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## Blended learning model for improving learning effectiveness on techniques of refrigeration and air conditioning courses

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**Abstract:** *This article was aimed at examining the effectiveness of the blended learning model, namely the combination of face-to-face learning and web-based e-learning. The study was classroom action research. The subjects were students who took the Technique of Refrigeration and Air Conditioning Course in the second half of the Year 2008/2009. Methods of data collection were questionnaire, observation, and tests. Data were analyzed descriptively. The findings of this study were: (1) blended learning model can improve the effectiveness of the learning process: make learning fun and challenging, able to increase enthusiasm, improve students' involvement, provide a conducive learning atmosphere, make learning more meaningful, and increase learning flexibility (with a mean score of 3.096 and 3.219 of a score range of 1-4 respectively for the cycle I and II); (2) Learning achievement increases, all students can achieve and exceed the minimum criteria (B-). Cycle I: The score of A= 3 people (18.75%), score A-= one person (6.25%), score B+= 4 people (25%), score B= 5 students (31.25%), and the B-= 3 people (18.75%). Cycle II: The score of A= 4 people (25%), score A-= 5 people (31.25%), score B+= 1 person (6.25%), and the B= 6 people (37.50%).*

**Keywords:** *blended learning, e-learning, web-based learning, learning effectiveness and flexibility, refrigeration and air conditioning*

### 1. Introduction

Students' achievement on the Technique of Refrigeration and Air Conditioning Course is not satisfactory, as the students' scores of Technique of Refrigeration and Air Conditioning Course in the odd semesters of 2007/2008 are as follows: from 31 students taking the course, only 3 students got an A (9.6%), as many as 5 students get B and B- (16.12%), as many as 12 students get C+ and C (38.70%), and as many as 11 students get D (32.25%). There are still many students who find difficulty in understanding the learning material. Students' motivation is low and they are passive in the learning

process. Students rely solely on the material provided by the faculty management, whereas other learning resources are still open such as the environment, libraries, the Internet, and others.

Availability of teaching materials or learning resources is not utilized by students well. Students rely solely on learning the material presented by lecturers with a way to copy the material presentation (ppt) in the form of soft copy that is just bullet-point. Due to limited ability to remember, students easily forget and if asked to disclose and explain back at the next meeting or at the time of the exam, many students cannot do it. In fact, learning materials that support

learning are available in the internet. Students are not accustomed to using the internet. The Technique of Refrigeration and Air Coinditioning Course has not been using the web-based *E-learning* systems. Thus, the learning resources available on the internet have not been used optimally.

With the rapid development of information and communication technologies, educational institutions are pushed to take advantage of the *E-learning* system to enhance the effectiveness and flexibility of learning. Through *E-learning*, instructional materials can be accessed at anytime and from anywhere. In addition, the materials can be enriched with a variety of learning resources including multimedia that can quickly be updated by lecturers. Although the study was developed using the *E-learning* system, it does not mean that conventional learning (face-to-face) is to be abandoned. Learning face-to-face is still ongoing, and enriched by using the *E-learning* systems. As we know, face-to-face learning is still important because the role of teachers/lecturers cannot be replaced in the education process in spite of the use of technology and sophisticated instructional media.

With such a reason then to improve the effectiveness of learning is necessary to develop and apply the blended learning model, a combination of conventional learning (face-to-face) with a learning system using *E-learning*. Effectiveness refers to the quality of the learning process and improved learning output. Flexibility means that learning materials can be accessed from anywhere and anytime; learning materials can be enriched with a variety of learning resources including multimedia and can be updated quickly. Thus, the problem can be formulated as follows: How is the effectiveness of blended learning model applied to the Technique of Refrigeration and Air Coinditioning Course?

The Technique of Refrigeration and Air Coinditioning Course is an elective course

for students of Electrical Education Study Program (EESP) College of Engineering (FT) Yogyakarta State University (UNY) weighing 2 theory credit hours (Curriculum FT UNY, 2002). The competence that is required in the Technique of Refrigeration and Air Coinditioning Course is covering the mastery of the concepts and working principles of Cooling Machines; Cooling machine components; a variety of refrigeration items such as refrigerators and freezers; a variety of air fresheners or Air Conditioner (window, split, cars, central); cooling load estimation; planning and installation of split air conditioning; and energy conservation in refrigeration. The classes of Technique of Refrigeration and Air Coinditioning Course for EESP are held in the even semesters.

*E-learning* is one form of distance education using electronic media as media delivery of contents and communication between teachers and students. *E-learning* is the latest term in the system of distance education and the term is reserved for electronics learning including computers and telecommunications media (web-based learning) (Alan et al, 2001; Goran et al, 1996; Rosenberg, 2001; Sohn, 2005).

*E-learning* allows the implementation of distance teaching and learning in either the synchronous or asynchronous mode. The facilities offered in *E-learning* include: *E-mails*, discussion forums, video conferencing, and live lectures. *E-learning* characteristics include: (1) Learning materials are arranged in the form of texts, graphics, and multimedia elements like video, audio and animation; (2) Communication can be done in a synchronous or asynchronous manner such as video confrerencing, chat rooms, or discussion forums; (3) Storage, maintenance, and administration of material exist on a web server; and (4) Uses TCP/IP as the communication facility between the learner and learning materials and/or other sources (Chu et al, 1998).

The blended learning model combines the conventional model with learning by using the *E-learning* systems (Herman Dwi Surjono, 2008). Thus, learning is still cultivated with face-to-face interactions between lecturers and students optimally and equipped with the *E-learning* (web-based learning) where the syllabus, lesson plans, lecture materials, and assignments are provided on the web so that students can access them. At any given moment, if the lecturer is unable to attend class, learning continues by taking advantage of the *E-learning* facilities that have been developed, and students can access learning resources and tasks by uploading them in the *E-learning* mode. *E-learning* also provides information relating to lectures and discussion facility via the "forum" if there are some things that need to be discussed whether in relation to lecture materials, clarity of tasks, or others.

*UPT Puskom UNY* (the *YSU Computer Center*) has built *UNY E-learning* systems in order to optimize the utilization of information technology to support learning activities. *UNY E-learning* is implemented by way of integrated on-line learning paradigms using the *LMS* (*Learning Management System*), *Moodle*, which is very famous. The *E-learning* system has been functioning as it should and can be accessed via the URL: <http://besmart.uny.ac.id> (Herman Dwi Surjono, 2008).

Through *E-learning* lecturers can manage course materials, namely: preparing the syllabus, uploading the lecture material, assigning tasks to students, collecting students' work, creating a test/quiz, providing scores, monitoring students' activities, cultivating the students' scores, interacting with lecturers and fellow students via discussion forums, chatting, etc. On the other side, students can access information and learning materials, interact with fellow students and lecturers, perform transaction lecture tasks, take a test/quiz, see the

achievement of their learning outputs, and so on.

## 2. Method

The study was classroom action research. Data collection was conducted from March 2009 through June 2009 in the *Electrical Education Study Program*, *College of Engineering*, *Yogyakarta State University (YSU)*. The research subjects were 16 students of the Study Program, who took the *Technique of Refrigeration and Air Conditioning* course in the even semester of 2008/2009. This action research procedure covered: planning, implementation of the action (action), observation, and reflection.

Research instruments used for collecting data were a list of questions/statements (questionnaire), an observation sheet, test questions, and a list of tasks. The data were analyzed descriptively using average and percentage scores. Each cycle produced the effects of actions that served as the reflection for the next cycle. The averages and percentages were then compared with indicators of success that had been set before. To determine whether the learning process was good or not, calculations were done in advance on the average ideal ( $M_i$ ) and the ideal standard deviations ( $SD_i$ ) with the formula:

$$M_i = 0.5 (\text{ideal maximum score} + \text{an ideal minimum score}) = 2.500$$

$$SD = 1/6 (\text{maximum score of an ideal} - \text{an ideal minimum score}) = 0.500$$

Furthermore, the category to determine whether the learning process good or not used norm as follows:

Good	= (> $M_i + 1.5 SD$ ) up => 3.250 to 4.000
Good Enough	= (> $M_i$ to $M_i + 1.5 SD$ ) => 2.500 to 3.250
Poor	= (> $M_i - 1.5 SD$ to $M_i$ ) => 1.750 to 2.500

Not Good = (Mi-1.5 SD) down  
= 1.000 to 1.750

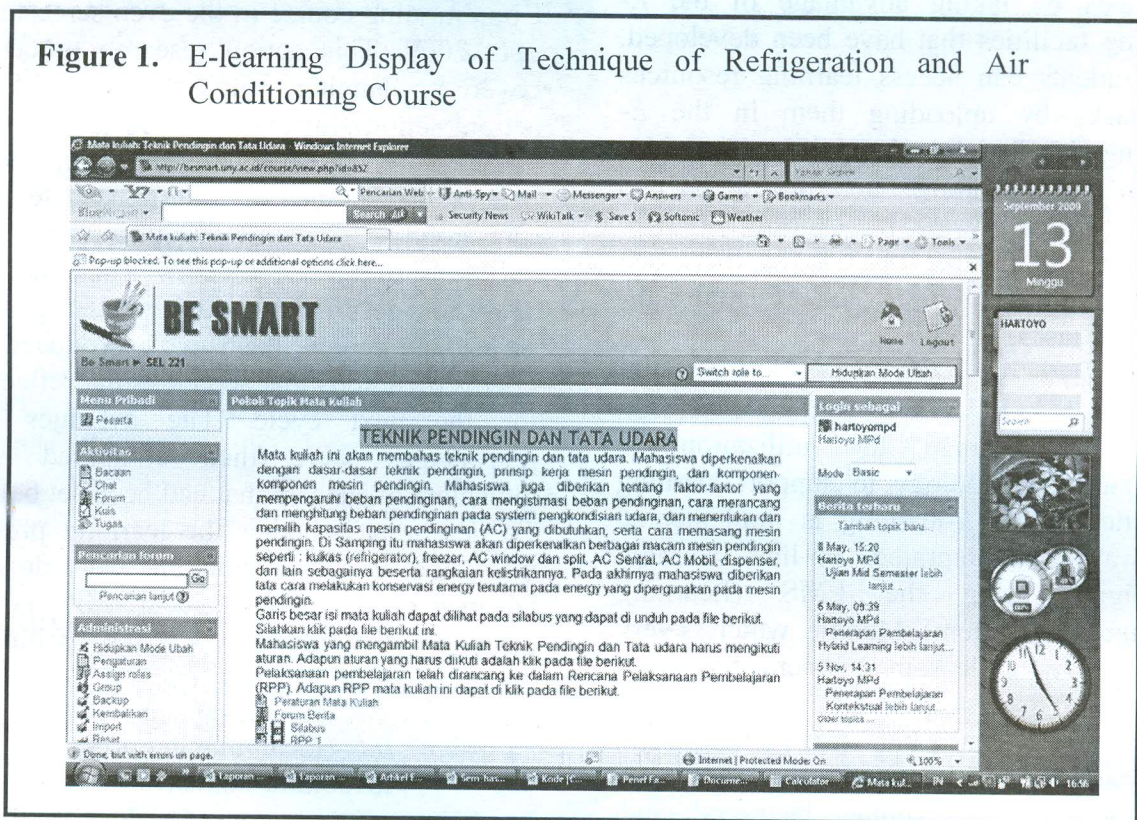
### 3. Findings and Discussions

#### Developing E-learning

The study does not develop its own E-learning system, but uses the E-learning system that has been developed by the UNY Computer Center with the URL address <http://besmart.uny.ac.id>. UNY E-learning developed the program using the LMS

(Learning Management System) open source Moodle. Advantages of using UNY E-learning was the integration and ease. The E-learning of this course is included and becomes part of UNY E-learning. The steps undertaken in this activity are: log in, add courses in E-learning systems, editing and uploading learning materials, assignments, discussion forums, and so forth. As for viewing, an example of this E-learning can be seen in the figure below.

**Figure 1.** E-learning Display of Technique of Refrigeration and Air Conditioning Course



#### Actions Implementation

##### 1. Cycle I

- a. The taken action was to implement a blended learning, i.e. learning which combined learning using E-learning and face-to-face interactions. The topics for discussion was on “refrigerant control devices”.

- b. Students were required to access the instructional material in the E-learning system first, then made face-to-face lectures to discuss the layout of the learning material. The learning approach taken was to focus more on the active involvement of students in the learning process by brainstorming, contextualization, questioning

discussions, lectures by media power-point presentations, exercises, and assignments.

- c. Class activities were also supported by discussion forums between lecturers and students through the *E-learning* system related to the use of learning materials, assignments, and subject-content lectures.
- d. Completion of the tasks was done at the students' home and its collection was done by uploading the students' works into the *E-learning* systems.
- e. Assessments were carried out within the students' activities, both in the learning process through *E-learning* and face-to-face interactions, given the quality of task completion, quality of papers, quality of presentation, and the mid term exams.

## 2. Cycle II

- a. Actions in Cycle II were the same as those in Cycle I, that is by blended learning, which combined learning with the *E-learning* and face to face interactions, but with a further increase in students' activeness in attending classes both face-to-face and via *E-learning* (lecture material, discussion forums, uploading assignments) or find other sources (links) that exist on the Internet to enrich and support the completion of the tasks given.
- b. The topics discussed were concerned with "calculation of cooling load".

Students were more involved in the exercises to calculate the cooling load in a room or building.

- c. Students were given the task to plan a room cooling load and capacity of air conditioning needed to cool the room. Students were asked to conduct surveys, field observations, and seek references and other sources of learning either from books or from the internet to enrich and support the work to be done.
- d. Tasks were done at home, collection of duties done by uploading materials to the system of the *E-learning*.
- e. Assessment included activities in both the classroom and *E-learning*, the Internet, quality of completion of tasks, and the semester exams.

## Monitoring, Evaluation and Reflection

Evaluation of the successful implementation of the action is seen from the effectiveness of learning. Effectiveness can be seen both in terms of learning process and student learning outputs. The quality of learning process can be seen from the student activity, the implementation of fun and meaningful learning, and learning flexibility. Students learning output or mastery of competencies can be seen from the score obtained by students.

Evaluation results and reflections of students about the learning process can be seen in the following table and figure.

Table 1.  
*Results of Evaluation and Student Reflection on Learning Process in Cycles I and II*

No.	Indicators	Mean Score	
		Cycle I	Cycle II
1.	Learning more enjoyable	2.833	3.167
2.	Students are challenged to explore the material	2.833	3.000
3.	Students are enthusiastic in learning	2.833	2.833
4.	Increased student involvement in learning	2833	3.333

Table 1. Continued

No.	Indicators	Mean Score	
		Cycle I	Cycle II
5.	Allows students to learn faster	2.833	3.167
6.	The learning atmosphere is comfortable and conducive	2.667	3.167
7.	Achievement of learning objectives is guaranteed	2.833	3.000
8.	It can foster the active participation of students	3.167	3.333
9.	The use of learning time is more optimal	3.333	3.333
10.	It can enrich the knowledge	3.333	3.167
11.	It can increase the learning frequency	2.833	3.167
12.	It strengthen the memory of the learning material	3.000	2.833
13.	Increase the professionalism of lecturers in teaching	3.000	3.000
14.	It is more meaningful learning	3.167	3.000
15.	Through a blended learning task completion is easier	3.167	3.167
16.	Learning material can be accessed from anywhere	3.667	3.667
17.	Learning material can be accessed anytime	3.667	3.667
18.	Learning material easily to enrich	3.167	3.500
19.	Learning material easily to update	3.667	3.667
Total mean score		3.096	3.219

Figure 2. Diagram of Learning Process Effectiveness

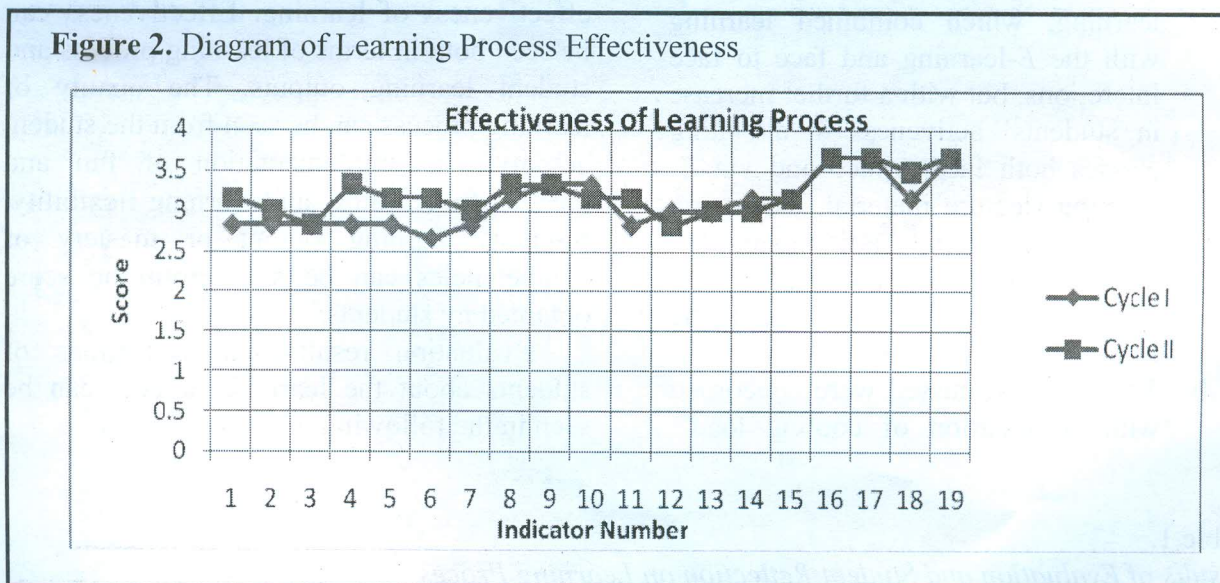


Table 1 and Figure 2 above show that for Cycle I the low score is 2.667 and the highest is 3.667 and the average score is 3.096. The ideal minimum score is 1 and the ideal maximum score is 4. Based on the average

score obtained for 3.096 and when seen from the above categories, then the learning process of blended learning that has taken place is good enough. When viewed on each indicator, the obtained lowest average score

of 2.667 and highest average score of 3.667 mean that all aspects are considered in the categories of good enough and good.

The application of blended learning also increases learning flexibility. It is based on the perceptions and opinions of students as listed in Tabel 1 above on indicators number 16-19. According to students, through web-based E-learning the learning and course materials can be done and accessed anywhere and anytime. Learning materials can be enriched and updated easily.

The learning process activities run good enough. It is based on the perceptions and opinions of students as listed in Table 1 above. It is also supported by observations and feelings of the researcher that the implementation of learning face-to-face is quite conducive. Students are active enough to ask, respond, give ideas, and make presentations in the learning process. In addition, all students are also active in accessing learning materials and collect and upload the tasks assigned to the E-learning. In fact, there are enough students who have made use of the existing "forums" on E-learning to inquire about the tasks given, ask for material course that has not been understood, and use it as a means to channel the aspirations to convey suggestions or proposed improvement of the learning processes.

Suggestions and comments of students about the learning process that has taken place are as follows: (1) the implementation of learning that utilizes E-learning is good enough and can be continued; (2) the E-learning materials are added further in order to be more fully equipped; (3) students who do not use the forum discussion are still numerous and they are advised to use it; (4) the E-learning tasks need to be added with questions that can be answered directly so that the students can see the results and they can revise them; (5) it is necessary to do

observation activity about the cooler machines in the Maintenance and Repair Workshop class.

Based on the data and the above description, when viewed from the learning process, then the application of the blended learning model is quite effective in enhancing the learning process. Although the process of learning has been going quite well, to further improve the quality of the learning process again, especially on those aspects of assessment scoring below 3.0, then the application of blended learning should be continued with some improvements in order to increase the quality of the learning process.

For the second cycle, the lowest score is 2.833, the highest is 3.667 and the average score is 3.219. Based on the categories as used above, the obtained mean score of 3.219 means that the learning process using blended learning is good enough. When viewed on each indicator, the lowest score of 2.833 and the highest score of 3.667 mean that all aspects are considered in the categories of good enough and good.

When compared to Cycle I, although the learning process cycle II is in the same category as that of Cycle I that is good enough, the observed mean score on the cycles increases from 3.096 to 3.219. This means that the effectiveness of the learning process on the cycle II has increased compared to that of Cycle I. Thus one indicator of success in this research through blended learning can enhance the effectiveness of the learning process that has been reached.

Increasing the effectiveness of the learning process on the second cycle is based on the perceptions and opinions of students as listed in Table 1 above. It is also supported by the researchers in the qualitative observation that the implementation of face-to-face learning in Cycle II is better than that in Cycle I. It is more conducive. Students are

more active to ask questions and give responses, give an idea, and do a presentation in the learning process. In addition, all students are active in accessing learning materials, collect and upload the tasks assigned to the E-learning. Even, make use of existing "forums" on E-learning to inquire about the tasks given, ask for material that has not been understood, and use the activities as a means to channel the aspirations to convey suggestions or proposed improvement of learning process.

Suggestions and comments of students about the learning process on Cycle II are as

follows: (1) the implementation of learning that utilizes *E-learning* is quite good and can be continued to be improved, (2) learning materials that are too much can be trimmed, (3) learning materials need to be developed and supplemented with video files, (4) enforcement of the use of E-learning are closely supported by the department policy of the flexibility of the learning process without having face-to-face sessions.

Student learning output in the form of the achievement of competence and mastery of the material between Cycle I and Cycle II can be seen in the picture below.

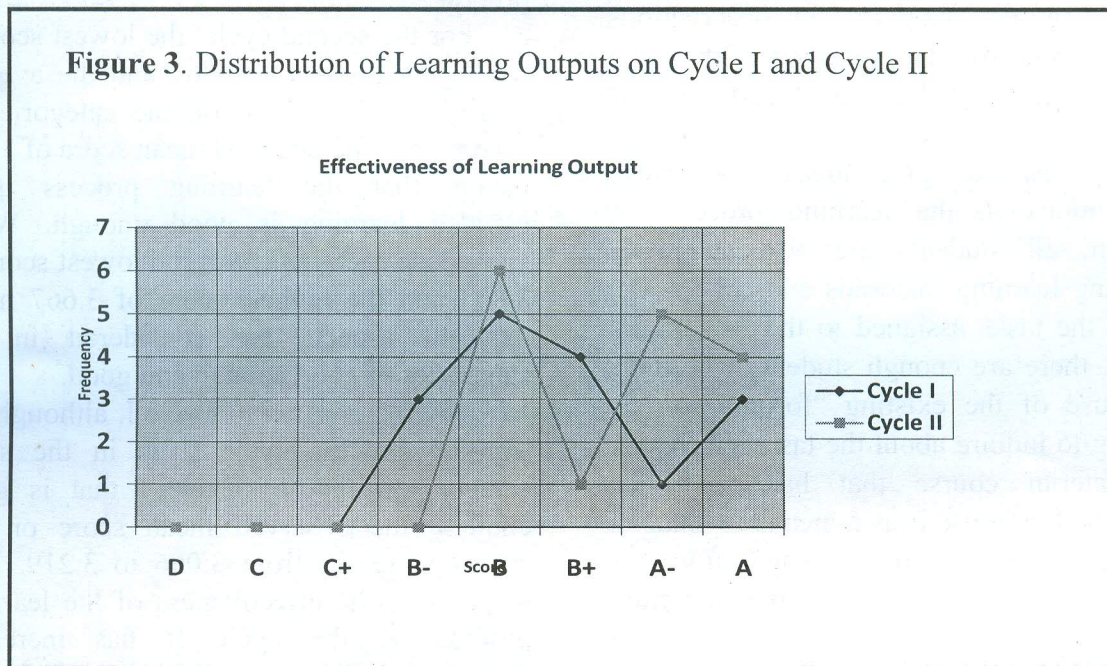


Figure 3 above shows that, for Cycle I, the lowest student score is a B- (three students, 18.75%) and the highest score is A (three students, 18.75%). No students score C+ or C or below. This shows that all students have met the minimum criterion of a B- as set at the beginning of the study. Thus, it can be said that the blended learning model can be quite effective. However, to further improve student learning output further, it

has been decided to continue the action while applying the blended learning on subsequent learning processes.

For the second cycle, the lowest student learning outcome is B (six students, 37.50%) and the highest score is A (4 students, 25.00%). No students score B-, C+, C, or below. This shows that all students have exceeded the minimum criterion of B- as set at the beginning of the study. Comparing the



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