Implementation of Active Learning Method in Unit Operations II Subject

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ABSTRACT: Active Learning Method which requires students to take an active role in the process of learning in the classroom has been applied in Department of Chemical Engineering, Faculty of Industrial Technology, Islamic University of Indonesia for Unit Operations II subject in the Even Semester of Academic Year 2015/2016. The purpose of implementation of the learning method is to assist students in achieving competencies associated with the Unit Operations II subject and to help in creating a conducive academic atmosphere so as to contribute to improving the quality of teaching and learning in the study environment. The implementation of this learning method synergized with the face-to-face method is quite successful. This is indicated by an increase in the students' final score of B from the baseline by 44% to 80%. This achievement exceeds the targeted percentage of 60%.

Keywords: active learning method, face-to-face method, process of learning, conducive academic atmosphere, unit operations II

INTRODUCTION

Since a few years ago, Islamic University of Indonesia (Universitas Islam Indonesia-UII) has committed itself to be a world-class university, so that UII graduates are able and ready to compete well in a global level. To achieve the target, UII has developed university development plans by making it as a teaching university in the period of 2008-2014 and further strengthened to be an excellent teaching university in 2015-2022 [1].

The purpose of study in the Chemical Engineering Department (ChED) of UII is as one of the tools to realize the vision and mission of the department in the effort of mastery of science and technology other than as a means to implement a curriculum.

Until now, the process of learning in the ChED of UII still use theface-to-face method as the main learning activity. Nevertheless, efforts to modify the teaching method have been done so that students can be more active in mastering the material and looking for the source that is by way of discussion and an active role of students in front of the class. Several ways have also been done to improve students' activeness in classroom learning activities, such as a real problematic based learning development, industry visits as a substitute for face-to-face and another lecture duties. Development of teaching methods in the ChED of UII continues to be carried out to obtain the most optimal method to support the achievement of ChED of UII vision in general and to improve graduates competencies in particular.

Unit Operations II (UOP II) is a compulsory subject for fourth-semester students in the ChED of UII with a credit load of 3 Semester Credit Units (SCUs). This subject contains the principles of mass transfer and its equipment as well as simultaneous mass and heat transfer operations. The learning objectives to be achieved from the UOP II subject are that students can understand the principles of mass transfer and are able to apply the concepts to analyze and design mass transfer operations as well as the simultaneous mass and heat transfer operations.

In the previous academic year, the learning method was one-way from the lecturer to the students (Instructor-Centered Learning, ICL) where the students received the theory, perform the exercise questions and perform the evaluation in the form of the quiz after completing one topic. In this one-way learning method, students tend to be passive because the delivery of the material is only done in one way by the lecturer. However, while doing the exercise questions, students can be a little more active by asking and/or discussing. The passive nature of students in the classroom may be among other due to their lack of understanding of the contents of given lecture materials.

Lack of understanding of UOP II materials content by the students may be caused by the content of the course materials and the method of delivery. Some of the things may be the cause of the problem include: (i) the method of one-way lecture material delivering needs to be improved so that the delivery of material is more interesting so as to increase students' understanding; (ii) visual aid is required in the course materials delivery, including simulation of calculations in completing sample questions, and (iii) varying levels of students' capabilities and abilities so that an appropriate teaching method is then required for this condition. These problems have been gradually improved by applying the Active Learning Method (ALM).

Based on the background of the problems encountered as described above, the following problem formulations are made, (i) how is the ALM applied to the Unit Operations II subject? and (ii) Does the ALM is applied to the Unit Operations II subject can improve the learning outcomes?

LITERATURE REVIEW

Active Learning Method that has been implemented and developed by some authors [2 – 11] is defined as all activities that engage students in doing things and thinking/finishing what they do [12,13]. The meanings of the activities here are such as reading, writing, discussion, or solving problems that require analysis, synthesis, and evaluation. Similarly, Bell and Kahrhoff [14] defined Active Learning as a process in which students are actively involved in building an understanding of facts, ideas, and skills through the completion of tasks and learning activities under the guidance of an instructor (lecturer).

Some of the main characteristics of the ALM strategy are as follows [13]:

1. Students are more active than the one-way learning model where the student is a passive listener.
2. Students engage in activities in the classroom such as reading, discussion, and writing.
3. More emphasized on the development of student skills rather than the delivery of information by thelecturer.
4. More emphasized on the exploration of attitudes and values/morals.
5. In general, there is an increase in student motivation.
6. Students can immediately receive feedback from the instructor (lecturer)
7. Students play a role in deeper thinking that is analysis, synthesis, and evaluation.

In the decade of 40/50s, Edgar Dale, an educational expert from the United States, had developed "the Cone Experiences" also known as "the Learning Triangle" as shown in Figure 1. In recent years, the results of the research became contentious because the original data of the study is not found. However, the percentage used in "the Learning Triangle" is generally correct.

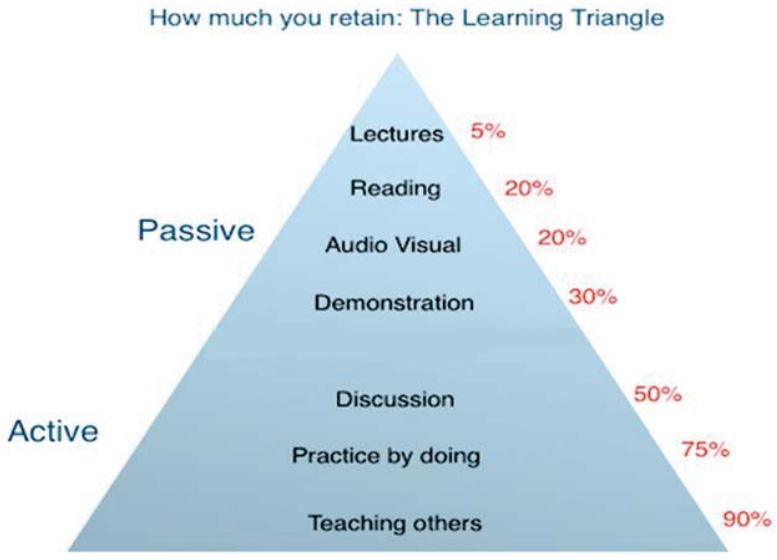

FIGURE 1. Level of Understanding Gained Based on Some Learning Types in the Learning Triangle [15]

Based on Figure 1., it can be seen that the one-way learning model does not involve the students to play an active role in the class. Classroom activities such as delivery of materials, reading, audiovisuals, and demonstrations are mostly done by the instructor (lecturer), while the students are just passive listeners. Level of understanding acquired for this *Passive Learning* category is maximum about 30%. Furthermore, to improve deeper understanding up to 50% it can be done by means of *Discussion*, where the students can convey their ideas to others and also keenly accept the ideas of others. This level of understanding can be increased again to about 75% by means of *Practice by doing*. At this level, students can learn/practice directly from the experiences they get or apply them to real problems. From the bottom of "the Learning Triangle," it is seen that *Teaching others* level indicates that students have been able to transfer the knowledge they acquired to others. Level of understanding of the students at this stage has reached 90%.

METHOD

As mentioned above, learning model that was applied is ALM which is synergized by the face-to-face method. Some of the learning activities that have been developed in this program are presented in the form of a *fishbone diagram* as shown in Figure 2.

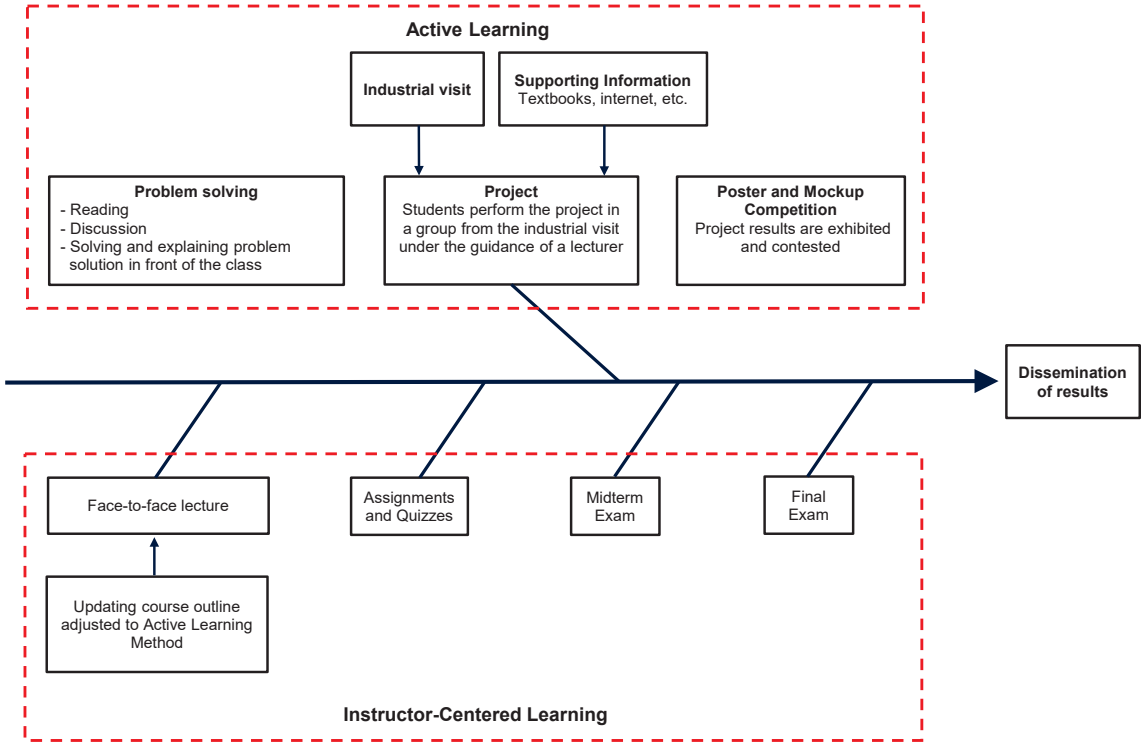

FIGURE 2. The Learning Activities that have been Developed in a *Fishbone Diagram*

The description of the activity design in the *fishbone diagram* above is as follows:

1. *Instructor-Centered Learning*. The face-to-face method is maintained with several considerations such as the adding capacity of students is varied so that the material explanation by the lecturer is still needed. However, the course outline and lecture events unit have been adjusted to the ALM. In addition, students will still be provided with tasks and quizzes as an evaluation of the material that has been delivered.
2. *Active Learning*. ALM is implemented in the form of several activities, among others: (i) *Problems solving*. For this activity, one of the students was asked to come to the front of the class to solve the problem presented by the lecturer. After that, the student is asked to explain the problem-solving in front of the class. In this case, students are required to be active in the classroom. (ii) *Project*. To work on this project, students are divided into groups with about 10 students per group under the

guidance of the lecturer. Each group is required to select Project topics taken from the industrial visit activity. In completing this Project, students are required to actively seek supporting information, for example from textbooks, internet, and others. The results of this Project are in the forms of reports, posters, and mockups of process units that were reviewed. (iii) *Poster and Mockup Competition*. Results of the Project in the forms of posters and mockups of process units are exhibited and contested.

RESULTS AND DISCUSSION

Instructor-Centered Learning activities in the form of face-to-face activities have been conducted before and after the Midterm Examination. Students have been provided with assignments and quizzes. In addition, it is also applied the ALM where the students solve the problems and one of the students is asked to come to the front of the class to solve the given problem and then the student explains the problem-solving in front of the class. In this case, students are required to be active in the classroom.

Industrial visit to Pertamina Refinery Unit (RU) IV Cilacap, Central Java, was held on the5thof April 2016 followed by 95 students divided into 10 groups. Each group has chosen a unit process that has been discussed more deeply in the group report. The unit in the forms of a poster and a mockup is then presented and contested. Figure 3 shows several models of process units in Pertamina RU IV Cilacap, Central Java.

FIGURE 3. Mockup Sample of Process Units designed by the Students

The implementation of this teaching grant has made a real contribution for both students in particular and for the ChED and UII in general. Some of the practical contributions that can be gained include (i) *Students*. Assist students to achieve competencies related to the UOP II subject. In addition, to help improve understanding of the principles of mass transfer and its equipment as well as simultaneous mass and heat transfer operations. (ii) *Chemical Engineering Department*. Help to create a conducive academic atmosphere and further contribute to improving the quality of teaching and learning in the department. (iii) *The Islamic University of Indonesia*. As a means to distribute the values set by UII in building college students character.

The ALM has been implemented for a long time. In the decade of 40/50s, Edgar Dale, an educational expert from the United States, developed "the Cone Experiences" which is also known as "the Learning Triangle" where the level of student understanding could reach 90% by using the ALM. This active learning model has also been applied by Bonwell and Eison [12] at higher education level

(university) where this method can be done by visual learning, writing in class, problem-solving, computer-based instruction, cooperative learning, debate, drama, role-playing, simulation, games, and peer teaching. Furthermore, Bonwell [13] developed this active learning method into the *Active Learning Continuum* where students at the beginning of the lecture are provided with simple tasks and then provided with more complex tasks in order to maximize the intellectuality of the students.

The ALM is also used by Tamasek Foundation and Singapore Polytechnic in TVET Program 2015 which is one of the standards used in CDIO (Conceive-Design-Innovate-Operate) framework.

Implementation of the ALM in the ChED of UII is quite successful. It can be seen from an indicator of the program which is the increment of students' final score of minimal B from 44% (baseline) to 80%. This achievement exceeds the targeted percentage of 60%.

CONCLUSION

Active Learning Method has been applied in the Chemical Engineering Department of UII for Unit Operations II subject. The implementation of the ALM synergized with the face-to-face method is quite successful which is indicated by the increase of the students' final score of minimal B from the baseline by 44% to 80%. This achievement exceeds the targeted percentage of 60%.

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