Advances in Social Science, Education and Humanities Research, volume 650
4th International Conference on Educational Development and Quality Assurance (ICED-QA 2021)

The Role of Using Problem-Based Learning in Engineering Economics Course

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ABSTRACT
The Engineering Economics course is a compulsory subject for civil engineering students at Andalas University in semester 7. The learning achievement of this course is that students can analyze and make decisions about infrastructure investment. Infrastructure is often associated with basic facilities for public purposes such as roads, toll roads, stadiums, bridges, building construction, electricity networks, dams and other public facilities. In engineering economics courses, students must conduct a feasibility study on infrastructure so that the infrastructure has maximum benefits in supporting a region's economy. Using Problem Based Learning method, some of the activities carried out can improve students' abilities in terms of time management. In this study, the statistical modelling technique used Structural Equation Modelling so that the analysis carried out was in the form of factor analysis, path analysis and regression. The values obtained from this SEM are R squared, path coefficient analysis, and Predictive Relevance analysis indicate that the PBL method can increase the self-learning value of students.

Keywords: *Engineering Economic, Problem Based Learning, Structural Equation Method, Student Learning*

1. INTRODUCTION

The Engineering Economics course is a compulsory subject for civil engineering students at Andalas University in semester 7. The learning achievement of this course is that students can analyze and make decisions about infrastructure investment. The syllabus of this course is an introduction to macroeconomics, an understanding of the principles of time value of money and its consequences. At the end of the course, students are expected to be able to carry out an economic evaluation and financial evaluation of an infrastructure case so that a feasibility study of the infrastructure development can be carried out.

Infrastructure is often associated with basic facilities for public purposes. Some examples of infrastructure in the physical form include roads, toll roads, stadiums, bridges, building construction, electricity networks, dams and other public facilities. But in general, infrastructure is divided into several groups, including water infrastructure, transportation infrastructure, energy infrastructure, building infrastructure, waste management infrastructure. This definition is also applied in America by ASCE [1].

In engineering economics courses, students must be able to conduct a feasibility study on infrastructure so that the infrastructure has maximum benefits in supporting a region's economy. This feasibility study begins with a brief macroeconomics study, analyzing the value of money and its growth. These two things must be applied to the infrastructure that is being analyzed for its impact on the global economy of the region where the infrastructure is located. These steps really need examples in the form of real projects that are done so that students can understand them perfectly. For that, problem-based learning is a very appropriate method in this learning.

1.1. Problem-Based Learning (PBL)

According to Chaw [2], Problem Based Learning (PBL) is a positive learning method for students compared to conventional methods in teacher-led education. As stated by Clive L Dim et al. [3], in engineering education, the important thing is proven principles are applied to analyze a problem to reach verifiable, truthful answers or solutions.

An optimal way to realize students' analytical skills is to apply them to a project. With this PBL method, design problems are often presented to teams of students, creating an environment in which others raise questions. There is the necessity to argue the advantages of alternative responses [3]. This interaction addresses ABET criteria, increases communication skills, and increases the likelihood of a successful design outcome, given diverse students [4].

1.2. The PBL in Engineering Economic Course

The learning outcomes of the engineering economics course are (a) Able to identify, formulate and solve problems in the field of civil engineering by considering the potential utilization of local resources; (b) Able to design systems and infrastructure in the field of civil engineering as needed by considering various constraints such as economic, environmental, health and security constraints; (c) Able to comprehensively analyze the impact of the implementation of infrastructure development on social, economic and environmental aspects. From these learning achievements, students need creative thinking skills so that the ability to formulate, design, and analyze comprehensively on a project can be fulfilled.

According to Mohsen [5], PBL enhances students' ability to learn on their own. Using the PBL method, some of the activities carried out can improve students' abilities in terms of time management, goal orientation, controlling their learning, a sense of personal responsibility for teaching others, self-assessment, decision-making based on information, etc.

2. RESEARCH METHODOLOGY

In general, the series of Problem Base Learning (PBL) activities are preparation, process, and evaluation. So PBL begins with the essential question about a project, the second step is Design a Plan for the Project, the third step is Creates a Schedule, the fourth step is to monitor student work, the fifth step is to conduct an assessment, and the last is to evaluate the process of teaching and learning which is a class action on this course.

A class action is carried out in the Engineering Economics course by evaluating (a) experience inability development (b) teamwork (c) ability to assess self-study progress (d) learning difficulties (e) scientific communication (f) real-world phenomena (g) understanding concept. This class action was carried out by distributing questionnaires to students taking engineering economics courses.

3. RESULTS AND DISCUSSION

Questionnaires are distributed to students taking Engineering Economics courses. These students consisted of 87 students who took this course the first time, eight people took the second time, and three people took the third time (Figure 1). Thus, 11 students have taken this course using conventional learning methods. Of the 98 students, 27 were women, and 71 were men (Figure 2). This shows that men still dominate civil engineering.

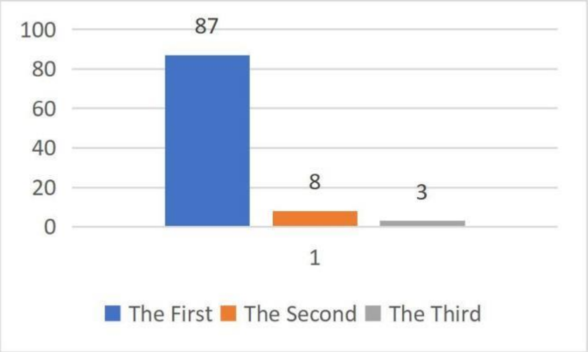

Figure 1. Number of student vs times the student take the course

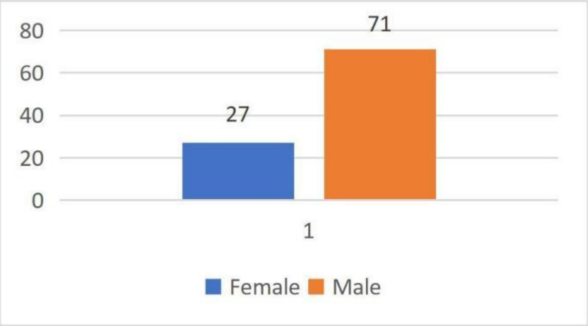

Figure 2. Number of students base on gender

3.1. Modelling and General Data of Survey Results

The indicators of classroom action research are:

A. Experience in ability development
B. Team work
C. Ability to assess self-study progress
D. Learning difficulties
E. Scientific communication
F. Real-world phenomena
G. Understanding concept.

From the structural equation modelling analysis as shown in Figure 3, it can be seen that the distributed questionnaires have a standard deviation that meets the requirements as data that can be further analyzed as shown in Table 1.

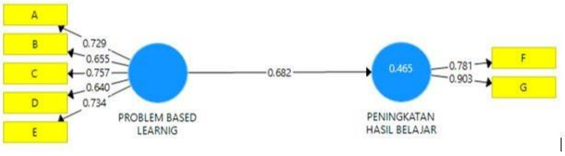

Figure 3. Structural Equation Modelling of indicators's classroom action

Tabel 1. General Data of Survey Results

Indikator	Mean	Median	Min	Max	Standard Deviation	Excess Kurtosis	Skewness
A	3.929	4	2	5	0.689	-0.388	-0.095
B	4.112	4	1	5	0.781	1.472	-0.854
C	4	4	1	5	0.857	0.488	-0.691
D	3.867	4	1	5	0.853	1.168	-0.742
E	3.827	4	2	5	0.756	-0.431	-0.127
F	3.887	4	2	5	0.716	-0.27	-0.169
G	3.888	4	1	5	0.844	0.703	-0.714

3.2. Evaluation of Measurement Model

3.2.1 Validity

A good survey instrument has a high level of validity, while a lousy survey instrument has a low level of validity. A good survey instrument will produce correct data that will lead researchers to a research conclusion according to reality. On the other hand, a bad survey instrument will have incorrect data, resulting in findings that do not match reality. For this reason, the validity test of the survey instrument was also carried out in this research. The validity of this research can be seen in Table 2,

Table 2. Validity of research indicator

Variable	Indicator	Improvement of learning outcomes	Problem based learnig	Validty
Problem Based Learning	A		0.729	Valid
	B		0.655	No Valid
	C		0.757	Ok
	D		0.64	No Valid
	E		0.734	Valid
Improvement of learning outcomes	F	0.781		Valid
	G	0.903		Valid

Because indicators B and D are not valid, it is necessary to re-examine the survey indicators, as shown in Figure 4.

Figure 4. Remodelling of Structural Equation Modelling of indicators' classroom action

The results of the remodelling survey indicators all have shown valid results, as shown in Table 3. Thus, further data analysis can be carried out.

Table 3. Final validity of research indicator

Variable	Indicator	Improvement of learning outcomes	Problem based learnig	Validity
Problem Based Learning	A		0.818	Valid
	C		0.771	Valid
	E		0.768	Valid
Improvement of learning outcomes	F	0.826		Valid
	G	0.868		Valid

3.2.2. Reliability research

To assess the level of consistency of this research, a reliability test was also carried out so that the data from the results of the study did not doubt the level of consistency. The results of this reliability test Composite Reliability is 0.836 for Improvement of Learning Outcomes and 0.829 for Problem Based Learning. This shows that the level of consistency of the research data is not in doubt.

The reliability test was also carried out with Cronbach's Alpha, where the reliability value for Improvement of Learning Outcomes was 0.608 and for Problem Based Learning was 0.693. The reliability test of Cronbach's Alpha it also shows that the level of consistency of the research data is not in doubt.

3.3. Structural Model Analysis

In this study, the statistical modelling technique used Structural Equation Modelling (SEM) so that the analysis carried out was in factor analysis, path analysis and regression. This is a multivariate analysis that tests statistical models in the form of causal models, as has been done in the validity and reliability tests above. This SEM has a function similar to multiple regression. Still, with SEM it considers interaction modelling, nonlinearity, correlated independent variables, measurement errors, interference with correlated errors (correlated error terms), some latent independent variables (multiple latent independents) where each is measured using many indicators, and one or two latent dependent variables which are also each measured by several indicators.

With SEM, the value of R squared is 0.455. It shows that the increase in learning outcomes is influenced by 45.5% by the Problem Based Learning method. From the path coefficient analysis, Problem Based Learning has a positive relationship with the learning method because it increases self-learning by 0.674%. From the Predictive Relevance analysis, the increase in learning outcomes with Problem Base Learning has a value of 0.306 which means this method has a good observation value.

4. CONCLUSIONS

Using Problem Based Learning method, some of the activities carried out can improve students' abilities in terms of time management. In this study, the statistical modelling technique used Structural Equation Modelling so that the analysis carried out was in the form of factor analysis, path analysis and regression. The values obtained from this SEM are R squared, path coefficient analysis, and Predictive Relevance analysis indicate that the PBL method can increase the self-learning value of students.

ACKNOWLEDGMENTS

The title "ACKNOWLEDGMENTS" should be in all caps and should be placed above the references. The references should be consistent within the article and follow the same style. List all the references with full details.

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