Assessment in Project Method within Outcome-Based Education Environment
A Practical Model for Typical Courses

Yuyun Estriyanto

Mechanical Engineering Education, Universitas Sebelas Maret, Surakarta, Indonesia
Corresponding author. Email: yuyun.e@staff.uns.ac.id

ABSTRACT
Outcome Based Education (OBE) provides a student-centered approach to teaching and learning that ensures students are provided with the necessary knowledge and skills to meet the desired learning outcomes. It has become increasingly popular in education because it provides several benefits. It ensures that learning objectives are specific, measurable, and observable. This clarity makes it easier for educators to design relevant and effective teaching and learning activities. It places a strong focus on student learning and the achievement of desired learning outcomes. This approach encourages educators to provide personalized support to each student to ensure they have the knowledge and skills necessary to meet the desired outcomes. It allows educators to design teaching and learning activities that are flexible and adaptable to meet the needs of individual students. This ensures that each student is provided with the necessary support to reach the desired outcomes. It includes the assessment of learning outcomes to ensure that each student has acquired the necessary knowledge and skills. This approach allows educators to measure the effectiveness of their teaching and learning activities and make any necessary adjustments to better support student learning. It focuses on the development of skills that are relevant to the real world, such as problem-solving, critical thinking, and communication skills. This approach ensures that students are better prepared for success in their future academic and professional endeavors. This paper provides a detailed description of how to design a project for typical practical course project methods in vocational teacher education. A sample implementation in the Mechanical Engineering Education Program, Practical Machining, is also described.

Keywords: *OBE, project method, assessment, learning outcomes, practical machining*

1. INTRODUCTION

1.1. About the Outcome Based Education

In the 1956s, Benjamin Bloom, an American educational psychologist, pioneered the concept of establishing educational objectives to reach better levels of learning [1]. Bloom Taxonomy became a pioneer in defining learning objectives in a structured way so that it is more possible to measure their achievement. Krathwohl, the former Bloom partner in writing Bloom's book, finally improved Bloom's taxonomy in 2000s with Anderson which was later known as the revised Bloom Taxonomy [2]. Bloom's taxonomy classifies educational goals into several domains and each of these domains is subdivided into more detailed divisions based on their hierarchy.

In the 1970s, in America, the concept of competency-based education emerged, focusing instruction on the mastering of certain abilities or competencies. It encourages three important changes associated with outcomes-based education: (1) establishing what competence in each subject area as defined learning outcomes; (2) identifying how students demonstrate such competence through actions and performances as the basis of assessment; and (3) shifting from standardized timeframes and methods to flexible timeframes and personalized instruction [3].

In 1990, the US National Centre on Education and the Economy propose the shifting of a new education system that focuses on the demonstrated achievement of high standards by applying effort-based education and assessment [4]. The recommendation was introduced through the publication of the report "America's Choice:

A. Kusumastuti et al. (eds.), *5th Vocational Education International Conference (VEIC 2023)*,
Advances in Social Science, Education and Humanities Research 813,
https://doi.org/10.2991/978-2-38476-198-2_94

High Skills or Low Wages." The article emphasizes the importance of competency criteria for the workplace as a guideline for implementing education, specifically how learning and evaluation are carried out. This concept became known as outcome-based education which was later adopted in many educational practices.

William Spady proposed outcome-based education (OBE) in the 1990s to shift the focus of formal education to what students learn rather than what they were taught [5]. OBE is a system of education that prioritizes goals, objectives, achievements, and results. The exit learning goals that students should exhibit at the end of a program or course govern all curriculum, assessment, and instruction decisions [6]. In short, Outcome-Based Education (OBE) is a teaching and learning strategy that focuses on defining specific, quantifiable learning outcomes or skills and designing instruction and evaluation to ensure that students attain these results. Learning outcomes in an OBE are identified based on the skills and information that students are anticipated to have upon completion of a course or program, and student learning evaluation is connected with those outcomes.

With an emphasis on clearly defined learning outcomes and assessments, teaching and learning can be more concentrated. OBE strives to provide students with the knowledge and skills they need to succeed in their academic and professional lives. OBE gives a tool to measure the effectiveness of training and find areas for improvement by focusing on outcomes. It becomes a popular educational strategy in many nations across the world, particularly in the context of vocational education and training, where graduates must be prepared for specific tasks in the workforce. Therefore, OBE is also very well applied to vocational teacher education which will later be required to teach hands-on competencies to their students.

Because of the various advantages of OBE, international educational accreditation authorities - such as ASIIN, AACSB, CACREP, and ABET [7] - adopt the OBE in ensuring that educational programs satisfy high quality and effectiveness requirements. These organizations serve to foster a focus on student learning and achievement in educational institutions by demanding or supporting the adoption of OBE in their accreditation requirements. The Indonesian Ministry of Research, Technology, and Higher Education encourages universities to adopt OBE to meet the standards of world accreditation bodies [8] and make OBE a reference in the internal quality assurance of higher education in Indonesia.

The implementation of OBE is manifested in learning outcomes statement, curriculum design, delivery (instruction), results documentation, and advancement [5, p. 8]. The alignment of these factors is required for an OBE to be successful.

The first thing to carry out OBE is to formulate Program Educational Objectives (PEO), Program Learning Outcomes (PLO), and Course Learning Outcomes (CLO) [9]. PEO is a general statement of the professional attributes of graduates in the workplace according to the graduate's job profile. That is, educational programs must prepare graduates towards that profile. PEO is measured using tracer study activities for graduates after three to five years completed their education. Measurements that are too early cannot measure the output of educational programs, and conversely, if measurements are taken too long after they begin to work, it is worried that it will produce biased data.

PEO is what a student should be able to perform after completing an academic program/course/instructional unit successfully. The term Learning Outcomes is also referred to as Instructional Objectives, Educational Objectives, Specific Learning Outcomes and Competencies. Learning outcomes consist of program learning outcomes and course learning outcomes. Each educational program consists of several PLOs which are competency formulations that characterize graduates' abilities after completing the education program. PLO achievement can be evaluated per student per semester, this is an aggregation of the results of the assessment of each subject that students have taken. The capacity of an institution's academic information system determines the success of OBE.

PLO is derived into the formulations of Course Learning Competencies which are then called the Course Learning Outcome (CLO). CLO is a formulation of competence after students completed a course. CLO should be observable and measurable [6]. Following the taxonomy of learning, the formulation of the CLO is preceded by identifying the various knowledge, skills, and attitudes that students are expected to have after completing the course. The CLO formulation must be clear about the domain and level. It is important to determine the appropriate assessment method to measure the achievement of learning objectives. Students also understand from the beginning of the semester what competencies they must be mastering and how they will be assessed.

In education management, curriculum means a series of learning programs that must be taken by students so that students master the specified learning outcomes. The curriculum must be based on a solid philosophy to create consistency in the education system that is being built [10]. Planning the curriculum involves determining learning activities, teaching methods, and assessment strategies which all lead to achieving learning outcomes.

In the Indonesian education system there are several categories of courses: (1) national compulsory; (2) university compulsory; (3) faculty compulsory; (4) study program compulsory; and also (5) study program

elective courses [11]. Starting in 2020, the Indonesian government launched the "Merdeka Belajar" (means *Freedom to Learn*) paradigm to encourage universities to facilitate students learning from the real world. This is intended to encourage the realization of 21st-century competencies [12] – 4C: Critical Thinking, Creative Thinking, Collaboration, and Communication – so that they are better prepared to face the world of work whose changes are increasingly unpredictable. Independent learning activities consist of: (1) student exchange; (2) internships; (3) Teaching Assistance in Education Units; (4) research; (5) humanitarian projects; (6) entrepreneurship; (7) independent projects; and (8) thematic community services [13].

The study program must be able to accommodate the skill and scientific core of the study program, the idealism of the OBE, and at the same time the government policies. In short, the curriculum must be built aligned with learning outcomes, flexible and adaptive, engaging student-cantered learning, multidiscipline and integrated, as well as emphasizing critical thinking and problem-solving respectively. Recognition of student learning experiences that are included in the eight Merdeka Belajar activities must be properly facilitated. Institutions are required to provide a clear recognition system for students.

All study program staff must have a similar understanding of the concept of outcome-based education. Internal training and workshops at the study program level are needed to build a uniform understanding of OBE concepts and curriculum building, and translate it into learning. All staff must participate in planning the curriculum structure and planning each CLOs. It needed to build a uniform understanding to avoid CLO overlapping between one course and another. All lecturers must also understand the pre-requisition and co-requisite for each course. Thus, it will be easier to design learning to produce graduates with the competencies defined in the PLOs. The agreement regarding the structure of the curriculum and CLOs was carried out in a curriculum reconstruction workshop which was also attended by representatives of graduates and alumni. Output evaluation information, which is often carried out in the form of a tracer study, is also needed as a consideration in curriculum reconstruction. MEEP assigned some students to conduct tracer studies to measure the performance of graduates in their careers and solicit input from graduate users to improve the quality of the education program.

OBE demands learning innovation from lecturers. Learning must be interpreted not by what the lecturer teaches but by what students learn. Lecturers must apply a variety of learning strategies that help students achieve the knowledge, skills, and attitudes specified in the learning outcomes.

Several strategies can be implemented to support OBE. Learning must be active. Learning methods must make students involved and feel they belong to the learning process they are going through. Problem-based learning, project-based learning, and collaborative learning are a few examples. Assessment in OBE must be ongoing and students must receive feedback to improve their learning. Assessment must also be authentic. Performance exams, portfolios, and other approaches that allow students to demonstrate their learning in a meaningful way are examples of this. In OBE, lecturers should also provide alternative strategies for learning, incorporating technology, and giving accommodations for each student with different learning conditions and learning styles. OBE emphasizes the benefits of interdisciplinary and integrated learning, in which students use knowledge and abilities from multiple subject areas to solve complicated problems. The government's policy of 'Merdeka belajar' is a policy that is in line with this paradigm.

Several principles underlie the assessment in OBE: (1) alignment with CPO and PLO; (2) authenticity; (3) continuity; (4) multiple measures; and (5) fairness. Assessment should be closely aligned with intended learning outcomes [14]. Assessment should be authentic, meaning that it reflects real-world contexts and situations for promoting deeper understanding and transfer of learning [15]. Assessment should be ongoing and continually, with students receiving regular feedback on their progress toward achieving the desired learning outcomes. It means that both formative and summative assessments are necessary for OBE. Dylan Wiliam emphasizes the importance of using formative assessment to support learning [16]. Similar to teaching-learning in other systems, assessment in OBE also adhere to valid and reliable principles [17]. Therefore assessment in OBE should involve multiple measures, using a variety of methods such as tests, projects, portfolios, and performance assessments. The last principle is fairness, which means that assessment must guarantee equality for all students and student rights must be respected. In short, assessment in OBE is applying various assessment methods, such as tests, projects, and performance assessments, which are accompanied by feedback during the learning process to ensure the achievement of learning outcomes.

As the main principle of total quality management in education, continuous improvement is an important part in the OBE system. This process must be part of the study program's internal quality audit so that OBE is continuously evaluated, and necessary adjustments are made to enhance student learning outcomes. This process applies various general management principles, such as planning, implementation, evaluation, and adjustment.

The continuous improvement in OBE is intended to ensure that the curriculum is current, and aligns with the needs of the workplace. This is important because the workplace is always changing so educational institutions must always be up to date. Improvements in OBE are also intended to identify areas of weakness and strength. It also accustoms institutions to make data-driven and reliable decisions. Educators can use data to make decisions about teaching and learning by regularly reviewing and changing the curriculum, instruction, and assessment.

1.2. About the Mechanical Engineering Education Program (MEEP)

Mechanical Engineering Education Program (MEEP) is a study program that educates prospective VHS teachers in mechanical engineering. Therefore, students must be prepared with basic engineering knowledge, hands-on practical skills, and instructional capabilities respectively [18]. The PEO of MEEP is shown in Table 1.

Table 1. Program Education Outcomes of MEEP.

PEO	Program Education Outcomes
1	Competent to integrate content knowledge, pedagogy, and curriculum development in technical and vocational education by considering national and ethical values.
2	Capable to apply knowledge and skills in mechanical engineering to provide solutions and positive contributions toward society.
3	Demonstrate a high level of professionalism, independent learning, and desire for life-long learning.

To correctly design its graduates' competencies, MEEP applies an outcome-based curriculum. The program learning outcomes (PLO) of MEEP is shown in Table 2.

Table 2. Program Learning Outcomes of MEEP.

PLO	Program Learning Outcomes
1	Apply ethical principles based on religious, legal, and social norms based on the noble values of the nation's culture
2	Demonstrate effective work both individually and as a team member
3	Demonstrate effective communication
4	Commit to professional ethics and responsibilities
5	Pursue a lifelong learning
6	Apply content knowledge of mechanical engineering and pedagogy to design the curriculum and learning activities
7	Capable to integrate the content knowledge of mechanical engineering and pedagogy to deliver learning experiences using a variety of instructional and assessment strategies in the teaching process at Vocational High Schools.
8	Apply the mathematical, scientific, and technical knowledge to scientifically carry out mechanical engineering-related works
9	Choose the appropriate material for engineering applications according to the specified technical requirements
10	Design mechanical components, systems, machines, and processes according to specified technical requirements
11	Select, operate, and maintain both conventional and computer-based machine tools
12	Investigate engineering problems and/or engage reflective instructional cycle following a scientific procedure

1.3. About Project Method in Machining Practice

One of the courses to support the achievement of PLO 11 is machining practice with the course learning outcomes as shown in Table 3. Machining practice is a project-based practice course that is packaged in such a way as to integrate various basic competencies in operating a lathe machine, including flat turning, taper turning, thread turning, groove turning, and knurling. This course also trains students in tool grinding and flat milling. To enroll in this course, students should have passed mechanical drawing and theory of machining as pre-requisite.

Table 3. Course Learning Outcomes of Machining Practice in MEEP.

No	Course Learning Outcome
1	Tool bit Grinding
2	Straight and tapered turning
3	Groove and thread turning
4	Knurling
5	Milling

The project method in practical courses is a kind of experiential learning which focus on hands-on skill. This method is an important vocational didactic approach [19] that may enhance students' practical skills and real-world problem-solving abilities [20]. Project practical work is important in engineering education to develop students' practical work [21]. During their project, students communicate with one another, discuss, collaborate, and try to solve any difficulties which enhances their creativity. They also learn about managing projects and time management which could be high added value for their future career [22].

The objective of this paper is to propose a method of designing and conducting teaching-learning activity for the Machining Practice workshop in MEEP UNS and applying appropriate assessment methods to ensure the achievement of the specified CLO. MEEP UNS is a study program that implements OBE. From the example of the implementation in Machining Practice in MEEP UNS, this article proposes a model of assessment method in project method within the OBE environment and could be adopted for typical courses.

4. METHOD

This section describes project development methods for Machining Practice courses. Alignment between CLO and PLO has been well designed in the study program curriculum documents. The list of CLO for each course has been formulated in the form of a module handbook and is provided on the study program's website. Therefore, the lecturer simply refers to the module handbook. The module handbook is seriously analyzed as a consideration in designing the project.

Each CLO must be represented in the project that students will work on. For each CLO, several indicators are set as the basis for the assessment. In this Machining Practice project, the assessment is based on the fulfillment of the geometric specifications of the job sheet. This assessment method is communicated to students at the beginning of the semester to ensure they understood how the assessment process at the end of the year will be carried out.

4.1. Ensuring Alignment between the CLO and PLO

The machining practice course is a very important subject for MEEP graduates because it is a provision for teaching vocational competencies in Vocational High Schools. All CLOs in machining practice courses support PLO No 11 and are included in the psychomotor domain.

Table 4. Alignment between CLOs and PLO.

No	Course Learning Outcome	Domain	Related PLO
1	Tool bit grinding	Psychomotor	PLO 11
2	Straight and tapered turning	Psychomotor	PLO 11
3	Groove and thread turning	Psychomotor	PLO 11
4	Knurling	Psychomotor	PLO 11
5	Milling	Psychomotor	PLO 11

4.2. Designing Aligned Teaching Learning Activity

The machining vocational competencies listed in the CLOs are hands-on, therefore students must be exposed directly to the work. This is in line with the rules of vocational education that learning must be conducted by doing various tasks needed in the world place. Students should be familiar with the related equipment [23]. The frequency and quality of training is the key to successful vocational learning. Therefore, the skills stated in the CLOs must be realized in the form of job sheets that students will work on for one semester.

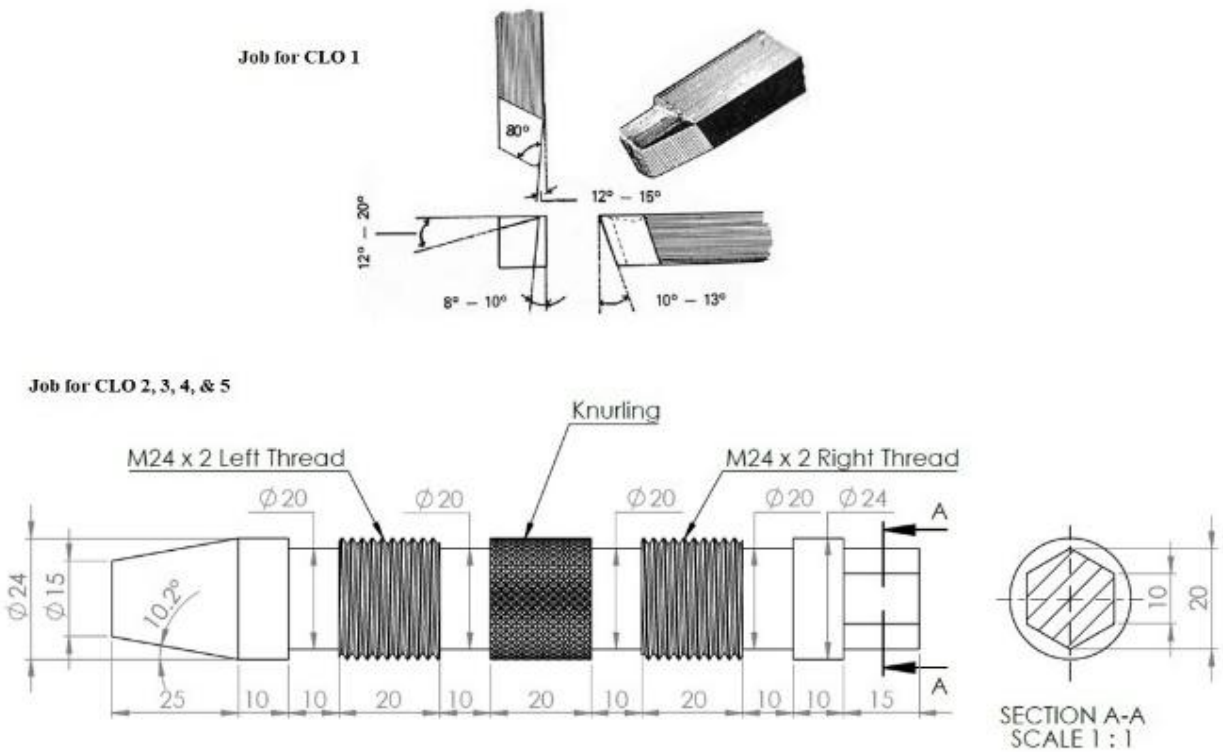

Figure 1 Job Sheet based on Intended CLO.

Table 5. Aligned Teaching and Learning Activity (TLA) of the CLOs

No	Course Learning Outcome	TLA	Evaluation
1	Tool bit Grinding	Individual project	20%
2	Straight and tapered turning	Individual project	20%
3	Groove and thread turning	Individual project	20%
4	Knurling	Individual project	20%
5	Milling	Individual project	20%

Of the five CLOs, the first one has different characteristics from the other four. In the machining practice at MEEP, the CLO 1 was packaged in a project to make lathe cutting tools from steel rods. Students have already understood the geometry of lathe cutting tools in the machining theory course. Drawings of the lathe cutting tools are given to students and they are assigned to form it based on the dimension in the drawings using a grinding machine. The angles formed between two planes on the lathe cutting tool will be a criterion for the quality of student products. CLO 2 to CLO 5 can be covered using a workpiece with a shaft-like shape. The shaft in this project is a dummy component, not a shaft that is a part of certain machine components. This is intended to accommodate as many CLOs as possible. CLO 2, CLO3, and CLO 4 will be machined on a turning lathe, while CLO 5 will be machined on a milling machine. The job sheet developed for machining practice in MEEP UNS is shown in Figure 1.

4.4. Designing Aligned Assessment Method

As explained above, assessment must be based on the principles of alignment with CPO, authentic, continuous, multiple measures, and fairness. The assessment on Machining Practice was developed by referring to the fulfillment of workpiece geometry dimensions which describe the competence in the CLO. The geometry specifications listed on the job sheet are mapped for their CLO representation. Furthermore, students are involved in measuring their results accompanied by the lecturer or assistants. Workpiece measurements can be carried out throughout the semester. If the measurement results do not meet the acceptance limits, students can bring them back to the machine and make them more precise.

Assessment for CLO 1 (Tool bit Grinding) is represented by a job sheet product for grinding lathe tool bit (Figure 1). The achievement of CLO 1 can be assessed from the products resulted by the students with assessment points at 4 corners designated by A, B, C, and D marks in Figure 2. If the angles do not meet the specifications on the job sheet, students can correct them again. But if it is too small, then there is a reduction in the score of the student.

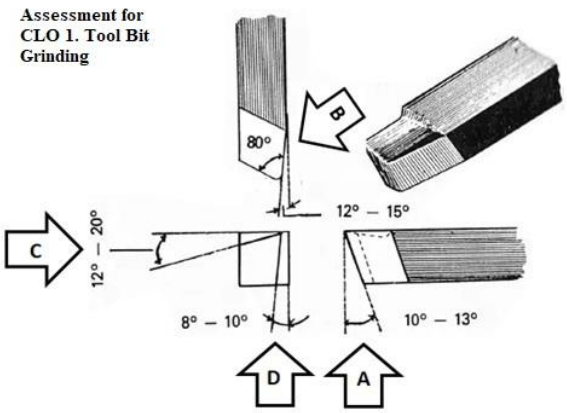

Figure 2 Geometries Identification for CLO 1 Assessment

The CLO 2 (Straight and tapered turning) assessment is carried out on two dimensions, which are the 24 mm diameter and 15 mm diameter of the taper, denoted with A and B in Figure 3. The 24 mm diameter is measured before other shapes are machined to a more precise justification of the straight-turning skill.

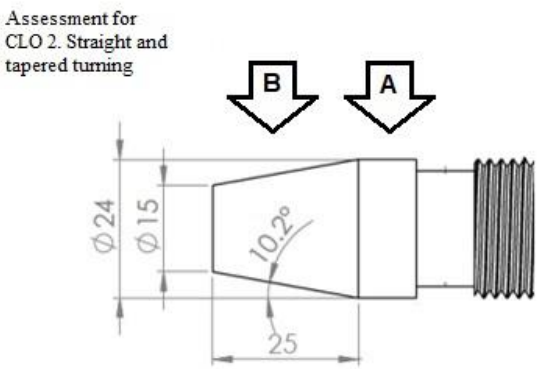

Figure 3 Geometries Identification for CLO 2 Assessment

CLO 3 consists of grooving and thread turning. Assessment grooving was conducted based on four 10mm grooves denoted with A, B, C, and D in Figure 4. While the assessment for thread turning consists of

M24x2 left-thread turning (E) and M24x2 right-thread turning (F).

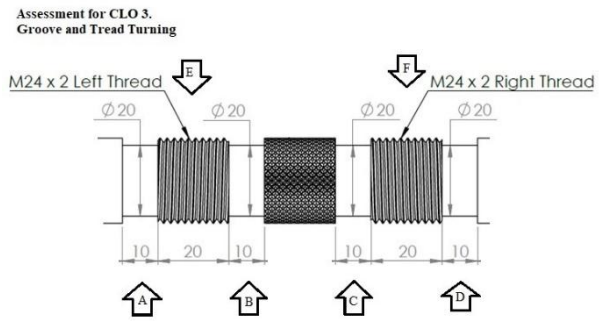

Figure 4 Geometries Identification for CLO 3 Assessment

Assessment for CLO 4 (Knurling) is conducted based on the knurling segment as shown in Figure 5. The length of the knurling segment and the diameter will be the object of measurement.

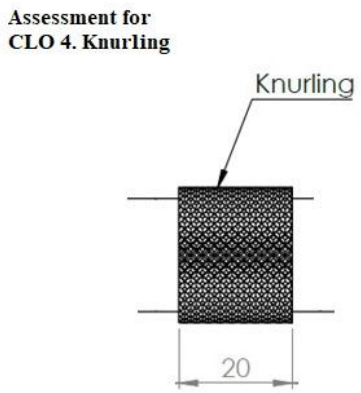

Figure 5 Geometries Identification for CLO 4 Assessment

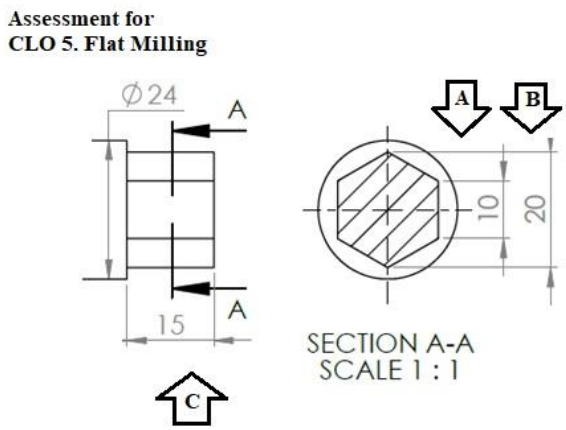

Figure 6 Geometries Identification for CLO 5 Assessment

Assessment for CLO 5 (Milling) is conducted on the hexagon part which is produced using a vertical milling machine. Students should use the dividing head to do this. The assessment point will be 15 mm in length, 10 mm hexagonal side, and 20 mm hexagon diagonal as shown with marks A, B, and C in Figure 6.

5. RESULT AND DISCUSSION

This section will discuss the alignment and effectiveness of the job-sheet-based project method teaching-learning activity and the assessment process. Some facts found during the course will also be presented.

At the beginning of the semester, student plan how they will complete the project. They analyze the job sheet and plan the steps needed to complete the project to avoid misordered steps which may cause fatal workpiece failure. Fatal workpiece failure means no improvement can be made to obtain geometry as specified in the job sheet. The student work plan is outlined in the form of a work preparation sheet (WPS) which is approved by the lecturer/assistant. The use of WPS has been proven by many teachers to be effective in supporting the achievement of practical course learning objectives [24]–[26]. During job sheet analysis, students develop analytical skills and critical thinking to solve problems in the workplace. This will continue to be honed throughout the completion of the project. In this case, students are trained to develop critical thinking skills as part of the 21st-century competencies [12].

During the project completion stage, students learn and practice operating workshop machines and equipment. They learn the working principle, machine parts, and their respective functions. They practice operating the machine repeatedly. They also learn to apply their basic knowledge about setting machining parameters according to the dimensions and material of the workpiece. They learn when one step must be done before another and what the consequences will be if the step is not in the correct order. The results of their work can be seen immediately so they can directly adjust the way they work. This process indicates a very-very vocational learning process, as well as preparing them to be agile in the workplace. This is in line with the Prosserian paradigm [23] but at the same time Deweyan [27] [28].

Students look enthusiastic to ask questions and work together when one of them is still having trouble doing a job. For students who have difficulties, this trains them to find solutions to the difficulties they are experiencing and this will be useful when they face the real world. But in general, the process builds communication skills among students. This individual project educates them

to be responsible and disciplined because if they don't manage their own time then their project will not be completed. Therefore this learning trains their personal abilities and at the same time their collective abilities [12]. Wijanarko [29] has reported that peer tutors in machining practice do quite well in realizing effective learning.

Grinding lathes tool bits in machining practice at MEEP UNS is conducted using a bench grinder, not a grinding machine that specializes in grinding tool bits. This manual process trains students' accuracy and appreciates the importance of workpiece geometry as an indicator of machining technician performance. Accuracy needs caution during working. This characteristic is needed when working with a lathe or even when working with various types of machines in their future career. This awareness was instilled from the beginning so that they will understand when they are assessed based on the fulfillment of the product geometry.

Assessment is carried out on student product results. Assessment is carried out while the practicum is still ongoing or at the end of the final product. Assessments carried out while work is still in progress provide opportunities for students to improve their work gradually. Due to the limited number of available machines, students carry out practice using the machines on a rotational basis. Some students work with grinding machines and most of them use lathes. And so on so that everyone can complete their jobs.

Assessment for CLO 1 is carried out by measuring the angles on the lathe tool bit using a protractor. For CLO 2 and 3, gaps and diameters were measured using a vernier caliper, while a metric screw thread gauge was used to measure left and right threads. CLO 4 was measured by the length and diameter of the knurled part using a vernier caliper. Likewise, measurements for CLO 5 were also carried out using a vernier caliper. Students measure their work one by one in front of lecturers/assistants. At this stage, students are often found who are not skillful in using measuring instruments so they need to be directed by the lecturer/assistant. This opportunity can be used by students to familiarize themselves with precision measuring instruments. During the completion of the project, the student reflects on their psychomotor experience to increase their knowledge and vice versa. This shows that providing feedback during the learning process can increase student engagement and improve student learning outcomes [16].

In this step, there is a learning process for students. They are also actively involved in the evaluation process so that they can accept judgment on their work. They are also invited to reflect on which parts of their work are good and which are still lacking. In other words, the principle of open and fair evaluation is carried out within this method.

From the explanation above, it appears that there is a good alignment between CLO, TLA, and the assessment method. All competencies defined in CLO can be translated into geometry on job sheets so that students are conditioned to learn, or rather to practice, when they are working on the project. This is in line with Vivek's view that engineering education requires a balance between knowledge and practical skills [30]. The module handbook provided in the MEEP curriculum document by the study program shows that it can be a good reference for realizing OBE. Therefore, the module handbook documents for all subjects in the curriculum should be available in the study program [31]. From this lecture, it can also be concluded that there is a need to define pre-requisite courses. This must be stated in the curriculum document. To be able to take part in Machining Practice courses, students are required to master the use of measuring instruments, be capable to read mechanical drawings and be aware of the importance of occupational health and safety. Those are obtained from other previous courses.

From the description above, it can be seen that this method assesses the five CLOs. However, other aspects occur and this is very important for student education. Habituation of the ability to work together, be responsible, work independently, communication skills, honesty, and time management are competency bonuses. This assessment method only assesses the observable competency (hard skills) but not yet the unobservable skills (soft skills). However, those soft skills are part of PLO MEEP, namely PLO 1 - 5. Therefore it is necessary to consider accommodating these aspects in improving the assessment method for this course.

The idea presented in this article is a proposed alternative assessment method for activity-based assessment in OBE [32] in the field of vocational teacher education. This method can be adopted for various other courses that have similar CLO characteristics. The Mechanical Practice course is a course that develops hands-on skills. The characteristic of the job is to produce a product/component. It is possible to adopt various courses that are product-producing but with a few adjustments. Examples of similar types of vocational education are Welding Engineering, Casting Engineering, Electronics Engineering, Visual Communication Design, etc. For service-producing vocational education such as Hospitality, Automotive Engineering, Cosmetology and Beauty, etc. may require more adjustments.

In this course, the workpiece is a dummy component. Workpieces that are actual components are better. However, it might be a bit difficult to find a real workpiece that accommodates all the CLOs assigned to a course. To realize this, perhaps it will require a greater

effort because it must condition the relationship between product users and educational institutions. But this is not impossible to do.

5. CONCLUSION

From the description above, it can be concluded that the use of job sheets in practical machining courses can be used as a reference for implementing TLA and assessments that are aligned with CLO Machining Practice and MEEP PLO. The key to this alignment is at the job sheet development stage. All competencies defined in CLOs must be manifested in the workpieces. This method can be adopted for various courses that have similar CLO characteristics, which is developing hands-on skills to produce products. This study also find that practical workshop has any potential to develop soft-skills related to PLOs. Furthere more, the implementation of OBE must be carried out institutionally, which is formally stated in the study program curriculum document. Staffs must refer to the documents that have been determined by the study program so that the OBE proclaimed by the study program can be realized. At the study program level, the most important thing is the availability of module handbooks which are developed collectively by all staff members. All staff only need to refer to the document to realize outcome-based learning in their courses.

REFERENCES

[1] B. S. Bloom and D. R. Krathwohl, Taxonomy of Educational Objectives: The Classification of Educational Goals, in *Handbook I: Cognitive Domain.*, 1956.

[2] Krathwohl and Anderson, Understanding the New Version of Bloom ' s Taxonomy The Cognitive Domain: Anderson and Krathwohl - Bloom 's Taxonomy Revised, A succinct Discuss. Revis. to Bloom. Class. Cogn. Taxon. by Lorin Anderson David Krat. how to use them Eff., 41(2), 2001.

[3] T. R. Nodine, How did we get here? A brief history of competency-based higher education in the United States, *Competency-based Education*. Wiley, Santa Cruz, 2015, pp. 5–11.

[4] NCEE, America's Choice: High Skills or Low Wages!, New York, 1990.

[5] W. G. Spady, Outcome-Based Education: Critical Issues and Answers, Arlington, Virginia: The American Association of School Administrators, 1994.

[6] N. J. Rao, Outcome-based Education: An Outline, *High. Educ. Futur.*, 7(1), 2020. DOI: 10.1177/2347631119886418.

[7] R. M. Felder and R. Brent, Designing and Teaching Courses to Satisfy the ABET Engineering Criteria, *J. Eng. Educ.*, 92(1), 2003, pp. 7–25.

[8] Kemenristekdikti, Roadmap Akreditasi/ Sertifikasi Internasional Program Studi di Perguruan Tinggi Indonesia, Direktorat Penjaminan Mutu Direktorat Jenderal Pembelajaran dan Kemahasiswaan Kementeri. Riset, Teknol. dan Pendidik. Tinggi 2019, 2020.

[9] E. Norinpel, S. Ganbold, and U. Tungalag, Assessment Experience on Program Learning Outcomes, 2018.

[10] E. T. Ogwora, G. Kuria, E. Nyamwaka, and B. Nyakan, Philosophy as a Key Instrument in Establishing Curriculum , Educational Policy , Objectives , Goals of Education , Vision and Mission of Education, 4(11), 2013, pp. 95–102.

[11] DJHE, Panduan Pengembangan dan Penyusunan Kurikulum Pendidikan Tinggi. Jakarta: the Indonesian Ministry of Education and Culture, 2012.

[12] K. Ananiadou and M. Claro, 21st century skills and competences for new millennium learners in OECD countries, 2009.

[13] Dirjendikti, Buku Panduan Merdeka Belajar - Kampus Merdeka, Jakarta: Direktorat Jenderal Pendidikan Tinggi, 2020.

[14] R. E. Stake, The Countenance of Educational Evaluation, Teach. Coll. Rec. Voice Scholarsh. Educ., 68(7), 1967. DOI: 10.1177/016146816706800707.

[15] G. Wiggins, A true test: Toward more authentic and equitable assessment, Phi Delta Kappan, 92(7), 2011. DOI: 10.1177/003172171109200721.

[16] D. Wiliam, What is assessment for learning?, Stud. Educ. Eval., 37(1), 2011, pp. 3–14. DOI: 10.1016/j.stueduc.2011.03.001.

[17] L. Harvey, Transforming Higher Education: Students As Key Stakeholders, in Quality Assurance as a Support for Processes of Innovation, 1996, pp. 1–13.

[18] Y. Estriyanto, A Review of Indonesian Pre-Service Teacher Certification Policy from the Point of View of the Philosophy of Vocational Education, in: International Confrence on Teacher Training and Education, 1, 2016, pp. 245–253.

[19] H. Duch and K. E. Andreasen, Reforming Vocational Didactics by Implementing a New VET Teacher Education in Denmark: Tensions and Challenges Reflected in Interviews with Vocational College Teachers, Int. J. Res. Vocat. Educ. Train., 2(3), 2015, pp. 195–213. DOI:

10.13152/IJRVET.2.3.5.

[20] D. Efstratia, Experiential Education through Project Based Learning, Procedia - Soc. Behav. Sci., 152, 2014, pp. 1256–1260. DOI: 10.1016/j.sbspro.2014.09.362.

[21] A. L. Yusof, N. Ya'acob, and A. E. Azhar, Implementation of Practical Work in Engineering Study, in: Redesigning Assessment For Holistic Learning CONFERENCE 2017, 2017. DOI: 10.32861/jssr.53.620.625.

[22] OECD, OECD Reviews of Vocational Education and Training: Learning for Jobs, 2011.

[23] C. A. Prosser and T. A. Ouigley, Vocational Education in a Democracy, Chicago: American Technical Society, 1950.

[24] Armansyah, H. Saputro, and N. Rohman, Upaya meningkatkan hasil praktik pada mata pelajaran pemesinan melalui penggunaan work preparation sheet siswa kelas XI TPM 1 SMK Pancasila Surakarta tahun pelajaran 2016/2017, VANOS J. Mech. Eng., 2(1), 2017, pp. 55–64.

[25] F. Fajri, D. S. Wijayato, and I. Widiastuti, Penggunaan Work Preparation Sheet Dalam Meningkatkan Motivasi Dan Hasil Belajar Praktik Kerja Bangku pada Mata Pelajaran Teknologi Mekanik di Kelas X SMKN 5 Surakarta Tahun Pelajaran 2016/2017, in: Pros. Semin. Nas. UNS Vocat. Day, 1(2013), 2018, pp. 213–219.

[26] R. S. Wijaya, M. Akhyar, and N. Sriwardani, Analisis Penggunaan Work Preparation Sheet dan Peran Instruktut Terhadap Ketrampilan Membuat Ulir Square Pada Mata Pelajaran Praktik Operasi Mesin Bubut Lanjut Siswa SMK Bhineka Karya, J. Pendidik. Tek. Mesin, 1(1), 2019, pp. 23–34.

[27] J. Dewey, Democrazy and Education (Indian Edition), Delhi: Aakar Books, 2004.

[28] P. Sudira, Praksis Pendidikan Kejuruan Indonesia diantara Mazab John Dewey dan Charles Prosser, in: Seminar Pendidikan Vokasi sebagai Disiplin Keilmuan, 2013, pp. 1–13.

[29] B. S. Wijanarka, Improving Students' Machining Competence by Applying Peer Tutoring Methods, Eur. J. Educ. Pedagog., 4(2), 2023, pp. 58–63. DOI: 10.24018/ejedu.2023.4.2.603.

[30] C. M. Vivek, Outcome Based Education – a Review, Int. Res. J. Eng. Technol., 4(7), 2017.

[31] G. Japee and P. Oza, Curriculum and Evaluation in Outcome-Based Education, Psychol. Educ., 58(2), 2021, pp. 5620–5625. DOI: 10.17762/pae.v58i2.2982.

[32] C. M. Vivek, G. Thamilvanan, and K. Mohanasundaram, Influence of activity based assessment in outcome-based education, Test Eng. Manag., 81(11–12), 2019, pp. 4524–4528.