Developing Instructional Materials for Garage Management Course At The Mechanical Engineering Department Faculty of Engineering State University Of Malang

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Abstract—There have been no special materials for teachers and students of the Garage Management Course at the Department of Mechanical Engineering Faculty of Engineering State University of Malang. Thus, we need to develop special instructional materials for the Course. This study aims to develop, deliver, and test the feasibility of the textbook developed for the Garage Management Course. The method used was a research and development model by Borg and Gall, with the stages of curriculum analysis, product development, expert validation, instructional technology expert validation, and trials consisting of a trial for individual (small groups) and for large groups. The data analysis technique used was quantitative descriptive using percentages. Expert validation resulted in P of 96.87% (valid/ fit for use); instructional technology expert validation resulted in P of 95.62% (valid / feasible to use); small group trial (10 students) resulted in P of 95.75% (valid / feasible to use); and large group trial (30 students) resulted in P of 93.87% (valid / feasible to use). The conclusion is that the instructional materials for the Garage Management Course is feasible and can be used in learning activities in the Department of Mechanical Engineering, Faculty of Engineering, State University of Malang.

Keywords: development, instructional materials, Garage Management Course

I. INTRODUCTION

Graduate of Mechanical Engineering have the following competence: (1) to be teachers at the mechanical engineering program at senior high vocational schools; (2) teachers in the fields of manufacturing and production in high schools; and (3) instructors for mechanical engineering training and education. The subjects taught in Mechanical Engineering study program consists of theory and practice courses. Since the number of classes and teachers in this study program are abundant, several professors or teachers may teach the same subject. This results in differences on the assessment systems. Lecturers have different levels of mastery of theory and of teaching experience, as well as educational background—different universities and different majors (engineering and teaching). This makes learning methods varied and affect on student achievement and learning outcomes.

Garage Management provides the basic theories for practical subjects. Many obstacles in the course include availability of textbooks. Additionally, there is no certain reference for the subject although the subject matter is a core course in mechanical engineering that must be mastered by students before they practice in the laboratory or workshop machinery. Students working in laboratory or workshop should understand the basic knowledge of workshop or garage and management of this place, and the safety in conducting activities in the workshop or garage.

To solve these problems, a change through the development of instructional materials on Garage Management Course. Through the development of of instructional materials on Garage Management Course, standardization issues related to this subject will be solved, as the products from the development of instructional materials are the syllabus, lesson plans, student textbooks, and assessment with an answer key.

There have been some efforts to facilitate the internal process when a person learns, so that the learning process is more effective and efficient [1]. Facilities and infrastructure, learning tools, professional teachers and instructors have been provided, yet they cannot guarantee effective and efficient learning. Furthermore, [1] explains that theory of learning is descriptive while learning theory is prescriptive, meaning that theory of learning describes the learning process, while learning theory prescribes strategy or method for optimal learning which can facilitate learning processes [1].

[2] states that learning is motivating and providing facilities for students to learn on their own. This is in line with the development of learning by John Dewey stating that ‘learning by doing’, it means that by giving freedom to students to learn independently, they would find the

knowledge through the natural and contextual learning process. This is in line with the learning theory with contextual approach which states that a contextual approach is the concept of learning where the teacher presents a real-world situation into the classroom and encourages students to make relationship between the knowledge they have and the application in their lives as members of family and society [3]. Within this concept, students are expected to experience meaningful learning, and the learning process takes place naturally in the form of activities and experience, not a transfer of knowledge from teacher to students.

[4] says that learning as an educational process cannot be done instantly. Learning is done in the form of training aimed at developing professional competence of learners. Learning in the form of training involves cognitive, affective, and psychomotor domain. Cognitive domain involves training to improve the ability to understand matters. Affective domain involves the ability to think logically in order to control emotions. Psychomotor domain involves training the muscles to control the driving limbs. These domains are the domains in Blomm Taxonomy believed to have different depths for different areas of work or science.

Factors to consider in learning are teachers, students, as well as other factors that come from outside either macro and micro or principles, operational, and practical. Teachers in teaching need to answer four things related to learning, namely: (1) what is taught, (2) who will learn, (3) how they learn, and (4) how teachers must organize learning. The answers will help forming the success of teachers in organizing learning as it is consistent with the objectives in the curriculum and the personal aspects of students [2].

Based on [5], the purpose of the Garage Management Course is to provide knowledge and skills to students of mechanical engineering education in applying management concepts. In detail, it is expected that students can competence in analyzing the definition of garage, the organization of garage, minimum standards for a garage, lay out making, equipment and machinery in the garage, analyzing the management of work in the garage, an evaluation of garage management, and planning for the development of garage.

Curriculum is a reference of learning and training in schools. Curriculum according to [6] is a set of plans and arrangements regarding the purpose, content, and teaching materials and methods used as guidelines for the organization of learning activities to achieve educational goals. In the [5], it is explained that curriculum is a set of plans and learning content, study materials, and methods of delivery and assessment used as guidelines in the organization of learning activities.

The curriculum used by all study programs in the Faculty of Engineering, State University of Malang is the competency-based curriculum (CBC) developed based on the decision of the Minister of National Education of the Republic of Indonesia Number 232 / U / 2000 and Number 045 / U / 2002. To place a curriculum in a central position in the whole process of education, educational institutions and teachers should be able to translate it as a motivator. A curriculum should be able to answer every challenge along with the rapid development and needs of change; it should contain new things that can help students to develop their potential in order to play an active role in the social life of the people who always move dynamically [7].

There are four important things that must be considered in curriculum development according to [7], namely: (1) curriculum design is discipline-oriented, (2) curriculum design is community-oriented, (3) curriculum design is learner-oriented, and (4) curriculum design is technology-oriented. First, the design of the curriculum that refers to the disciplines is defined as the knowledge-centered design by [8], designed based on the structure of disciplines; therefore, the design model is also called as an academic subject model curriculum directed to the intellectual development of students. Experts look at this curriculum design as a model to develop cognitive processes or thinking skills of students through exercises using ideas and scientific research process [9].

Second, the assumption underlying the form of community-oriented curriculum design is that the purpose of school is to serve the needs of the community. Therefore, the community needs to be used as the basis to determine the contents of the curriculum. Community in vocational education is industrial society as users of graduates. Third, the assumption underlying the learner-oriented curriculum is that education is to help students. Therefore, education should not be separated from the lives of the students. This curriculum emphasizes students as a source of curriculum contents. Curriculum content should not be separated from the lives of young people as learners.

In designing learner-oriented curriculum, [7] suggests the following: (1) the curriculum should be tailored to learner's development, (2) the content of the curriculum should include the skills, knowledge, and attitudes that are considered useful for present and future, (3) learners should be placed as a subject of study trying to learn on their own, which means that students should be encouraged to do various learning activities, not just accepting information from teachers, and (4) students must be placed in a position to learn according to their interests, talents, and the level of their development, which means what should be learned is not specified and is viewed not from teachers' perspective but from the students' themselves.

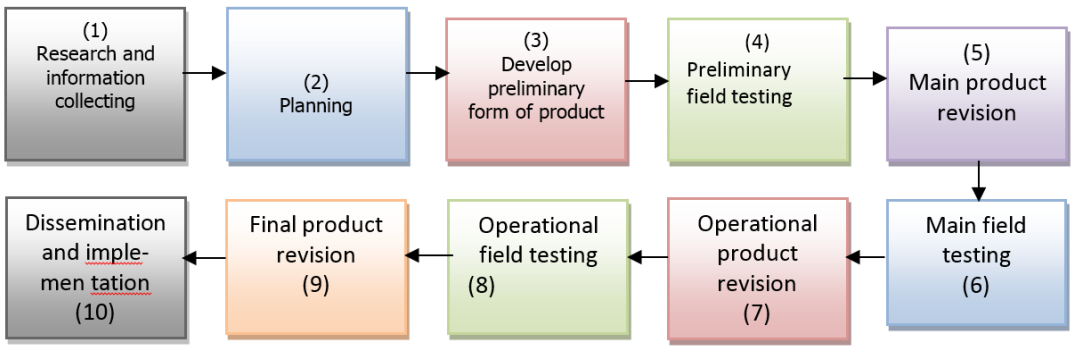

Fig. 2. he stages of R & D by Borg dan Gall Source: Borg and Gall (1983)

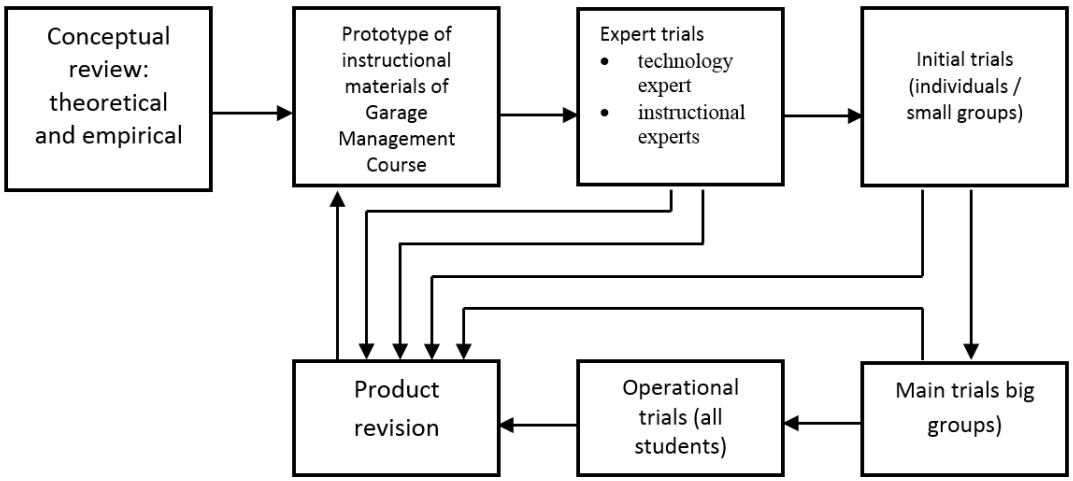

Fig. 1. Stages of Trial of the Product

Fourth, technology-oriented curriculum design, according to [9], the purpose is on achieving a change in behavior which is measurable. Therefore, the general objectives are translated into specific goals. This curriculum focuses on the effectiveness of programs, methods, and materials to achieve the goal. Perspective of technology has been widely used in various contexts, for example in a training program in the field of industry and the technology learning and vocational education. Technology-oriented curriculum needs to pay attention to the condition and the impact it has on the students.

According to [7], a technology-oriented curriculum can be viewed from two sides, namely the application of results of technology and the application of technology as a system. The first is associated with the application of technology as systematic planning by using media in the learning activities. Utilization of these tools is merely to improve the effectiveness and efficiency of learning. With the implementation of the results of technology as a tool, it is assumed that learning will be successful, effective, and efficient. Examples of the application of the results of the technology are computer-assisted learning, teaching through radio, film, video, and so forth. The second, technology as a system, emphasizes on the preparation of the learning program using a systems approach that is characterized by the formulation of specific objectives or behavior that must be achieved. The learning process is directed to achieve these behavioral goals. Thus, learning success is measured by the extent to which learners can master or achieve a particular purpose. Thus, the application of technology as a system is not determined by the application of the results of the technology but more on how to design a curriculum implemented with a systems approach.

[10] explains that curriculum development can be done through several levels, namely: (1) macro-national level, with reference to national educational goals based on the laws on National Education System; (2) institutional level, that is tailored to the mission, vision, and objectives of the institution; (3) field of study or subject level, which lays out the outlines of learning program into the syllabus and the development of sub -topics in accordance with the conditions and the situation on the field; and (3) teaching program level, which is developing a set of modules, teacher's book, student's worksheets, units of learning, and the like.

[11] explain that in the preparation and development of vocational education curriculum, we should pay attention to several characteristics. Those characteristics are (1) a curriculum is oriented towards processes and products or results, (2) a curriculum is based on the needs of work that has been identified, (3) curriculum focuses on helping students to develop the knowledge, skills, attitudes, and the values eventually contribute to the employment of graduates, (4) standards of student success in school is based on the performance expected in the world of work, and (5) determining the success of the students is not limited to what taking in the school environment, but also on the success of graduates in the world of work.

With regard to opinions, theories, and analysis afore-presented, in the preparation of curriculum for the Garage Management Course, some things to consider are as follow: (1) the purpose of mechanical engineering study program, (2) the characteristics of learners (students), (3) technological developments, (4) facilities for learning, (5) the work environment in the industry, and (6) the time available in a single semester.

This study aims to produce a prototype of teaching materials for Garage Management Course of the Mechanical Engineering Education, Faculty of Engineering University of Malang, described as follows: (1) identifying problems related to instructional materials of the Garage Management Course, (2) designing expert-validated instructional materials, and (3) testing the feasibility of the instructional materials of Garage Management Course.

II. Research Method

Research and development model used in the study was a Research & Development model (R & D) by [12]. This model was chosen for the following reasons: (1) the steps are complete and sequential, (2) the components include all required in the learning process, (3) it involves teaching expert and technology expert in evaluating instructional materials, (4) it involves learners in the development of teaching materials, and thus students can directly experience the effectiveness and feasibility of the product. The ten procedural stages proposed by Borg and Gall are shown in Fig. 1.

The procedure of Research and Development by [12] involves ten stages. The ten stages above were operationalized into actions related to research and development activities in the development of teaching materials for Garage Management Course as follows: (1) establishing the need of the course, (2) identifying problems of the course, (3) studying the various models of the course, (4) developing a prototype of instructional materials, (5) expert review and testing of the prototype, (6) product revision (revision 1), (7) field trials, (8) product revision (revision 2), (9) product development in the form of instructional materials, and (10) dissemination and implementation.

Product trials were conducted like the development stage aiming to collect or obtain data used to determine the level of validity of the prototype of the instructional materials for Garage Management Course, so it can be used as a basis to establish the effectiveness and efficiency as shown in Fig. 2.

According to [13], research and development consists of three phases, namely: (1) a preliminary study, (2) the development of the model, and (3) testing the model. Preliminary study is an early stage or preparation for development, consisting of literature reviews, field surveys, and the preparation of the initial product. At the stage of development of the model, researchers can discuss, consult, and ask for input or advice from peers who have experience in the field of study or subjects. Based on inputs from peers, researchers can revise the draft of instructional materials developed. The next step is testing the model, namely limited testing (individuals) and extensive testing (large groups).

Data analysis technique to analyze quantitative data was in the form of a questionnaire scores for instructional material experts and technology experts, as well as product testing for small groups and large groups by calculating the percentage of answers. The formula for processing data per item is as follows:

$$\mathbf{P = \frac{x}{xi} x\ 100\%} \qquad (1)$$

In which:

P	= Percentage
100%	= Constanta
x	= Respondent's answer of one item
x_i	= Ideal score of one item

Meanwhile, as the basis for the decision to revise the instructional materials, the assessment criteria adapted from [14] as shown in Table 1 was used.

III. Results And Discussion

A. Analysis on Instructional Material Expert Validation Results

The two experts validated four aspects, namely (1) content and objectives, (2) motivation, (3) assessment materials or test items, and (4) technical materials. The results are shown in Table 2.

TABLE I. Validity Criteria for Percentage Analysis

Percentage range	Criteria	Note
76% - 100%	Valid	No Revision
56% - 75%	Valid Enough	No Revision
40% - 55%	Less Valid	Minor Revision
<40%	Not Valid	Major Revision

[a.] (Source: [14]; [15])

TABLE II. EXPERT VALIDATION RESULTS

Aspect to Validate	Percentage	Feasibility
Content and objectives	94.64%	Feasible without revision
Motivation	93.75%	Feasible without revision
Assessment or test items	100%	Feasible without revision
Technical	100%	Feasible without revision

[b.] (Source: data analysis results, 2015)

TABLE III. INSTRUCTIONAL EXPERT VALIDATION RESULTS

Aspect to Validate	Percentage	Feasibility
Content and objectives	95.83%	Feasible without revision
Motivation	93.75%	Feasible without revision
Assessment or test items	96.87%	Feasible without revision
Technical	95.83%	Feasible without revision

[c.] (Source: data analysis results, 2015)

TABLE IV. SMALL GROUP TRIAL RESULTS

Aspect to Validate	Percentage	Feasibility
Content and objectives	93.92%	Feasible without revision
Motivation	95.00%	Feasible without revision
Assessment or test items	94.37%	Feasible without revision
Technical	95.00%	Feasible without revision

[d.] (Source: data analysis results, 2015)

TABLE V. LARGE GROUP TRIAL RESULTS

Aspect to Validate	Percentage	Feasibility
Content and objectives	93.57%	Feasible without revision
Motivation	94.58%	Feasible without revision
Assessment or test items	94.16%	Feasible without revision
Technical	93.50%	Feasible without revision

[e.] (Source: data analysis results, 2015)

Component on validation of the instructional materials by instructional material experts consisted of 20 indicators. Total score given by the two validators was 153 of 160 (overall score). The calculation for the entire item or aspect assessed resulted in a score of 95.62%. Thus, based on the validity criteria, it can be concluded that the components of the instructional materials are considered valid and can be used in the teaching and learning process at the Department of Mechanical Engineering, Faculty of Engineering, State University of Malang without revision.

B. Analysis on Technology Expert Validation Results

The two experts validated four aspects, namely (1) content and objectives, (2) motivation, (3) assessment materials or test items, and (4) technical materials. The results are shown in Table 3.

Component on validation of the instructional materials by technology experts consisted of 20 indicators. Total score given by the two validators was 153 of 160 (overall score). The calculation for the entire item or aspect assessed resulted in a score of 95.62%. Thus, based on the validity criteria, it can be concluded that the components of the instructional materials are considered valid and can be used in the teaching and learning process at the Department of Mechanical Engineering, Faculty of Engineering, State University of Malang without revision.

C. Analysis on Small Group Trial Results

Small group trials involved individual or small group of ten students of the Department of Mechanical Engineering, Faculty of Engineering, State University of Malang. The four aspects assessed by the students are (1) content and objectives, (2) motivation, (3) assessment materials or test items, and (4) technical materials. The results are shown in Table 4.

Component on validation of the instructional materials by small group of students consisted of 20 indicators. Total score given by ten students was 766 of 800 (overall score). The calculation for the entire item or aspect assessed resulted in a score of 97.75%. Thus, based on the validity criteria, it can be concluded that the components of the instructional materials are considered valid and can be used in the teaching and learning process at the Department of Mechanical Engineering, Faculty of Engineering, State University of Malang without revision.

D. Analysis on Large Group Trial Results

Large group trials involved large group of 30 students of the Department of Mechanical Engineering, Faculty of Engineering, State University of Malang. The four aspects assessed by the students are (1) content and objectives, (2) motivation, (3) assessment materials or test items, and (4) technical materials. The results are shown in Table 5.

Component on validation of the instructional materials by large group of students consisted of 20 indicators. Total score given by thirty students was 2253 of 2400 (overall score). The calculation for the entire item or aspect assessed resulted in a score of 93.87%. Thus, based on the validity criteria, it can be concluded that the components of the instructional materials are considered valid and can be used in the teaching and learning process at the Department of Mechanical Engineering, Faculty of Engineering, State University of Malang without revision.

E. Product Revision

Revision of the instructional materials is done by means of improvement based on the results of data validation, from experts and from students during the trials.

Revisions were done so that the instructional materials were feasible to be used in the learning process of the Department of Mechanical Engineering, Faculty of Engineering, State University of Malang. The instructional materials were expected to be used by students from other universities, institutes, or colleges of engineering, including in institutions of vocational education such as Polytechnic, Vocational Education Development Center (VEDC), Vocational Training Course (BLK), training centers and others. The instructional materials are also expected to be used as reference materials in the learning process at vocational high schools (SMK) especially technology and industry groups or field of mechanical engineering.

F. Findings and Discussion

Validation of the instructional materials for Garage Management Course consisted of validation by instructional expert and validation by technology expert, small group trial (pre-trial), large group trial (main trial); all produced high validity in the category of valid or without revision. This means the instructional materials for Garage Management Course could be used in the process of learning of students of Department of Mechanical Engineering, Faculty of Engineering, State University of Malang. With the instructional materials, students should be able to improve the ability to follow the course realized in the improved learning outcomes. Increased learning achievement means that graduates have the ability to emulate in the field of technology, especially in the Garage Management Course. [16] states that technology education is able to prepare a workforce capable of winning the competition and having high endurance, thus the technology education (vocational) has a capability known as emulation capabilities in the field of technology. By using the instructional materials of high validity level, transformation of development and behavioral changes that include intellectual dimension in cognitive domain, skills in psychomotor domain, and responsibility in affective dimension can be manifested.

The instructional materials for Garage Management Course has fulfilled its validity and fit for use in the learning activities, therefore the materials should be able to improve learning outcomes, interaction in learning and motivation generated as well as the finance affordability. [1] states that instructional materials should be able to improve the precision in describing things, increase interaction, improve specific abilities, and increase the motivation in the learning process. This is in accordance with the opinion of [17], which suggests that the main purpose of the research and development is not to formulate or test the theory, but to develop effective results to be used in learning at school.

With the development of instructional materials for Garage Management Course that have been declared valid and can be used in the learning activities, it will provide benefits in learning. [18] confirms the benefits of instructional materials as follows: (1) to help teachers implement the curriculum, (2) as the guidance in determining teaching methods, (3) to provide an opportunity for students to review lessons or learn a new lesson , (4) to give standard on materials and teaching methods, and (5) to provide continuity in class although there have been changes in teachers.

The development of instructional materials for Garage Management Course will help the effectiveness of independent learning system, face-to-face learning system, as well as combination of both. According to [19], instructional materials should be able to provide convenience to both learners and teachers in the learning process, be it independent, face to face, as well as combination system. In the independent learning, teachers act as facilitator, while learners learn using the instructional materials designed based on the curriculum. In face-to-face learning system, teachers act as a presenter of the instructional material prepared, while students learn from teachers and from the instructional materials. Independent learning can be combined with face-to-face learning system.

IV. Conclusion And Suggestions

A. Conclusion

The instructional materials have valid criteria as assessed by the expert experts and the students learning the instructional materials. This means that the instructional materials for Garage Management Course can be declared feasible and can be produced in large numbers to disseminate to users, such as students of machinery engineering, automotive engineering, industrial engineering, heavy equipment engineering, electrical engineering, chemical engineering, and the like. It can even be developed for use at the universities, institutes, and high schools, as well as the technology group at the vocational high schools, and students in vocational training centers and vocational fields of technology.

B. Suggestions

For the mechanical engineering faculty, instructional materials developed are expected to be used as a guide in teaching Garage Management Course at the Department of Mechanical Engineering, Faculty of Engineering, State University of Malang. In addition, the instructional materials developed can be used in the learning process at the Department of Mechanical Engineering at institutes or colleges of technology and vocational, and vocational high schools.

For students, the instructional materials for Garage Management Course that have been validated are feasible to be used as reference materials in the learning activities. The instructional materials shall be used well in the teaching and learning process. In addition, students are still required to learn from other sources in order to enrich their knowledge.

For the mechanical engineering department, the instructional materials for Garage Management Course is expected to serve as one of the teaching materials used in the

Department of Mechanical Engineering to improve the effectiveness of learning and improve student achievement.

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