is smaller than the post test, namely 77.30 < 95, meaning that descriptively there is a difference between the average value of the pretest and posttest. This can be interpreted that there is an increase in learning outcomes after using the Project Based Learning Model in object-oriented programming

learning. Therefore, it can be concluded that the use of the PjBL model is effectively used at the Polytechnic.

4. CONCLUSION

Based on the results of development research, and discussion related to the Project Based Learning Model in object-oriented programming learning that has been developed, there are several things that can be concluded, namely:

1. Analysis of the needs for developing a Project Based Learning Model in object-oriented programming learning is obtained by analysing the implementation of lectures, analysing student characteristics, and determining the description of the learning model needed.
2. The design of the Project Based Learning Model in object-oriented programming learning is obtained by determining the CPMK and determining the learning achievement indicators. As well as compiling a learning model design based on the components of the learning model which consists of compiling learning syntax, establishing a social system, establishing reaction principles, and establishing a support system.
3. The Project Based Learning model in object-oriented programming learning has met the valid criteria.
4. Project Based learning model on object-oriented programming learning has met the practical criteria.
5. The Project Based Learning model in object-oriented programming learning has met the effective criteria in the range of 3.31 with a very effective category.
6. The Project Based Learning model in object-oriented programming learning is stated to be able to improve student learning outcomes with the acquisition of the average pretest and posttest scores of 77.30 < 95 has met the effective criteria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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