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Constructivistic Learning Method with Simulation to Increase Classroom Engagement

Dani Yuniawan[*,***,†] · Teruaki Ito[**]
[*]Department of Mechanical Engineering, The University of Tokushima, Japan
[**]Department of Industrial Engineering, Merdeka University of Malang, Indonesia
[***]Institute of Technology and Science, The University of Tokushima, Japan

ABSTRACT

It is reported that the constructivistic learning method (CLM) enhances the understanding of the students in the learning process, especially in engineering classes. In CLM-based classes, the students can take the initiative in the learning process, which is called the student-centered model of the learning process. This is different from the traditional learning method based on the teacher-centered model, where a teacher plays the central role in the learning process of students. The authors have applied the method of CLM to one of the Engineering classes, namely production planning and inventory control (PPIC) class for undergraduate students. The PPIC class provides multimedia-based study materials and factory visits as well as regular lecture sections to cover the whole subject of inventory control theory and practice. In the review sessions, students are divided into several groups, and question-and-answer discussions were actively carried out among these groups under the support of the teacher as a facilitator. It was observed that the student engagement in the class was very active compared to the conventional lecture-based classes. As for further support of students understanding on the subject, simulation-based materials are also under study for the class. This paper presents the review of case study of CLM-based PPIC class and discusses the feasibility of simulation-based study materials for further improvement of the class.

Keywords: Constructivistic learning method, production planning, Inventory control, classroom engagement, simulation

I. Introduction

When a teacher gives a lecture on an Engineering subject using some course materials to students, interaction between the teacher and the students helps the students to well understand the subject. Furthermore, interaction among the fellow students could also help them to understand each other.

However, one of the typical and conventional methods of teaching often conducts in one direction, namely from a teacher to students. This kind of typical approach is often found in almost every course in the department of industrial engineering at the Merdeka University Malang (UNMER), East Java in Indonesia [1,2]. It is reported that the constructivistic learning method (CLM) enhances the understanding of the students in the learning process, especially in engineering classes [4]. In CLM-based classes, the students can take the initiative in the learning process, which is called the student-centered model of the learning process. This is different from the traditional learning method based on the teacher-centered model, where a teacher plays the central role in the learning process of students [6]. The CML was first introduced to UNMER in 2007 and some associated programs were started in the Industrial Engineering Department at UNMER in 2008. The authors have applied the method of CLM to one of the Engineering classes, namely production planning and inventory control (PPIC) class for undergraduate students [3]. The PPIC class provides multimedia-based study materials and factory visits as well as regular lecture sections to cover the whole subject of inventory control theory and practice. In the review sessions, students are divided into several groups, and question-and-answer discussions were actively carried out among these groups under the support of the teacher as a facilitator. It was

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† Corresponding Author: dyuniawan@gmail.com

observed that the student engagement in the class was very active compared to the conventional lecture-based classes. As for further support of students understanding of the subject, simulation-based materials are also under study for the class. This paper presents the review of case study of CLM-based PPIC [8] class and discusses the feasibility of simulation-based study materials [9] for further improvement of the class.

II. Problem Description

PPIC (Production Planning and Inventory Control) class of Department of Mechanical Engineering at Merdeka University Malang (UNMER) covers the broad subject of production planning and inventory control for 15 weeks in one semester. The lecturer provides participating students lots of teaching support materials in each class as a supplement to the teaching textbook. Each lecture is given by a power-point presentation style to cover the subject. Even though some of the students engaged in the lecture quite well, but others have a tendency of just attending the class. Unfortunately, participating students of PPIC have a general tendency of asking fellow students about questions regarding the course materials, instead of asking the teacher who provides the materials. What is frequently seen in PPIC class is an unfavorable situation; some students get bored in the class, some may fall asleep during the class, others may even chat with friends without listening to the lecture's talk. When a student asks a question to his /her fellow student about the lecture, it is often happened that even the fellow student does understand the lecture and could not answer the question. One of the reasons why these things happen may be due to the one-way communication in the lecture, which means that a teacher just gives a lecture without enough interaction with the students. Students learn the subject of PPIC in a passive manner. At the end of the class, a small quiz is given to the students to make sure their understanding. The results are very low scores mostly. Another reason for this problem is derived from unreal examples in the textbook. What the students learn from the lecture is different from the real world and do not get a clear picture of how to apply the theory to real world applications. In order to overcome these two problems, an approach of CLM was applied to PPIC.

III. Constructivistic Learning Method

Constructivist learning is a theory about how people learn. It states that learning happens when learners construct meaning by interpreting information in the context of their own experiences. In other words, a learner constructs their own understandings of the world by reflecting on their experiences.

Constructivist learning is related with pedagogic approaches that promote active learning, effective learning, and meaningful learning, constructive learning, also learning by doing. There are some fundamental differences between the methods of constructivist learning and conventional learning methods (behavioristic method). The differences are shown in Table 1.

Since the curriculum system of UNMER is based on the conventional teaching method, it is difficult to apply CLM fully in PPIC class. Therefore, PPIC introduced some of the CLM shown in Table 1.

Here are some of the examples of CLM implementation in PPIC:

1. Inventory management data from the local partner company was used in the class so that the students should know the real problems in inventory management. (Correspond with Constructivistic #8)
2. Simulation study using spreadsheet was assigned to the students so that the students should learn more than one solution to the problems,. (Correspond with Constructivistic #11)
3. Intensive consultation was given in the class so that the students should learn how to implement theory in the practical. (Correspond with Constructivistic #9)
4. Opportunity of group discussion was given in the class so that the students should learn to share their ideas. (Correspond with Constructivistic #4)
5. Students are more active in the class in term of learning (correspond with Constructivistic #10).

Table 1 The difference between behaviouristic method and constructivistic method [4]

No.	BEHAVIORISTIC	CONSTRUCTIVISTIC
1	Knowledge: objective, definition, fixed	Knowledge: non-objective, temporary, constantly changing
2	Learning: the acquisition of knowledge	Learning: the meaning of knowledge
3	Teaching: transferring knowledge to the learner	Teaching: exploring the meaning
4	Mind serves as a plagiarist knowledge structure	Mind serves as a means of interpreting the meaning
5	Control of learning held by the system beyond the self-learning	Held by the control of the learner
6	The purpose of learning emphasizes on the addition of knowledge	Emphasize the learning objectives in the creation of understanding
7	Isolated skills	The use of knowledge in a meaningful
8	Learning activities follow the textbook	Learning activities in a real context
9	Emphasis on results	Emphasis on process
10	Passive Response	Preparation of meaning is active
11	Demanded one correct answer	Demands multiple solutions
12	Evaluation is a separate part of the learning	Evaluation is an integral part of learning

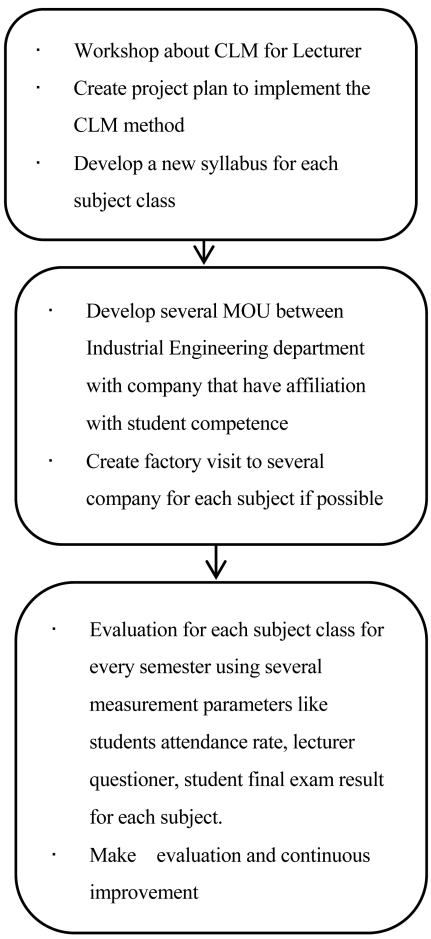


Fig. 1 Framework for CLM implementation Project

6. Evaluation meeting was held after the presentation session so that all members of the class should share the ideas. (Correspond with Constructivistic #12)

CLM is not a new method in education. However, it is quite rare to find a CLM example at the university level in Indonesia. This is because the rule of the Ministry of Education in Indonesia had been basically referred to the conventional curriculum until the year 2007. However, in 2008, the Ministry of Education in Indonesia started to introduce a competency-based curriculum system, where the implications of CLM implementation were adopted at the same time.

It is not possible to apply CLM to every class because the model of the education system in Indonesia is based on the conventional curriculum system. However, CLM can be applied in the process of learning based on a real case study, which uses information obtained from real world applications, group discussions on real world problems, factory visit to see the real world situations, and etc. Before implementation of CLM, a CLM Workshop was held at UNMER in order to socialize the CLM method for all lecturers in the Industrial Engineering Department. Fig. 1 shows an example of long term project using CLM.

IV. Implementation of CLM with Simulation

This course covers the two major categories of subjects, namely deterministic inventory control and probabilistic inventory control. Deterministic inventory control is presented before the midterm exam in a semester, and probabilistic inventory is conducted after the midterm exam in the same semester. The factory visit tour is held either

before or after the midterm exam, depending on the schedule of a partner company. Thanks to the cooperation with some local partner companies, the PPIC class uses case studies of inventory control data in the local factories. This section covers the two basic ideas of inventory control taught in the PPIC class, factory visit tour which is held during the course.

1. Deterministic Inventory
   A method based on the assumption that all parameters and variable associated with an inventory are known or can be computed with certainty, and that the replenishment lead time is constant and independent of the demand, as follows: the ordering cost is constant, the rate of demand is known, and spread evenly throughout the year, the lead time is fixed, the purchase price of the item is constant, and the replenishment is made instantaneously.
2. Probabilistic Inventory
   Situation or model where there are multiple possible outcomes, each having varying degrees of certainty or uncertainty of its occurrence. Probabilistic is vice versa with deterministic inventory, where the ordering cost is not constant, the rate of demand is unknown, the lead time is unfixed, the purchase price of the item is not constant, sometime there are calculation for discount quantity, and the replenishment is uncertainty.

V. Factory Visiting Tour

Department of Industrial Engineering at UNMER agreed to hold several memorandum of understanding (MOU) between several companies such as PT Supra Aluminium Industri, Pandaan city, East Java, PT Indopherin Jaya, Probolinggo city, East Java, PT Bank Jatim, Kediri city, East Java, so that UNMER students could see the real production. One class is commonly consisted of 15-30 students, out of which 3-5 students form a team. The whole class composed of 5-6 teams pays a one-day visit to one of the factory to see how the inventory management is controlled in the real factory. During the factory visiting tour, students learn the real inventory management in the factory, production line, maintenance of machines, warehousing management [5], marketing policy and management [7], etc.

VI. Technical Implementation of CLM

The whole class is composed of 15days in one semester, including lecture (5 days), factory visit (1 day), presentation (3-4days), and other lectures (5days). At the beginning of lectures, discussion groups are formed in 3-5 students at random and presentation schedule is made. The teacher assigns the inventory data based on raw data from the factory to one team and theoretical data based on different inventory policy to other teams. Students give a presentation regarding simulation data from the factory. As a special event of the class, students pay the factory visit

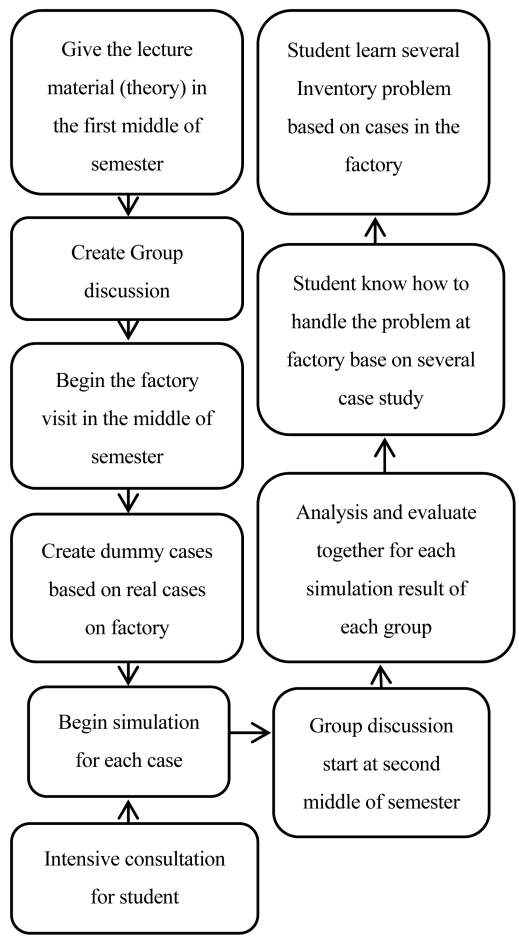


Fig. 2 Technical Implementation CLM in the Class

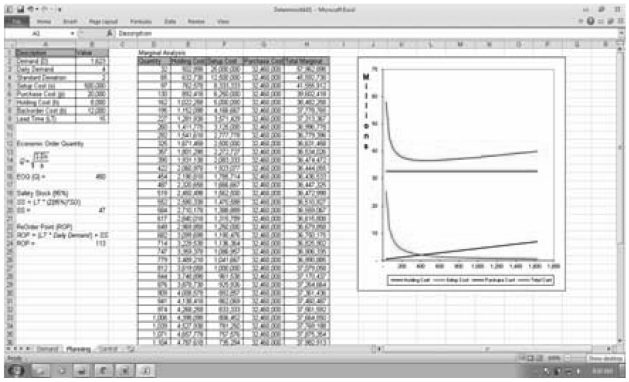


Fig. 3 Example of Marginal Analysis simulation data

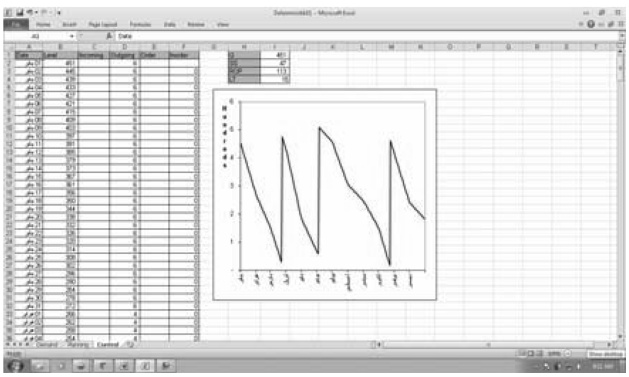


Fig. 4 Example of Inventory level control simulation

and see who the inventory management is performed in the factory.

Two weeks before the presentation, each group has a discussion meeting with the lecturer to decide what is supposed to present in the class. Students learn many things from PPIC and one of the lessons they learn is that reality in companies are quite often different from the theory taught in the class (see Fig. 2). [3]

VI. Evaluation of the Effect of CLM In PPIC Class

All classes during the semester are evaluated at the end of the semester. This evaluation includes the assessment for the teacher as well as the assessment of the teaching materials used in the classes. Evaluation results are reported to the lecturers' meeting of industrial engineering department at the end of the semester. This section covers how the evaluation was made to PPIC class. Three parameters were measured in evaluating the performance of the learning process in PPIC, including performance of lecturer, attendance rates of students, and final examination results of students.

1. Performance of the lecturer: A questionnaire regarding the performance of the lecturer is given to the students at the end of the semester. This index is based on the results of the questionnaire
2. Attendance rates of students: Attendances of students are all recorded in each class. The average student attendance rate is calculated as an index. This index is used as a benchmark to show how important the students consider the class.

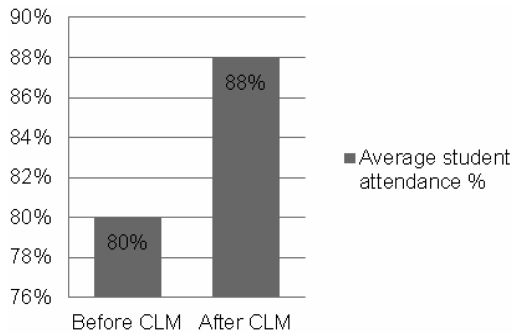
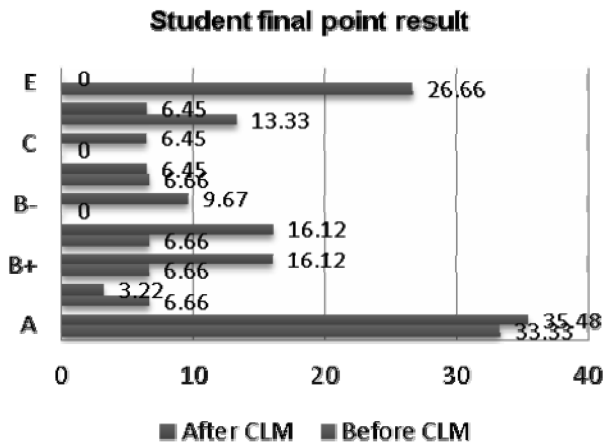


Fig. 5 Rate of attendance from the PPIC class [1]



A for point between 80-100
A- for point between 76-79
B+ for point between 71-75
B for point between 67-70
B- for point between 63-66
C+ for point between 60-62
C for point between 56-59
D for point between 46-55
E for point between 0-45

Fig. 6 Result exam test at the end semester for PPIC [1]

3. Final results of examination: Percentage of students' final examination results of these subjects are used as an index. Students cannot obtain the credit of the subject if the score is E. If the score is D, students must take the course again. The percentage distribution of these values is shown in Fig. 6. Fig. 6 shows the significant difference in the final scores after CLM implementation in PPIC. Especially, the number of students with "E" score was decreased significantly.

VII. Conclusion

This paper described the experiences of CLM activities in PPIC class at UNMER and showed how CLM was implemented in the class using real case studies from local factories. CLM provides students the opportunity to apply what they learn in the class to the real world problems. As opposed to the regular lecture classes where students are not willing to talk to the teacher, students are more eager to discuss the problems with the teacher as well as the fellow students in CLM-based class work. The positive effects of CLM-based class are recognized in the increase of final examination scores.

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Yuniawan, Dani

History: Lecturer at Merdeka University of Malang, East Java, Indonesia since 2001 until present. Work at Indonesia Ministry Education (DIKTI - KOPERTIS Wilayah VII, East Java) Assigned at Industrial Engineering, Merdeka University of Malang since 2005 until present. He served as Head of Industrial Computation Laboratory at Industrial Engineering Department Merdeka University since 2004 until 2011. He is lecturer in several subjects such as Quality Engineering, Quality Management, Management Information System, and others. He gets his Master degree in Industrial Management at Institute Technology of Tenth November Surabaya in 2002. Currently He takes PhD Course at Graduate School of Advanced Technology and Science, The University of Tokushima since 2011 until present.

Phone: 080-3929-8525

E-mail: dyuniawan@gmail.com