

The Modules Development of Material Testing by Using Constructivist Approach at Mechanical Engineering Department of UNIMED

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Abstract— This research aims to develop the material testing modules by using constructivist approach at mechanical engineering department of State University of Medan (Unimed). The methode used was Research and Development Approaching Methode (R & D) by Borg and Gall. The model development phases for the studies referred to the development model of Dick and Carey, consisting of need analyse phase, development phase and evaluation phase. Data collection technique was performed through observations, questionnaires and objectivity tests. The result of reaserch and development was modules of material testing by using constructivist approach. The modules validity was determined by having some experts' validations, one to one evaluations and small group evaluations. The results of reaserch showed that the expert validity giving an average rating of 89,08 %, one to one evaluation was 87,03% average and small group evaluation was 89,09% average, this showed that the reaserch was valid to be used. The effectiveness of study was obtained from pretest and post test which was conducted at field trial, and proved the increasing of study results i:e 86,22% The research and development delivered good implications to the improvement of students' instructional outcomes who were taking material testing at mechanical engineering department of Unimed.

Keywords : *modules, material testing, constructivist, mechanical engineering*

I. INTRODUCTION

The colleges need to creatively develop the new instructional process more comprehensive to improve the skills of the learners. Conceptually the development of instructional materials is the means for universities to provide and broaden the insights of learning about knowledge, skills and other basic values with expectation it can be reflected in the ways of thinking and acting. This is relevant to the research conducted by Mursid (2009), entitled " Model Development of Learning Practice based Competency with Production Oriented in Mechanical Engineering Study Program ", Journal of Educational Technology UNJ.

Instructional process in colleges that applied lecturer of Mechanical Engineering Departement of Unimed has not shown as an effective instructional, where the Instructional process that is applied in the subject of material testing is classical instructional.

The weakness of classical instructional forces all students to study the same instructional materials at the same rate. Learners with higher learning ability will wait for other students, so they difficult to explore theirs ability and ultimately individual learning ability is not optimal. In order to learners' learning ability to the maximum can be done by providing materials and a series of tasks by using the module so that learners can learn independently at home. On that basis this module was developed by using constructivist approach tailored to the learning objectives

One form of instructional materials are modules. The term modules is a complete measurement tool, an independently functioning unit, separately, but also can serve as an overall unity of other units. The modules also means "is a free-standing, self-contained component of an instructional system (Heinich et al., 2007).

The module is a unit of planned instructional program, designed to help learners achieve instructional objectives, (Hermawan et al, 2010: 7).

From the description above it can be concluded that the module is a unit consisting of a series of instructional activities systematically arranged to help learners achieve the objectives that have been formulated with effective results, or simply be said that the module is a packaged curriculum is provided for students to learn independent.

Each module contains at least the subject matter, a matter of practice and test capabilities.

Alternative approach to instructional that can be apply is constructivist where learners construct their own knowledge in mind both individually and with friends (discussion).

Constructivist is a philosophical school that holds the view that the knowledge we have is the result of construction or form of ourselves, so that will be able to build and improve the knowledge of learners.

The form of instructional strategy that is considered complying with constructivist is an instructional strategy of Problem Based Learning (PBL). Refer to Hmlo Silver et. al (2013) that problem based learning is a learner centered pedagogical approach in which students engage in goal directed inquiry. In PBL, students work collaboratively to learn through solving complex and ill structured problems.

Development of learning materials requires a model as a reference for developmental steps. Popular models used in the development of learning materials, including Model Assure, Model ADDIE, Model PPSI, Model Banathy, Model Kemp, Dick and Carey Model. As a reference, this research used Dick and Carey Model whose stages of development consisted of identifying stage, developing stage and evaluation phase.

This research aimed to (1) know the validity of material testing modules by using constructivist approach at mechanical engineering department of Unimed; (2) know the effectiveness of material testing modules by using constructivist approach at mechanical engineering department of Unimed.

II. METHOD

This research was conducted on Mechanical Engineering Department of Unimed. The method used in this research was the Research and Development (R & D) approach by Borg and Gall (2007) which started that R & D method was used to design new products and procedures to meet the criteria of effectiveness, quality and standardized.

This research started with requirement analysis by collecting information about current condition of instructional process of material testing and information of ideal condition of instructional needed by students. Information was obtained through observation activities, questionnaire distributions, and focused group discussion (FGD) involving students and lecturers of material testing.. All information obtained was applied as data used for the next steps.

The steps of developing the material testing modules referred to the Dick and Carey Model consisting of 8 (eight) steps (Carey and Carey, 2009): (1) identifying the instructional needs and formulating the TIU; (2) performing the instructional analysis (3) identification of the initial characteristics of the students, (4) formulating the purpose of special instructional (TIK), (5) determining benchmark of test reference, (6) developing instructional strategy, (7) developing instructional materials, (8) conducting formative evaluation. This formative evaluation was done after the draft of result of product development was completed.

Formative evaluation began by conducting validation by experts, namely: 2 (two) instructional design experts, 2 (two) instructional material experts, and 2 (two) experts of instructional media.

The revised draft product after validating by experts, continued with one to one evaluation on 3 students, followed by revisions and then small group evaluation on 12 students. The next step was to perform field trials on 30 students, as the last step of the evaluation phase.

III. RESULTS AND DISCUSSION

The results of research were presented in 2 parts, namely : (1) the validity of material testing modules by using constructivist approach at mechanical engineering department of Unimed; (2) the effectiveness of material testing modules by using constructivist approach at mechanical engineering department of Unimed.

Validity of Material Testing Modules

The validity of material testing modules development results could be found out from experts' validations, one to one evaluation and small group evaluation. Instrument of data collections to find out the validity of model was using questioners.

Experts' validations, this stage involved three (3) areas of experts instructional design experts, instructional material experts and media learning experts. The results of data analysis taken from the experts' validations showed that the design expert of the study giving an average rating of 87,70%, the material expert giving an average rating of 89,30%, and the instructional media expert giving an average grade of 90,25%. The results of reaserch showed that the expert validity giving an average rating of 89,08 %.

One to one evaluation, this evaluation involved three (3) students who had high, medium and low academic abilities. The results of the assessment provided in the one to one evaluation was 87.03% average.

Small group evaluation, this test involved twelve students where four students had low academic abilities, four students had medium academic abilities, and four students had high academic abilities. The analysis of data obtained from this kind of small group evaluation was at 89.09% average.

The results of experts' validations, one to one test and the small group test proved that the modules of the development result was valid to be implemented.

Effectiveness Material Testing Modules

To know the effectiveness of the modules developed was by collecting data through a field trial test involving thirty students. The data were obtained through a class

observation which was conditioned based on the same the actual condition. Field trial started from pre-test followed by presentation of modules using constructivist approach and ended with post-test. The effectiveness of modules of development results was done by comparing the pre-test and post-test results.

Based on the calculation of the average pre-test value was 45,63 and the average post-test was 85,77. The results of pre-test and post-test showed the increasing incurred by 40,14 or 87,97%. It meant that there was an increasing of instructional outcomes during the instructional process of material testing study by using a constructivist approach as applied. The use of material testing modules, proved to be effective in increasing students' knowledge and insights based on the increasing of post-test values.

DISCUSSION

An instructional design should be in line between the instructional objectives and needs analysis. If instructional objectives are not based on needs analysis, a very high qualified instructional will not give any advantages for the students. Vice versa, if the needs analysis is not in accordance with the purpose of learning, the results of needs analysis does not reflect the purpose of instructional. This is in accordance with Anderson's and Krathwohl's opinions (2015).

The results of this research indicated that quality improvement and instructional process in universities need to creatively develop new educational concepts that are more comprehensive and competitive. This can be done with the renewal of a more flexible instructional approach, by placing the students as the subject rather than as the object of instructional. Therefore, the development of instructional materials conducted on the material testing study is appropriate and can be used as a reference in the development of instructional models for other studies.

Instructional objectives are the abilities or skills (competencies) that are expected to be possessed by students after they perform a particular instructional process (Sanjaya: 2008: 110). Similarly, according to Munthe (2009), "where the competency is the ability of students to do something well as a result of the process of instructional or education that followed".

The facts on the ground show the development of material testing modules refers to theoretical competency by having affective, cognitive, and psychomotor aspects. The specific instructional objective is a reference for lecturers to develop benchmark of reference assessments, develop instructional strategies, develop instructional materials, and as a basis for selecting appropriate instructional media

The facts on the ground show that in the modules developed, the lecturers' instructional activities have performed reinforcement by explaining the benefits of material testing knowledge and skills. Basically the reinforcement is performed to provide the strengthening to

students in order to have motivations and passion to follow the instructional activities.

Besides the instructional approach and learning strategy, an important factor for the success of instructional activities is media utilization. The process of instructional a process of communication requires media to deliver messages can be effectively accepted by students. Gerlach and Elly in Sanjaya (2015) stated "that the media included people, instructional materials, tools or activities that create conditions that enable students to acquire knowledge, skills, and attitudes of behavior".

The modules of material testing development outcomes are validated by the instructional media experts. According to the media expert of material testing textbook, the development results are feasible to be used in the instructional process. This is in line with the opinions of Smaldino, Loether, and Russell (2011) i.e "the text elements must consider the style or type of letters, size, spacing, and color. The visual elements presented in the instructional material were layout settings, color balance, readability, and interest".

Miarso (2007) in his book "Sowing the Seeds of Educational Technology", citing Wright's opinion, based on his study of a number of studies, identified seven (7) indicators that demonstrate effective instructional, namely (1) well organized lectures, (2) effective communication, (3) mastery and enthusiasm in the course (4) positive attitudes toward students, (5) giving test and fair value, (6) flexibility in teaching approach, (7) good student instructional outcomes. In line with these indicators, the development of material testing modules has been effective and provides good instructional outcomes.

The final products are ; instructional text books of material testing, lecturers' manuals and students' manuals. These products have some advantages: (1) recorded as the first book about material testing compiled by following the steps of developing of the existing instructional model in Mechanical Engineering Department of Unimed; (2) modules are in accordance with the needs of students, graduate and users; (3) interesting and easy to understand in terms of color selection and display of illustrations of images, photographs, and tables; (4) train students to solve problems and think logically and systematically.

IV. CONCLUSION

Based on the research objectives and discussions on the research results that have been raised, then from this research and development , it can be concluded that:

1. The validity of the material testing modules by using constructivist approach has been valid to be implemented because it has been proved through the formative evaluation. The formative evaluation was performed by the instructional design experts, instructional material experts, and media instructional experts. Next step is to perform a validity test by having a one to one evaluation and small group evaluation. Each stage always held revisions to product result of material testing modules development.

2. The effectiveness of material testing modules of the developed result was known by performing pre-test and post-test on field trial. The results of pre-test and post-test showed an increasing of students' instructional outcomes of 86,22%. It can be a proof that the material testing modules developed by constructivist approach has been effective.

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