

# Application of Assessment for Learning to Improve Student Learning Outcomes in Engineering Drawing Using CaD

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**Abstract**—This study aims to show the application of assessment for learning can improve learning activities and student learning outcomes. The type of research is action research. The study was carried out in two cycles, in which each cycle consisted of two meetings. Research respondents were students of grade XI<sup>th</sup> at Vocational High School No.1 West Sumatera. The research instrument consisted of observation sheets to observe student learning activities, rubrics to assess students' skills in using CAD, and tests. Data is analyzed with descriptive statistics. The results of learning activities in the first cycle are in the sufficient category and in the second cycle are in the active category. Meanwhile the results of learning technical drawings in the first cycle are still in the sufficient category. After reflection and next actions, the results of learning technical drawings in the second cycle have been increased with a high category. This means the application of assessment for learning can improve learning activities and student learning outcomes on engineering drawing using Computer Aid Design (CAD).

**Keywords**—assessment for learning; learning activity; student learning outcomes; engineering drawing; CAD

## I. INTRODUCTION

Drawings are also referred to as "technical languages " or "languages for engineering undergraduate" [1]. The ability to read drawing is the most important requirement of all technical people in any profession [2]. Technical drawing is a communication tool to express someone's intentions and goals [3]. Forwarding information is an important function for language and images, must forward the information accurately and objectively. The information in the picture, which cannot be expressed in verbal language, must be given sufficiently as symbols. The amount and quality of the information that can be given in the picture depends on the talent of the designer (design drafter). Good communication by the use of drawings of quality relies on ensuring that they conform to established standards [4].

Technical drawing is one of the productive subjects that are given to students of Vocational High School No.1 West Sumatera. Technical drawing outline contain material about knowledge of drawing, reading and understanding of technical drawings. Technical drawings learning at Vocational High

School No.1 West Sumatera is carried out manually in grade X<sup>th</sup> and using AutoCAD as a supporting application for students grade XI<sup>th</sup>. AutoCAD is one of the image applications using a computer. CAD in technical drawing means to design using computer graphics systems to make mechanical designs (machine/machine components), electronic circuits [5,6] and architecture/civil engineering. In general, CAD is also known as a method to draw components or other with computer software assisted, for example AutoCAD release 2000, RoboCAD, Master engineering, and others. Companies or industries use CAD to design products that are produced. Mastery of CAD is important in the engineering world and a CAD expert is much needed in the industrial world because CAD is the basis for a variety of engineering activities such as drawing, design, analysis and manufacturing processes. Because it is done with the computer assisted, so that a design or image can be analyzed, revised, and modified more easily [7,8].

Technical Drawing subject requires students to be more active in the learning process. Learning implementation is not only done by giving theory, but also accompanied by practice, so that students' skills in drawing and students' understanding of technical drawings can be maximized. Technical Drawing learning that occurs at Vocational High School No.1 West Sumatera, especially in grade XI<sup>th</sup> of Mechanical Engineering are still not optimal, it can be seen that students are less active in the learning process and student learning outcomes that are still low. Students are less active in asking questions, expressing opinions and students are less initiative to practice independently.

Technical drawings are one of the productive subjects with the Criteria Minimum of Mastery score is 80. Learning outcomes which is obtained by students are still relatively low, and there are still many students who have not received good grades. It can be indicated by the data of students grade XI<sup>th</sup> of Mechanical Engineering of 2016/2017 academic year learning outcomes which show that 73% have not been able to achieve the desired learning outcomes or under the Criteria minimum of mastery (Source: Technical Drawing Teacher at Vocational High School No. 1 West Sumatera in the learning process, students are seen less skilled and less deft to draw using

AutoCAD applications. Students still have not understood the function of each tool in the AutoCAD application. The assignment that given by the teacher is only example form or images model that is displayed through the projector, without explaining the drawing procedure, so that the lack of communication between students and teachers that causes the learning process to be passive. The process of doing exercises or tasks are too long and less varied that causes boredom in the learning process. So that, it can make the Drawing Technique subject to be less attractive for students. The exercises are also less effective, so students can forget easily what they have been taught. The teacher has to repeat the material that should have been mastered by the students, so that the learning process takes longer. During the training process, students still look confused and deft, so that the learning outcomes that obtained by students are still relatively low or have not reached the KKM.

The students' failure to learn the technical drawings using AutoCad can be caused by internal and external factors. Internal factors come from students, while external factors come from outside of students, such as teachers. Teacher-centered learning models causes students to be less active. Similarly, media that is less varied and interested can cause a lack of student interaction in learning. Another component in learning is assessment. Assessments are considered one of the ways in which to help students achieve their desired goals and become self-directed learners [9,10]. Assessment is a process that focuses on student learning, a process that involves reviewing and reflecting on student performance and improving student learning [11-13]. Research has shown that assessment have a considerable influence on students' learning [14] it may also improve it [15].

There are three approaches in assessment, as follows: (1) assessment of learning, (2) assessment for learning, and assessment as learning. Generally, teacher uses assessment traditional approach to collect information about achievement. Usually, it is done at the end of the course and using tests to determine grades and reporting the achievements or failures. Assessment for learning occurs at all stages of the learning process. Students are encouraged to take an active role, to becoming students who are independent, capable, and confident to continue learning so that can achieve the goals set. Assessment for Learning (AfL) is integral to outstanding teaching and integral to developing outstanding learning [16]. Assessment for learning is also referred to as formative assessment, i.e. the process of collecting and interpreting evidence for use by teachers and learners to decide where they are in their learning, where they need to go, and how best to get there [17]. Assessment for learning encourages learning and promotes motivation by emphasizing progress and achievement rather than failure. The studies AfL have mainly concentrated on particular aspects of it, such as feedback [18-20] and the relation between summative and formative assessment [21]. Therefore, this study aims to show assessment implementation for learning to increase activities and Technical Drawing learning outcome using AutoCAD on students at Vocational High School No.1 West Sumatera.

## II. METHOD

This study belongs to the type of research that uses classroom action research methods, where researchers with collaborators carry out direct observations. Data collection is done based on the results of observations and tests that are used to see students' ability to draw using AutoCAD. The results of this study will elaborate the concrete situation that occurs in the implementation of the assessment for learning in technical drawing learning where the implementation uses AutoCAD in grade XI<sup>th</sup> students of Vocational High School No.1 West Sumatera. Grade XI<sup>th</sup> students are numbered 26 people.

Classroom action research is defined as an action research that is conducted by a teacher who simultaneously acts as a researcher in his class, or together with others. The teacher designs, implements, and reflects actions collaboratively and participatively. The aim is to improve the quality of the learning process in its class through a certain action in a cycle [21-23].

The study was carried out in two cycles, in which each cycle is consisted of two meetings. At the end of each cycle are conducted tests and evaluations as a result of reflection. The number of cycles depends on the indicators of success in each cycle, but it is recommended that the study carried out not less than two cycles [24]. In this study, indicator of success on the first cycle is 50%, while indicator of success on second cycle is 80%. The data is analyzes using descriptive statistics [25,26].

This study starts from observing student learning activities and student learning outcomes. Researchers observe student learning activities by direct observation using observation sheets, while student learning outcomes are measured using objective test instruments. According to Diedrich students learning activities consists of: (1) visual activities, (2) oral activities, (3) listening activities, (4) writing activities, (5) drawing activities, (6) motor activities, (7) mental activities, and (8) emotional activities [27]. Indicators of students learning activities and assessment guidelines are liste in table 1.

TABLE I. STUDENTS ACTIVITY ASSESSMENT GUIDELINES

Indicators of activities	Learning Activities	Code	Max Score
Visual Activities	a. Pay attention	Va	4
	b. Read	Vb	4
Oral Activities	a. Ask	Oa	4
	b. Answer question	Ob	4
	c. Express opinion	Oc	4
	d. Cooperate	Od	4
Listening Activities	a. Listen actively	L	4
Writing Activities	a. Write	W	4
Drawing Activities	a. Conduct the task	D	4
Motor Activities	a. Practice independently	M	4

The contents of the learning activities observation sheet in the percentages form. Researchers with collaborators observe directly the activities that are carried out by students during the learning process. The Technical Drawing takes conducts and

provides an assessment based on the assessment sheet of student activities. To determine the percentage of student activity in each learning cycle that is used the following equation:

$$\text{Students Activities} = \frac{\sum \text{Score of activities sub-indicator}}{\text{max imum score activities}} \times 100 \quad \dots(1)$$

$$\text{Average of students activities} = \frac{\sum \text{students activities value}}{\text{max imum score}} \times 100\% \quad \dots (2)$$

Assessment percentage of students learning outcomes are obtained using the following equation:

$$\text{Level of mastery} = \frac{\text{Amount of correct answer}}{\text{Amount of itemtest}} \times 100 \quad \dots\dots(3)$$

This study can be said to be successful and can be stopped if the learning outcomes have reached the desired indicator. Indicators of the success of the implementation of learning quality improvement actions can be determined by the teacher who in this case is the researcher, according to the student's ability and the level of improvement will be achieved. The criteria of success in improving the quality of learning in this study through implementation assessment for learning, namely:

**A. Activities Learning :**

- On the 1<sup>st</sup> cycle, students learning activities reach 50% percentage.
- On the 2<sup>nd</sup> cycle, students learning activities reach 75% percentage.

**B. Learning Outcomes:**

- On the 1<sup>st</sup> cycle, students learning outcomes reach 50% percentage.
- On the 2<sup>nd</sup> cycle, students learning outcomes reach 80% percentage.

**III. RESULTS AND DISCUSSIONS**

**A. Students Learning Activities**

Students learning activities result of the first meeting learning activities can be seen on figure 1.

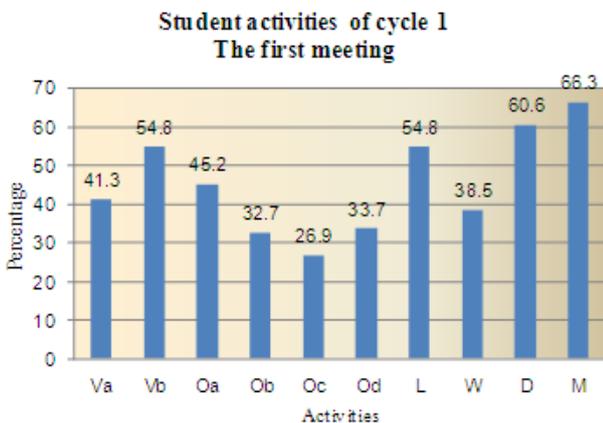


Fig. 1. Students activities graphic of 1<sup>st</sup> meeting of the 1<sup>st</sup> cycle.

Figure 1 shows at 1<sup>st</sup> cycle meeting that the lowest percentage is 26.9% (expressing opinions), while the highest percentage is 66.3% (independent practice). Based on the observation sheet and analysis of the overall students' activities, an average percentage of 45.5% was obtained. Students' activity is still relatively low because the classical completeness of 1<sup>st</sup> cycle requires a value of  $\geq 50\%$ .

1<sup>st</sup> cycle is continued for the second meeting. Student learning activities results of the second meeting of 1<sup>st</sup> cycle can be seen in figure 2.

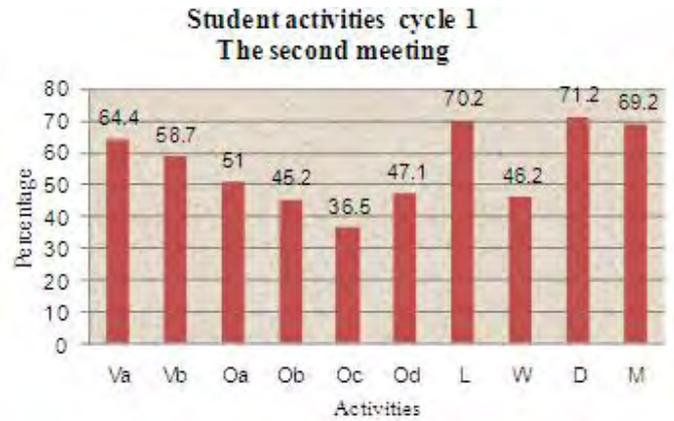


Fig. 2. Students activities graphic of 2<sup>nd</sup> meeting of 1<sup>st</sup> cycle.

Based on the data above, it can be seen that the lowest percentage is 36.5% (expressing opinions), it means that there are still many students who have not been active in expressing opinions. The highest percentage in the data is 71.2% (doing assignments), it means that students' awareness of learning has increased. At the second meeting, the average percentage is 55.96%. Learning activities have not been good, but the implementation of the research can be continued to the next cycle, because the achievement of the activities percentage have reached  $\geq 50\%$ .

Data was obtained from the first meeting to the second meeting in cycle I that were obtained the average percentage value of student learning activities is presented in figure 3.

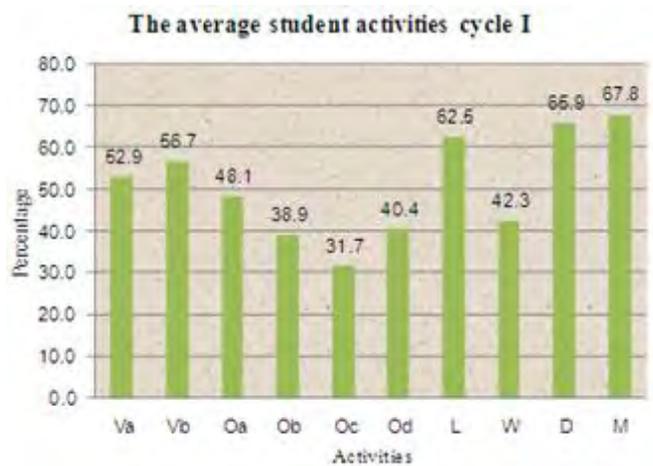


Fig. 3. Average graphic of 1st cycle activities.

Based on figure 3, it can be seen that student activity in asking questions, answering questions, expressing opinions, cooperating and writing, are still low because the percentage does not reach 50%. Student activity in expressing opinions is the lowest percentage activity, which is only 31.7%, while the highest percentage activity in the first cycle is student activity in independent training, where the percentage reaches 67.8%.

The cycle is continued to the second cycle. Student learning activities result of the first meeting of the second cycle can be seen in figure 4.

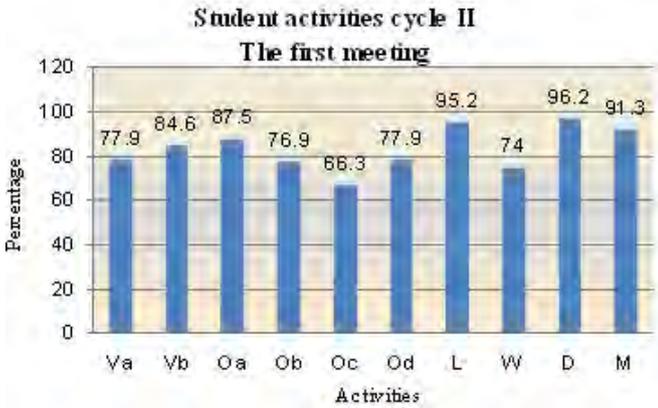


Fig. 4. 2<sup>nd</sup> cycle activities of 1<sup>st</sup> meeting.

Based on the data on the activity sheet and diagram above, it can be concluded that students' activity has been good, because 9 out of 10 types of activities have reached 70%. Second Cycle is continued for the second meeting. Student learning activities result of the second meeting of second cycle can be seen in figure 5.

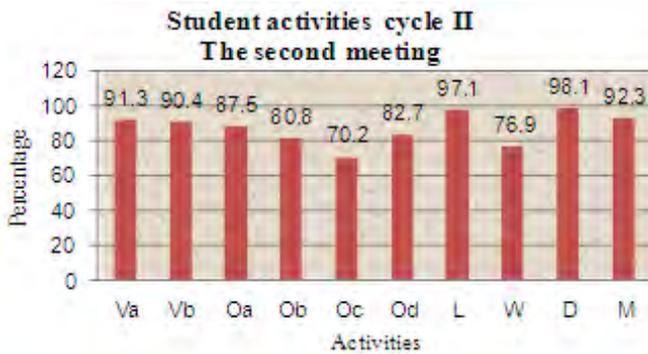


Fig. 5. Students learning activities of 2<sup>nd</sup> meeting of the 2<sup>nd</sup> cycle.

Based on the data above, it can be seen that the lowest percentage is 70.2% (expressing opinions). Although the activity of students in expressing opinions has the smallest percentage value, the percentage value has increased and has been considered successful, because it reaches  $\geq 70\%$ . The highest percentage in the data is 98.1% (doing assignments), it means that almost all students conduct the training task well. Students are considered to be very good in activities of paying attention, reading, listening actively and practicing independently, it can be seen from the percentage of these activities which reached  $> 90\%$ .

Data was obtained from the first meeting to the second meeting in cycle I obtained the average percentage of student learning activities presented in figure 6.

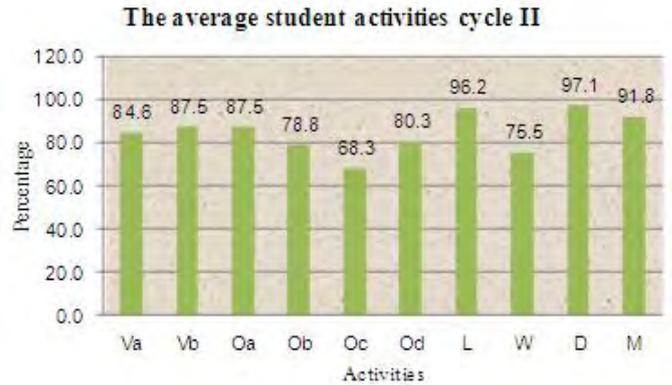


Fig. 6. Average of 2<sup>nd</sup> cycle activities achievement.

Based on the graph above, it can be seen that students' activeness in Technical Drawing learning by applying assessment for learning has increased from cycle I. Student activity in expressing opinions becomes an activity with the lowest percentage of 68.3%, although student activity in expressing opinions has the lowest percentage value, students of grade XI<sup>th</sup> Mechanical Engineering have been active in participating in Technical Drawing learning, because each type of activity in second cycle has an average percentage value of 84.76% ( $> 70\%$ ).

*B. Students Learning Outcomes*

The learning outcomes were obtained from the skills value (psychomotor) using AutoCAD and the value that is obtained from the test (cognitive). Weight rating is 60% for psychomotor and 40% for test. In the first cycle, the completeness of learning outcomes was only 53% of the total students in the class. There are still many students who have not reached the established the Criteria Minimum of Mastery, which is  $\geq 80$ . Of the 26 students, there were 12 students who had not yet achieved their learning abilities. This is because there is still a lack of involvement (activity) of students in participating in the learning, besides that the learning process has not been implemented optimally. Based on the analysis of the learning outcomes data above, the study is continued into second cycle.

In the second cycle, learning outcomes that were obtained in the second cycle has increased, because 23 of 26 students were able to get scores above the Criteria Minimum of Mastery ( $\geq 80$ ). The percentage of learning completeness achieved in the second cycle was 88%, so the Technical Drawing learning activity using assessment for learning in grade XI<sup>th</sup> of Mechanical Engineering was successful, improvement of activity and learning outcomes are presented in figure 7.

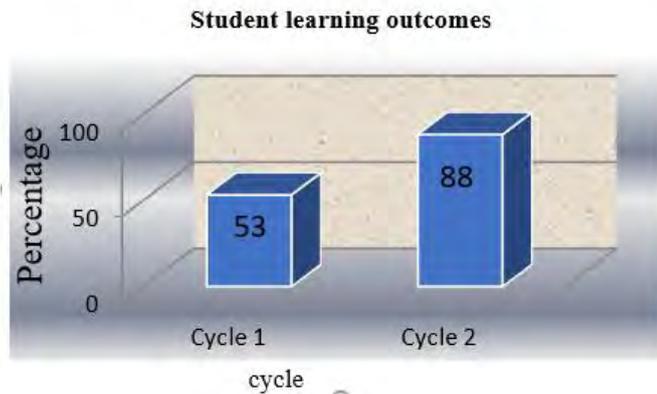


Fig. 7. Students learning outcomes improvement.

### C. Discussions

The findings of the study indicate that there has been an increase in student learning activities from first cycle of 50.72 to 84.76 to second cycle, and learning outcomes from first cycle are 53 to 88. Assessment for learning involves the using of assessment to assist students who enable them to progress [28]. The AFL strategy contributes for student self-regulation, as a catalyst for independent learning, and has a full impact on students' thoughts, actions and feelings [29].

Assessment for learning aims to improve learning process. Weakness and failures in learning process are given feedback. Provide feedback that supports students to help them to take the next step in their learning [29]. Feeding back includes: (1) reviewing material that has not been mastered by students at the previous meeting, (2) explaining the purpose and benefits of technical drawings learning using AutoCAD, (3) explaining the material about component drawings, (4) explaining the steps to make component drawings and image layout in a drawing paper, (5) provide an example of a good and complete component, (6) demonstrate how to draw components using AutoCAD, (7) provide opportunities for students to do questions and answers, (8) provide a re-explanation of the material that have not mastered by students, (9) provide training (drill) independently job sheet to be done and facilitated by the teacher, (10) revise again the items that have given to test student competence using AutoCAD in technical drawings, related with content, compilation of questions, language used, difficulty index, and problem differentiation.

The results of the back feed are follows: (a) students are very enthusiastic to conduct technical drawing learning, it can be seen from the more active learning environment, (b) students are motivated to compete in completing the training assignments that are given by the teacher, and (c) there is an increase in activity and learning outcomes in technical drawings using AutoCAD.

Teacher can apply assessment for learning in Technical Drawing learning effectively, because AfL is marketed as a crucial concept in the quest for an improved goal attainment [30] and become a widespread approach across many educational systems and need teachers' knowledge, skills, and practices [31,32].

## IV. CONCLUSION AND RECOMMENDATION

### A. Conclusion

Based on the findings of study, it can be concluded that the application of assessment for learning on technical drawing learning that is carried out using AutoCAD can increase the activity and learning outcomes of students grade XI<sup>th</sup> of Mechanical Engineering at Vocational High School No.1 West Sumatera.

### B. Recommendations

Based on findings of study, researcher suggests:

- The activity of students in learning should be of particular concern for teacher, because student activities will affect to learning outcomes.
- The teacher can provide guidance and training to improve students' ability to use AutoCAD for technical drawings.
- AfL involves teachers and students collaboratively to set learning targets and success criteria and then actively using assessments (of various forms) to provide self, friends, and teacher feedback on student learning to reach the set targets.
- AfL will effectively include discussions about standards, criteria, tasks and feedback about progress. Therefore, the teacher can explain learning objectives clearly, assessment criteria and feedback, must be used in ways that challenge students to enter into discussions and express their thoughts to teachers and peers during the learning process. As a result, students will be actively involved to make a meaning during the learning, which will lead to deeper understanding.
- Teacher can implement AfL effectively, so that it can support students to become confident, reflective, innovative, and engaged.

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