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# INTERNATIONAL SEMINAR
## Reformulating the Paradigm of Technical and Vocational Education

## DAFTAR ISI

# LEARNING MODEL WITH COMPETENCY-BASED MODULE FOR IMPROVING STUDENTS' ACHIEVEMENT

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**Abstract:**

This study aims to examine the improvement of students' achievement with learning model of Competency-Based Module on the Course of Refrigeration and Air Conditioning Technique. The research was carried out in the D3 Study Program of Electrical Engineering, Engineering College of Yogyakarta State University. This research method is classroom action research. Stages of each cycle of research include: planning, implementation, observation, and reflection. The subjects of this study are the students of D3 Electrical Engineering Study Program who took course of Refrigeration and Air Conditioning Technique in the first half of the Year 2008/2009 which amounted to 13 people. Methods of data collection were questionnaires, observation guide, tests, and giving the task. Data analysis was descriptive analysis. The results indicated that: (1) the competency-based module of the subject of Refrigeration and Air Conditioning Technique that is developed is a good quality, useful and assist the students learning; (2) by applying the learning model with competency-based module can improve students' achievement. This is demonstrated by the acquisition score of student learning that meet and exceed the minimum criteria (score B-). The students' achievement are as follow: the cycle I, which got an A- as many as 4 people (30.77%), the score of B as much as 3 people (23.08%), the score of C+ as many as 3 people (23.08%), and the score of C as many as 3 people (23.08%), while the second cycle, the score of A- as many as 6 people (46.15%), B+ by 2 people (15.38%), B by 4 people (30.77 %), and B- as many as 1 person (7.69%).

*Keywords*: *Competency-Based Module, Learning Model, Refrigeration and Air Conditioning Technique, Learning Achievement*

## Preliminary

Students' achievement on the Course of Refrigeration and Air Conditioning Technique are not satisfactory. The distribution score of students' achievement of the course of Refrigeration and Air Conditioning Technique for the first half-Year 2007/2008 are as follows: of the 31 students who take course only 3 students got an A (9.6%), the score of B and B- as many as 5 students (16.12%), the score of C + and C as many as 12 students (38.70%), and D scores were 11 students (32.25% ).

The predicted factors affecting students' achievement are: student ability, enthusiasm and motivation of students, teaching materials, instructional media, faculty skills, and learning strategies adopted by the faculty. During this time, courses of Refrigeration and Air Conditioning did not use a module. The course material is drawn from a wide range of learning resources such as various kinds of reference books that amount is not less than five books, the material is taken from the internet, training materials, and so forth.

It seems that the factor of learning resources is an obstacle for students. Since the number of reference books and other learning resources to be referenced, students are less able to hold or access a wide range of sources to learn it. Currently there is no module as a handle of faculty and students in the learning. It is as an obstacle in the implementation of the learning that resulted in unsatisfactory student achievement.

Based on the above description, the constraint in the implementation of learning courses of Refrigeration and Air Conditioning Technique is no a module as course material. So that, to overcome obstacles to the implementation of learning and increase students' achievement needs to

be done the application of competency-based learning module on the course of Refrigeration and Air Conditioning Technique based on competency.

The problems posed in this study can be formulated as follows: How does the effectiveness of learning by using a competency-based module on the Course of Refrigeration and Air Conditioning Technique to improve student learning achievement?

The purpose of this study was to determine the effectiveness of learning by using a competency-based learning module on the Course of of Refrigeration and Air Conditioning Technique in an effort to improve student learning achievement.

Course of Refrigeration and Air Conditioning Technique is elective course for students of D3 Electrical Engineering, College of Engineering Yogyakarta State University with weights 2 credits. Competencies required in the course of Refrigeration and Air Conditioning Technique are mastery of concepts and working principles of Cooling Engine, Engine Cooling components, a wide range of cooling engine such as refrigerator, freezer, wide range of AC (window, split, package, auto, central), the cooling load estimation, planning and installation of split air conditioning, and energy conservation in cooling engine. Course of Refrigeration and Air Conditioning Technique for D3 was held in the firs-half Year (Curriculum of Engineering College of YSU 2002, 2002).

The module is composed of teaching materials in a systematic and interesting content that includes materials, methods, and evaluation that can be used independently. The characteristics of the module are as follows: (1) made simple linguistic level in accordance with the thinking of students, (2) used independently, learning pace of each individual to effectively and efficiently, (3) has characteristics that stand alone modules developed not depend on other media, (4) the user friendly, helping ease the user to respond to or accessible, (5) able to self learning, (6) between and ultimate the objective of the module should be clearly defined and measurable, (7) material is packaged in small units and complete, provided clear examples and illustrations, (8) questions, exercises, tasks, and so forth are available, (9) the material is up to date and contextual, (10) a simple, a straightforward language and communicative , (11) there is a summary of the learning materials, (12) available assessment instrument that allows training participants to self-assessment, (13) measures the level of self mastery, (14) there is a feedback on the assessment of training participants, (15) has useful information about referral / enrichment / references to support material, (16) used for other people rather than to the author (Ministry of National Education of Indonesia, 2006).

The purpose of the module are as follows: (1) Clarify and simplify the presentation of the message in order not to be verbal, (2) Overcoming the limitations of time, space, and the senses, both students or training participants and teachers / instructors, (3) Can be used precise and varied, such as: (a) Increase the motivation and desire to learn for students or training participants; (b) Develop the ability of learners to interact directly with the environment and other learning resources; (c) Allows students or training participants learn to be independent according to ability and interest; (d) Allowing students or training participants can measure or evaluate their own learning outputs (Ministry of National Education of Indonesia, 2006).

Each student has the motivation, talent, intelligence, and different abilities. Mastery of the material for students who have low skills, lack of talent, low motivation will require more time than students who are intelligent, talented, and high motivation. In order to students with different characters in the same time unit can achieve and master the material provided, it needs to be pursued learning strategies that are tailored to individual private students.

Forms of learning strategies by taking into account individual student is to divide the materials into sections consisting of several subject matter in accordance with sub-competencies to

be achieved are known as modules. Such a learning process called modular learning. With this system are expected course learning objectives of the course of  Refrigeration and Air Conditioning Technique can be achieved, but still consider the differences in student capabilities. For students who have a high ability to be faster to complete tasks more efficiently, while students who lack the ability have the opportunity to learn and improve their own modules that have not mastered.

There are several factors that influence student success in achieving the goals of learning which is based on the student's self personal, namely: 1) the talent of students, 2) interest and motivation, 3) the ability to learn, 4)  the desired quality of education, and 5) the time to learn that available (Utomo, Ruijter, 1989:70).

Students who are low capability take longer to learn than the students who are smarter. The time required to master the course material between students is not equal to each other. The time required depends on the personality factors as mentioned above.

From the above description can be summed up some of the advantages of modular teaching systems, namely: (1) increased student motivation because every time the task is clearly limited in time and according to his ability, (2) After completed a module lecturers and students know where the successes and failures of students, (3) Students achieve according to his ability, (4) Load lectures more evenly divided throughout the semester, (5) Education is more powerful, especially when the course material prepared according to academic level, ie if the material in a module is required to study the following modules.

**Research Method**

The research was carried out in D3 Study Program of Electrical Engineering, Engineering College, Yogyakarta State University. The research was conducted in September 2008 until December 2008. The subjects of this study are students of D3 Study Program of Electrical Engineering who take course the Refrigeration and Air Conditioning Technique in  first half-Year 2008/2009 as many as 13 people.

This study was a classroom actian research,  consists of several cycles. Each cycle is done changes in accordance with the purpose of research to be achieved. To find out the weaknesses of students in the mastery of competencies in the learning process performed diagnostic tests that serve as the initial test. Furthermore, preliminary observations carried out to determine the appropriate action to minimize those weaknesses. Both of these actions (evaluation and preliminary observations) is used as a reflection of the actions set for student weaknesses.

Based on these initial reflections, then conducted research with the classroom action research procedure: planning (planning), implementation of the action (action), observation (observation), and reflection (reflection). Some of the activities undertaken to support this research, that are: 1) develop learning modules of the course of Refrigeration and  Air Conditioning Techniques based on competency, 2) create learning scenarios using competency-based modules, 3) make the observation sheet, 4) setting up  learning aids, and 5) plan evaluation istruments.

The data in this study are quantitative data. Data collection techniques used, that are: the assessment sheet, test, and giving the task to measure the achievement of competence. Modules assessment sheet for students is used to reveal the opinions and judgments about the quality and usefulness  modules for students. Tests and lists of tasks  are used to reveal the mastery of the material and learning achievement of students in achieving competency standards have been set. The research instruments used to collect the data are as follows: (1) module assessment sheet for student, and (2) test and task lists.

Data will be analyzed by descriptive analysis with a mean and percentages  then compared with indicators of success that has been set. Each cycle will be obtained the effect of the action that is used as a reflection on the next cycle.

**Result and Discussion**
**Cycle I**
Activities undertaken are:

a. At the start of lectures each student was asked to make a photocopy of the course learning modules of Refrigeration and Air Conditioning Techniques based on competency.

b. Furthermore, students are described on the course syllabus  Refrigeration and Air Conditioning Techniques along with the plan and regulations of the lecture, including the method of evaluation, assignments, lecture modules and supporting reference materials.

c. At the next meeting, students are given the topic of discussion on "Introduction to Cooling Technique and Its Application". Then the students are explained about the required competencies and objectives in the learning activities.

d. Before further discussion, the lecturer posed the question to all the students about "what kind of cooling engines you know or have you see around you, either directly or through print and electronic media?" Students were asked to answer in turn by the method of brainstorming, the student answers are written on the blackboard. All  students did brainstorm actively. The next the faculty complement and verify the student opinion.

e. Then the students were asked to make groups of 3 students per group. Formation of groups based on the adjacent seat. Task of each group is to discuss about the grouping of usefulness of cooling engine  based on its function, namely: as a store and a food preservative, air conditioner, for use in chemical plants, for special use, medicine, ice factories, sports and so forth based on the results of students brainstorming list that have been verified. Then the representative of the group was asked to write on the discussion board, and the lecturer verify the results of the discussion.

f. Furthermore, a lecturer explain the course material with the use of instructional media in the form of power point, which contains things that are important accompanied by an interesting illustrations and always relate it to the context of the students, so that students are easier to understand. In addition, a lecturer  is always provoke students to think that students should be able to construct their own knowledge associated with prior knowledge of students.

g. The next is a ask question and answer session conducted. A Lecturer gave questions to students to encourage, guided and assessed students thinking skills. Students were given the opportunity to ask question with the aim to explore and confirm what is already known and leads to the unknown aspects, and as a means to conduct inquiry.

h. The next students were shown pictures of a variety of cooling engine that is used in various applications. In addition, faculty shows one type of cooling engine, ie Air Condotioner equipment (AC) installed in the classroom as an example or model. It aims to make students more easily to understand the material presented.

i. Furthermore, students are asked to do exercises that is to answer all questions and tasks in the module, then all answers were collected. In addition,  a lecturer assign additional tasks to be done at home. The assignment is collected at the next meeting.

j. Finally, students were asked to reflect on what has been learned and asked to submit suggestion for the improvement of subsequent learning.

The success of the implementation of actions is measured based on the learning outputs and assessment of students on modules for learning activities (chapters) are discussed. Evaluation of

learning outputs can be seen from the acquisition of the scores obtained by the students. Assessment of learning output is conducted using the test, and giving assignments. Assessment of learning process is conducted by observation of students' activeness. Distribution of the scrore obtained by the 13 students are as follows: an A-(4 people); B (3 people), C + (3 people), C (3 people). The results showed that it still need to be improved and continued to next cycle so that students who have a grade of C could be improved.

To reflect on their learning has taken place and to know the assessment of students on the module, especially that related to learning (chapters) are discussed, students were asked to complete a questionnaire and suggestions to further optimize the process and learning outputs. Results of reflection can be seen in the table below.

Tabel 1. Students Assessment of the Module

| No. | Indicators | Cycle I Mean Score | Cycle II Mean Score |
|---|---|---|---|
| 1. | The completeness of the module | 4,44 | 4,77 |
| 2. | The quality of the module | 4,20 | 4,54 |
| 3. | The material is easy to understand | 3,76 | 3,92 |
| 4. | The material is coherent | 3,92 | 4,00 |
| 5. | The material is contextual | 3,20 | 3,62 |
| 6. | Suitability exercise | 3,02 | 3,38 |
| 7. | Clarity of answer key | 3,00 | 3,15 |
| 8. | Suitability evaluation | 3,33 | 3,46 |
| 9. | Facilitate learning | 3,55 | 3,77 |
| 10. | Usefullness of the module | 4,40 | 4,62 |

Description: the range of the scores: 1-5

Based on Table 1 above shows that the reflection and students assessment of the module conducted after following the learning in cycle I can be explained as follows: (1) the module is complete, (2) a good quality module, (3) the material easy to understand, (4 ) the material is coherent, (5) sufficient contextual material, (6) is quite appropriate exercises, (7) answer key is quite clear, (8) is quite appropriate evaluation, (9) module assist in the students learning, and (10) module developed is useful.

**Cycle II**

In accordance with the results of monitoring, evaluation, and reflection of actions taken on the cycle I then need to be intensified again some action taken. Activities performed on the second cycle are:
a. Learning activities to be discussed is about the "Working Principles and Main Components of Cooling Engine". Students are asked to read a glimpse of the material that has been distributed. Further, the faculty explained about the competence and student learning objectives will be achieved.
b. After that, the students were asked to discuss the given topic in small groups. One group consisted of three people. Faculty directed a guide line discussion so that students are able to understand the working principle of cooling engine and their main components easily through discussion with the use of language and their own words. There are two types of cooling engines, which uses compression and absorption systems. At that point, the discussion is limited to a compression system only, while for other type, absorption systems, was as a home task of the group that will be discussed at the next meeting.

c.  Students perform discussion in each group and create a resume that includes the results of the discussion: the block diagram, the main components of the cooling engine and its functions, the thermodynamic cycle of the cooling material which include changes in shape, pressure and temperature of the coolant in each component. In the discussion, students were encouraged to observe actual cooling engine or practice devices that exist in the workshop.

d.  After the group discussion is completed, the next step is to ask representatives of the group wrote in the discussion board. Thus, the results of the four discussion groups plastered all on board. Then the lecturer asked students to examine and compare the results of the four discussion groups. After verifying the results of discussion from four groups, the lecturer give a correct explanation of the working principle of cooling engine.

e.  In explaining the right working principle of cooling engine, a lecturer used a practice devices, refrigerator unit, in the workshop. Lecturer demonstrated how the workings of the cooling engine, showed the components and how the coolant circulation and its changes in shape, pressure, and temperature.

f.  Then the student asked to do home assigtnment in the form of individual and group tasks. For individual assignments, each student is required to collect duties on the workings of the cooling engine for compression systems that have been discussed and has been given an explanation by lecturer. The assignment gathered in the next meeting. This activity is intended to strengthen students' understanding of the workings of a compression refrigeration system. As a group assignment, students were asked for discussion outside of class about how the other types of refrigeration systems, namely absorption, with the number and members of the same group with the previous group. Students were asked to look for discussion materials from books in the library and download via the internet. The results of group discussions were made in the form of power point file to be presented at the next meeting.

g.  At the next meeting, students were asked to collect the individual tasks. Furthermore students were asked to make presentations in front of the class discussion group in turn. Each group was given ten minutes for presentation and ten minutes for question and answer.

h.  Then the lecturer verifying the presentation made by the four groups and give a correct explanation about how the working principle of absorption refrigeration system.

i.  Furthermore, students are asked to do exercises to determine student mastery of competencies. Then lecturer gave back of both individuals and groups duties accompanied by feedback.

j.  At the end of the meeting, students were asked to reflect on learning in the second cycle.

The results of monitoring, evaluation and reflection of the implementation of actions in the second cycle were outlined as follows:

Evaluation of student learning outputs indicate that student learning outputs significantly increased. Distribution of grades is as follows: The score of A- (6), B+ (2 people), B (4 people), and B- (1 person). The score is the average score of the individual tasks, group work, and quizzes.

The student reflection and assessment of students on the modules in Cycle II can be seen in Table 1 above. Based on Table 1 shows that the reflection and students assessment of the module conducted after following the learning in cycle II can be explained as follows: (1) the module is a very comprehensive, (2) the quality of the module is very good, (3) the material easy to understand, ( 4) the material is coherent, (5) contextual material, (6) is quite appropriate exercises, (7) answer key is quite clear, (8) is quite appropriate evaluation, (9) assist in the learning, and (10) the modules is very useful.

Based on the monitoring, evaluation and reflection on learning at the second cycle, it means that the success indicators both students' learning output and assessment of the module that was developed has been reached. This indicates that the implementation of competency-based learning modules of the courses of Refrigeration and Air Conditioning Technique is an effective. The use of competency-based modules on the course of Refrigeration and Air Conditioning Technique can improve students' achievement (outputs).

After the action, namely the use of the competency-based module on the Course of Refrigeration and Air Conditioning Technique showed that students' achievement improved. Students are required to have a module. With this module students have a clear course materials so that students can learn the material and do the exercises that exists in the module. Only through two cycles, the learning of Refrigeration and Air Conditioning Technique has shown that indicators of success achieved.

In the first cycle, the achievement of the competence of students to the activity material 1 are: Score A- of 4 people (30.77%), B for 3 people (23.08%), C+ as many as 3 people (23.08%), and C as many as 3 people (23.08%). According to students, the modules used in the study had good quality, easy to understand, relevant, good and helpful in learning. However, these results are improved, but its need to be optimized so that it should be continued in the second cycle.

In the second cycle, the achievement of student competencies of the activity material 2 increased when compared to the first cycle with the distribution of grades as follows: Score A for 6 people (46.15%), B+ by 2 people (15.38%), B as 4 people (30.77%), and B- as many as 1 person (7.69%). No more students who get C's, the acquitition of score A- also increases. Thus, the pre-defined success criteria have been met, namely the achievement of students' learning (outputs) is improved by using the learning modules. Students' achievement of learning outputs for the first cycle and second cycle can be summarized in the following table.

Table 2 Students' Achievement (Learning Outputs)

| No. | Score | Cycle I | | Cycle II | |
|-----|-------|---------|---|----------|---|
|     |       | No. of Students | % | No. of Students | % |
| 1. | A- | 4 | 30,77% | 6 | 46,15% |
| 2. | B+ | - | 0% | 2 | 15,38% |
| 3. | B | 3 | 23,08% | 4 | 30,77% |
| 4. | B- | - | 0% | 1 | 7,69% |
| 5. | C+ | 3 | 23,08% | - | 0% |
| 6. | C | 3 | 23,08% | - | 0% |

If viewed from a mean score of learning outputs, the achievement of learning outputs of students in learning that using this module is better when compared to the achievements of learning outputs of students who follow course of Refrigeration and Air Conditioning Techniques in the past year (first-half Year 2007/2008) that did not use the module assuming the characteristics of both groups of students is the same. Where students' achievement (learning outputs) in the past year there were many students who did not meet the criteria of minimal score obtaining the score of D as much as 32.25% of all students. The students' achievement on the course of Refrigeration and Air Conditioning in the past year were as described in the background. It shows that the use of module as the handle of learning is an effective, it can improve students achievement and helps

students in learning. This is also supported by the results students reflection of learning who stated that the learning module used in the learning had a very good quality and relevance, the material easy to understand and very useful and helpful in learning.

This results is appropriate with the result of research conducted by Imam Mustholiq and Basrowi (2004) who concluded that the pattern of module learning with the use of computers in Electrical Installation Design course is a variation of effective teaching to enhance student learning achievement. Thus, it is understood that by using the learning modules will assist students in learning. Students can learn the material that has been developed by the lecturer in accordance with the required competence. Students can do the exercises to practice and deepen mastery of the material. It can enhance the mastery of the course material better, which in turn can improve student learning achievement.

**Conclusion**

The students assessment of the competency-based module on the Subject of Refrigeration and Air Conditioning stated that the module developed are: (1) complete, (2) good quality, (3) the material is easily understood, (4) the material is coherent, (5) contextual, ( 6) quite appropriate exercise, (7) quite clear answer key, (8) quite appropriate evaluation, (9) assist in learning, and (10) very useful.

The Implementation of competency-based modules on the courses of Refrigeration and Air Conditioning Techniques is proven successful in increasing the effectiveness of learning. It has succeeded to improve student learning output. All the students have succeeded to exceed the minimum criteria (score B-). In addition, an increase in the score of student learning outputs significantly between cycle I and cycle II. This is demonstrated by the following grades. Cycle I: Score A- as many as 4 people (30.77%); B as many as 3 people (23.08%), C + as many as 3 people (23.08%), C for 3 people (23.08%), while the cycle II: Score A- for 6 people (46.15%), B + by 2 people (15.38%), B by 4 people (30.77)%, and B- as many as 1 person (7.69%).

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