Analysis of Outcome Based Education (OBE) on the Achievement of the Program Learning Outcomes (PLO) in Welding Design Course

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ABSTRACT

Undergraduate Mechanical Engineering study program curriculum is evaluated regularly every three years. The evaluation is carried out so that the curriculum is in accordance with the conditions and needs of the job market. The curriculum currently implemented by Universitas Negeri Surabaya is an independent learning curriculum that focuses on outcomes or Outcome Based Education (OBE). Because it is based on outputs, the outputs in the form of knowledge and skills must be concretely measurable. Assessment of achievement must be based on criteria, so that students are assessed based on achievements against predetermined outputs. Measurement of PLO achievement is carried out through several assessments including participation, assignments, midterm exams and semester final exams. The PLO measurement model used is the Provus Discrepancy Evaluation. This study resulted in calculation of PLO achievement. PLO 1 CO 1 the good category has the highest percentage of 42.86%. In the PLO 3 CO 2 assessment, it was found that the very good category got the highest percentage with a value of 32.14%. On the PLO 6 CO 3, the highest value was the good level of 35.71%. The very good category is the highest percentage for PLO 7 CO 4 analysis. Based on this information the students able to identify specific facts and able to demonstrate the identification of specific facts about the history of welding, welding techniques, understanding of welding in "Good" level. From PLO 3 assessment students able to formulate problems (identify needs) and analysis constraints on welded joints, able to establish appropriate criteria for alternative solutions to welding techniques, able to produce alternative solutions for the process of welding joints, and able to make a prototype of the welding joint process and analysis of the performance of the welded joint in "Good" level. From PLO 6 the students able to present content in own words to demonstrate understanding of welding design concept, able to use language properly and correctly, deliver presentation in the presentation of the final welding design project in "Good" level. From PLO 7 assessment the students able to plan projects related to problems in the industrial field in the field of welding design in "Very Good" condition.

Keywords: OBE, PLO, Provus Discrepancy Evaluation.

1. INTRODUCTION

Curriculum is a set of plans and arrangements regarding graduate learning outcomes, study materials, processes, and assessments that are used as guidelines for implementing study programs (SNPT, 2015). Merdeka Learning is a flagship program initiated by the Minister of Education and Culture in 2019. There are three pillars in an independent campus according to the key message of the Minister of Education and Culture. Pillar 1, the lecturer is the driving force, must be professional and innovative. Pillar 2, change is difficult and full of discomfort. Pillar 3, policy consolidation. The independent campus has four main policies, namely the opening of new study programs, the higher education accreditation system, legal entity state universities, and the right to study three semesters outside the study program [1].

OBE is an educational process that focuses on achieving certain specified concrete results (knowledge, abilities and results-oriented behaviour). OBE is a

process that involves restructuring curriculum, assessment and reporting practices in education to reflect higher levels of learning achievement and mastery rather than accumulation of course credits. OBE is not a single idea in carrying out the curriculum. The two methods have similarities as well as differences. OBE is designed to cover objectives based on what happens in the learning process outcomes. The goal is strongly future oriented and asks the lecturer how to imagine the real conditions in the future and make our students change at the end of the course. Identification of these outcomes allows us to determine the specifications of the outcomes [2].

In implementing OBE, the curriculum must be designed so that teaching activities, learning activities and assignments, as well as assessments are coordinated refers to this type of process as constructive alignment. Constructive refers to the mode of learning and what students do as learners. Alignment refers to what is done by the Lecturer. Biggs shows that in a good teaching system, learning methods, learning activities and methods of assessment are all coordinated to support the student learning process. The evaluation stages of the Learning Outcome Program (PLO) are:

- Determine the PLO of the Study Program
- Define performance indicators for each PLO
- Determine the relationship matrix between PLO and courses
- Develop a rubric for assessing the achievement of PLO indicators
- Collect data (assessment results)
- Conduct course assessments to determine the PLO from each course
- Select courses for the evaluation process for each other
- Determine achievement targets for each PLO
- Conduct PLO Assessment: recap results for each PLO achievement – Evaluation [3]

Universitas Negeri Surabaya constantly attends the development of the world of education and industry. One of the efforts is to proper the study program to be competence to achieve international accreditation predicate. This is a manifestation of the achievement of the University's vision and mission as well as Universitas Negeri Surabaya and Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi. The implementation of OBE in the education system of The Mechanical Engineering Undergraduate Study program, Faculty of Engineering, Universitas Negeri Surabaya. The PEO and PLO formulations of the Mechanical Engineering Study Program have also been formed, and an analysis of the achievement of the determined PLO needs to be carried out continuously in order to determine the steps for continuous improvement, both improvements at the level of curriculum implementation and (if necessary) curriculum revision. The learning outcomes of the

Mechanical Engineering study program are presented in Table 1.

Table 1. Program Learning Outcomes (PLO) of The Mechanical Engineering Undergraduate Study Program

No	PLO
1.	Science and Engineering Knowledge
2.	Design and Development of Environmental and Sustainability of Concerned Solutions
3.	Experiment and Data Analysis
4.	Problem Analysis
5.	Introduction to Modern Equipment
6.	Communication
7.	Project and Cost Management
8.	Work Independently and In Groups
9.	Engineering and Professional Ethics
10.	Lifelong Learning

The Undergraduate Mechanical Engineering Program Evaluation using Provus Discrepancy Method. The word discrepancy means gap, discrepancy evaluation model developed by Malcolm Provus (1971) is a prominent model program implementation gaps, so that the evaluation carried out by the evaluator on the program can measure the size of the gap that exists in each component. Discrepancy evaluation serves to find out the level of conformity between the standards (criteria) that have been set with the actual appearance of the program in question. Next evaluate the gaps is a method to identify; difference or gap between specific goals set with actual performance. In addition, evaluate the model gap (discrepancy model) is to determine the level of alignment between standards (standards or established criteria) that have been set in the program with the performance (performance / results of program implementation) should be from the program. The characteristics of the discrepancy model evaluation are the process for (1) agreeing standard (which is used for the purpose), (2) determine whether there is a difference between performance of several aspects of the program and standards set for performance, and (3) use information about the difference to decide whether to repair, maintain, or stop the program or some aspect. The purpose of the gap evaluation is to determine whether to repair, maintain, or terminate a program. Discrepancy model evaluation as a process for agreeing program standards, determine whether there are differences between some aspects of the program and standards, and uses gap information to identify them program weaknesses [4].

This study aims to analysis the achievement of PLO which has been determined in the Mechanical Engineering Study Program, Faculty of Engineering, Surabaya State University in the Welding Design course. The purpose of the analysis is to evaluate and determine the feasibility of these elective courses. The PLO measurement model used is the Provus Discrepancy Evaluation, namely by comparing the PLO achievements assessed with the PLO standards that have been set in the

Welding Design Course. The gap between quality and standard performance is taken into consideration for making modifications. Modifications are made to performance that is not in accordance with predetermined standards, or standard modifications can be made if performance has exceeded them. Next, it is decided whether improvements are made to quality performance or standards, or quality performance is considered complete in the evaluation process. Improving the quality of performance can be done through improving learning methods.

2. METHOD

The assessment of PLO based on Badan Kerjasama Teknik Mesin (BKS-TM) an organization. formed at a meeting of the heads of the department or study program or department of Mechanical Engineering universities throughout Indonesia. Welding design as a course in skill elective course based on BKS-TM standard. The stage assessment scheme shows on Fig 1 [5] :
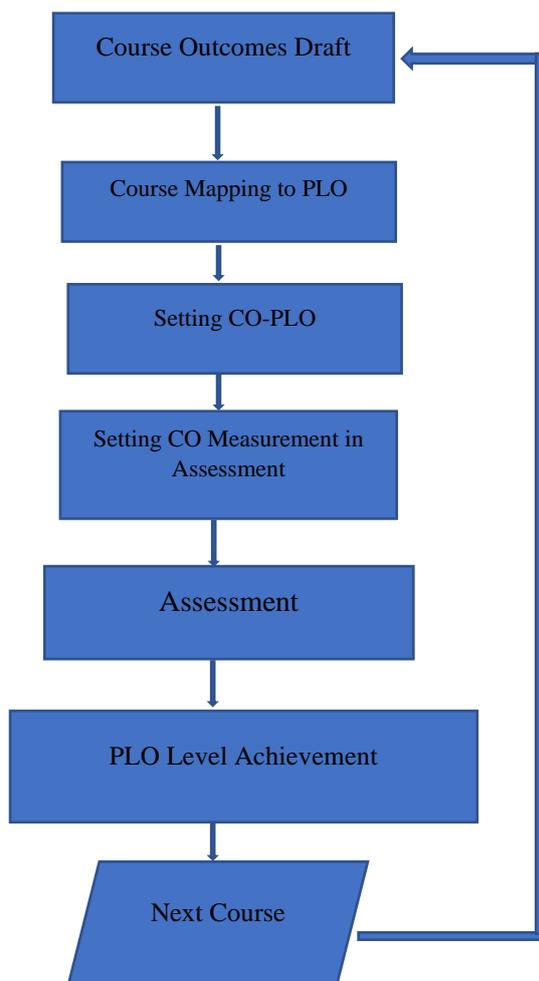

Figure 1. Stage Assessment Scheme.

Figure 1 represent the stage before program results can be calculated. It is significant to define and evaluate the outcomes of the course. It certain the number of questions on the test as well as any associated project and assignments. The level of achievement can be assigned and accepted for between program members so that everyone has standard of reference.

The Program Learning Outcomes (PLO) analysis for Welding Design Subject. This program using PLO 1 (Science and Engineering Knowledge), PLO 4 (Problem Analysis), PLO 6 (Communication), PLO 7 (Project and Cost Management). This program analysis for 2022/2023 academic year on even semester. The assessment is implementation through the final evaluation of students achieved based on the classification and review matrix on the PLO by each lecturer in welding design course [5].

3. RESULT AND DISCUSSION

According to the steps in the data analysis flow chart, the sequence is as follows:
Course outcomes draft shown in table 2

Table 2. Course Outcomes Welding Design Course

No	CO
CO-1 (PLO 1)	Able to identify specific facts about the history of welding, welding techniques, understanding of welding Able to demonstrate the identification of specific facts about the history of welding, welding techniques, the meaning of welding
CO-2 (PLO 3)	Able to formulate problems (identify needs) and analyze constraints on welded joints Able to establish appropriate criteria for alternative solutions to welding techniques Able to produce alternative solutions for the process of welding joints Able to make a prototype of the welding joint process and analysis of the performance of the welded joint
CO-3 (PLO 6)	Able to present content in own words to demonstrate understanding of welding design concepts Able to use language properly and correctly in the presentation of the final welding design project Able to deliver presentations orally at the final welding design project presentation
CO-4 (PLO 7)	Able to plan projects related to problems in the industrial field in the field of welding design

The second stage is Course Mapping to PLO which is shown in Table 3 and Tab:

Table 3. CO mapping to PLO

Course	PLO									
	1	2	3	4	5	6	7	8	9	10
Welding Design	v		v			v	v			

Each semester of the welding design course has its own course result. Course results are included in each semester learning plan (PLO).

The third stage is Setting CO-PLO which is shown in Table 4:

Table 4. Correlation of Welding Design Course Outcomes to PLO

Course	CO	PLO									
		1	2	3	4	5	6	7	8	9	10
Welding Design	CO-1	v									
	CO-2			v							
	CO-3						v				
	CO-4							v			

The fourth stage is setting CO measurement in Assessment which is shown in Table 5:

Table 5. Percentage of each test item for Welding Design Course

Assessment	Percentage	PLO 1	PLO 3	PLO 6	PLO 7
		CO-1	CO-2	CO-3	CO-4
Participation	20	30%	30%	20%	20%
Assignment	30	20%	30%	10%	40%
Mid Exam	20	25%	20%	20%	35%
Final Exam	30	20%	20%	20%	40%

Table 5 shows the percentage of assessments adjusted to the semester learning plans that have been prepared. The percentage is adjusted to the composition of each CO and PLO.

The fifth stage is assessment. Assessment is carried out to see the percentage of the score of the welding design course for each CO (Course Outcomes). The next stage is the correlation of the course CO to the study program's PLO. The correlation of CO courses to PLO of study programs is presented in Table 5.

After correlating the CO of the course with the PLO of the study program, the next step is to determine the evaluation weight used in the calculation. The determination of the weight is carried out by each lecturer for the subjects taught. The following is taken from welding design course as an example of a calculation, where the calculation is also carried out in other subjects, so that the PLO value is obtained. Percentage in welding design courses can be observed in Table 6. While the total weight that contributes to the calculation of each PLO is shown in Table 7.

Table 6. Total percentage of CO

	Score(%)	Percentage to Course Outcomes				Total Score
		CO-1	CO-2	CO-3	CO-4	
Participation	0.20	0.30	0.30	0.20	0.20	1.00
Assignment	0.30	0.20	0.30	0.10	0.40	1.00
Mid Exam	0.20	0.25	0.20	0.20	0.35	1.00
Final Exam	0.30	0.20	0.20	0.20	0.40	1.00
	1.00	0.95	1.00	0.70	1.35	4.00

Table 7 Total Percentage of PLO

Total Percentage				Total Score
CO 1	CO 2	CO 3	CO 4	
0.06	006	0.04	0.04	0.20
0.06	0.09	0.03	0.12	0.30
0.05	0.04	0.04	0.07	0.20
0.06	0.06	0.06	0.12	0.30
0.23	0.25	0.17	0,.5	1.00

The sixth stage is PLO Achievement. PLO achievement for the welding design course can be seen in Figure 2, where the figure explains about nine categories achievement (excellent, very good, good, very satisfy, satisfy, fair, poor, very poor, and fail).
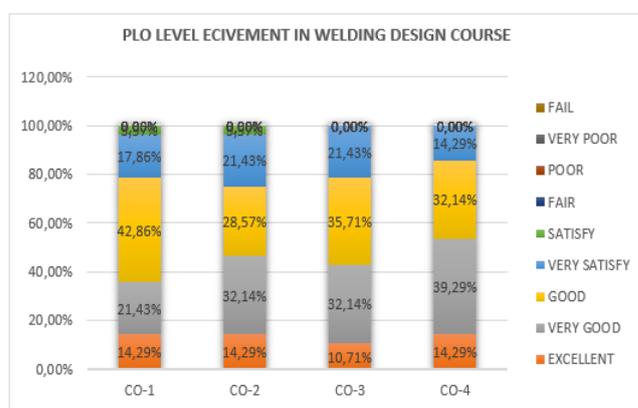
		PLO 1	PLO 3	PLO 6	PLO 7
NILAI	KRITERIA	CO-1	CO-2	CO-3	CO-4
≥85	EXCELLENT	14.29%	14.29%	10.71%	14.29%
≥80	VERY GOOD	21.43%	32.14%	32.14%	39.29%
≥75	GOOD	42.86%	28.57%	35.71%	32.14%
≥70	VERY SATISFY	17.86%	21.43%	21.43%	14.29%
≥65	SATISFY	3.57%	3.57%	0.00%	0.00%
≥60	FAIR	0.00%	0.00%	0.00%	0.00%
≥55	POOR	0.00%	0.00%	0.00%	0.00%
≥40	VERY POOR	0.00%	0.00%	0.00%	0.00%
<40	FAIL	0.00%	0.00%	0.00%	0.00%
		100.00%	100.00%	100.00%	100.00%

Figure 2. PLO level achievement (PLO 1, 3, 6, AND 7) in welding design course.

Refer to the information in the figure above it is found that in PLO 1 CO 1 the good category has the highest percentage of 42.86%. In the PLO 3 CO 2 assessment, it was found that the very good category got the highest percentage with a value of 32.14%. On the PLO 6 CO 3, the highest value was the good level of 35.71%. The very good category is the highest percentage for PLO 7 CO 4 analysis. Based on this information the students able to identify specific facts about the history of welding, welding techniques, understanding of welding

and able to demonstrate the identification of specific facts about the history of welding, welding techniques, the meaning of welding in "Good" level. From PLO 3 assessment students able to formulate problems (identify needs) and analysis constraints on welded joints, able to establish appropriate criteria for alternative solutions to welding techniques, able to produce alternative solutions for the process of welding joints, and able to make a prototype of the welding joint process and analysis of the performance of the welded joint in "Good" level. From PLO 6 the students able to present content in own words to demonstrate understanding of welding design concept, able to use language properly and correctly in the presentation of the final welding design project and able to deliver presentations orally at the final welding design project presentation in "Good" level. From PLO 7 assessment the students able to plan projects related to problems in the industrial field in the field of welding design in "Very Good" condition.

4. CONCLUSION

Achievements in PLO analysis in welding design courses are in a good category. In general, students are able to apply lecture objectives which are carried out using the Project Based Learning method. To improve results in the course, some suggestions for corrective action are collaborate with collaboration with small and medium enterprises (UMKM) in creating products, holding product exhibitions, increasing the number of visits to industry, repairing and adding laboratory facilities for activities in completing a project, building collaboration between students to improve the discussion process.

AUTHORS' CONTRIBUTIONS

The contribution of the authors are Drastiawati and Yunitasari : concept, design, and data analysis. Ningsih and Irfa'i : Collect data. Rasyid and Adiwibowo: interpretation of result.

ACKNOWLEDGMENTS

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