

Development of an administration management application in a mechanical engineering educational workshop based on information and communication technology

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ABSTRACT: Workshop management is an attempt to regulate all the activities and to manage existing infrastructure in the workshop. Workshop management can be done through an information system on a computer application that was created to support administrative operations in the Mechanical Engineering Department workshop in the Engineering Faculty at Universitas Negeri Malang. The result of the development of the administration management application in the mechanical engineering educational workshop based on information and communication technology (ICT) shows: 1) the material expert validation was 90%; 2) the learning technology expert validation was 86.71%; 3) testing a small groups of 10 students obtained 85.95%; and 4) testing a large groups of 30 students obtained 90.57%. Based on analysis of the results, the workshop administration management application is valid and can be used in the learning process. By using the application, activities in the workshop are faster, more orderly, more secure and seamless.

Keywords: Computer applications, workshop administration, information technology and communication, administration management, mechanical engineering workshop

INTRODUCTION

The mechanical engineering study programme in the Engineering Faculty at Universitas Negeri Malang, Malang, Indonesia, has a vision to establish a national centre of excellence in the implementation of educational personnel education and to develop it as an application of science and technology in mechanical engineering education.

The mission is to provide superior education to vocational educational personnel in mechanical engineering; to conduct research and development of science and technology in the field of vocational education in mechanical engineering; and to provide assistance to communities in developing and improving the quality of vocational education in mechanical engineering. The goal to be reached in the mechanical engineering education study programme in the Department of Mechanical Engineering [1] is to produce graduates (S1/Bachelor degree) that have the competence and authority to become novice teachers at vocational high schools or instructors in other mechanical engineering vocational training institutions. These graduates will have expertise in mechanical engineering education and production machines.

Management workshop is an attempt to organise all the activities and to manage existing infrastructure in the workshop [2]. Some workshop tools are sophisticated, and skilled professionals staff may not be able to function properly, if they are not supported by the presence of good workshop management. Therefore, workshop management is an inseparable part of the workshop's daily activities.

A good workshop is a space to practice or produce that is supported by a complete range of workshop equipment and infrastructure [3]. All activities in the workshop require orderly administration and must be organised, so that the workshop can function optimally. A workshop in technological and vocational education can be well arranged and administered, if it is managed by people who have the ability, willingness and a high responsibility to undertake their duties [4]. Therefore, the workshop manager should understand the skills of workshop management.

One thing that is essential in the workshop activity is an equipment lending system that requires a good control system. This is intended to minimise the loss of equipment and materials, the placement of tools and materials in accordance with the order of use, guide students to take responsibility, make sure the workshop looks neat and clean, and ensure that security is maintained. Other things that are urgent and must be well administered include procurement of goods (tools, materials and machinery), inventory and maintenance.

Successful learning in the educational mechanical engineering workshop/laboratory is highly dependent on several factors including educators, students, infrastructure in the workshop, technology, and information and communication systems that exist in the workshop or laboratory [5]. In advanced countries, the administration services of workshops/laboratories at vocational schools use information and communications technology in their daily activities [3]. These services include the management of goods, tools and materials, as well as an inventory of all assets including borrowed and returned laboratory equipment during the workshop practical activities.

Based on observations over the last few years and by paying attention to complaints of students and tutors about practicum in the Mechanical Engineering Department, workshop management in administrative services is still considered conventional; hence, an information system for administration services with complete and fast information is needed, so that it can support the decision-making process.

Information service systems are computer applications that have been created to support the operations of an organisation [6]. Inside the workshop, a good information system is necessary, so that it will improve services for users (faculty, students, other users), and the workshop manager will find it easier to control, schedule and develop the workshop in a better direction, as well as easier decision making that is based on data and information that is complete and accurate.

Learning is motivating and providing facilities for students to learn on their own [7]. This is aligned with the development of learning promoted and practised by John Dewey that is *learning by doing*, it means that by giving freedom to students to learn independently, they would find something with the natural and contextual learning process. This is in line with the theory of learning with the contextual approach, which states that a contextual approach is the concept of learning where the teacher presents a real-world situation to the classroom and encourages students to make connections between their knowledge with the application in their lives as a member of a family and society [8]. With this concept, learning is expected to be more meaningful and the learning process takes place naturally in the form of student activities and experiences, not just knowledge transfers from teacher to student.

If the workshop's administration management application based on information technology and communications is applied, it will provide many benefits to students, so that they will learn real-world situations in managing engineering workshops using information technology. Thus, the learning objectives of the workshop management subject can be optimal.

METHOD

According to Sukmadinata [9], the steps of research and the development consist of three phases, which are: 1) a preliminary study; 2) model development; and 3) model testing. Preliminary study is an early stage or preparation for the development, and this stage consists of: literature studies, field surveys and the preparation of the initial product. At this stage of model development, researchers can discuss, consult and ask for feedback/suggestions with the colleagues who have experience in the field of study and the same subjects. Based on inputs from such meetings, the researchers held a session to consider the improvement of teaching materials (books, media and programmes) that are developed. The next step is model testing, which includes limited testing (individual, small groups) and extensive testing (large groups).

The research and development model that has been selected and used in this study is a model of procedural research and development (R&D) by Borg and Gall [10]. The Borg and Gall research and development procedure uses ten steps relating to research and development activities conducted by researchers in the development of workshop management teaching materials in the form of application development of engineering workshop/laboratory administration management. Those steps are:

- 1) research and information collecting, seeking information and identifying problems to determine the needs of the management workshop subject;
- 2) planning, drawing up plans related to the activities and the needs of management workshop subject;
- 3) research and information collecting, including reviewing various development models and preparing workshop management subject pre-development product;
- 4) preliminary field testing, i.e. preliminary testing of workshop management subject teaching material prototype in the form of workshop administration management applications based on ICT by material experts and learning media experts;
- 5) main product revision, i.e. revising preliminary test results of the workshop management subject teaching material prototype (Revision 1);
- 6) main product testing, i.e. testing the results of Revision 1 of the developed product;
- 7) operational product revision, revising the result of main product testing (Revision 2);
- 8) operational field testing, testing the results of Revision 2 developed product;
- 9) final product revision, the results of product development in the form of ICT-based workshop administration management application as teaching materials or teaching media;

- 10) dissemination and implementation - at this stage the product can be disseminated in various ways, such as through seminars, workshops, training, etc [10].

Product testing activity conducted in teaching material/learning media product development aims to collect or obtain data that can be used to determine the validity level of workshop administration management applications based on an ICT teaching materials prototype, so it can be used as a basis to establish its effectiveness and efficiency.

Based on the development procedure, according to Borg and Gall [10], the researchers compiled a design that is simpler and easier to understand in developing teaching material without reducing the development process in the field. This is as shown in Figure 1.

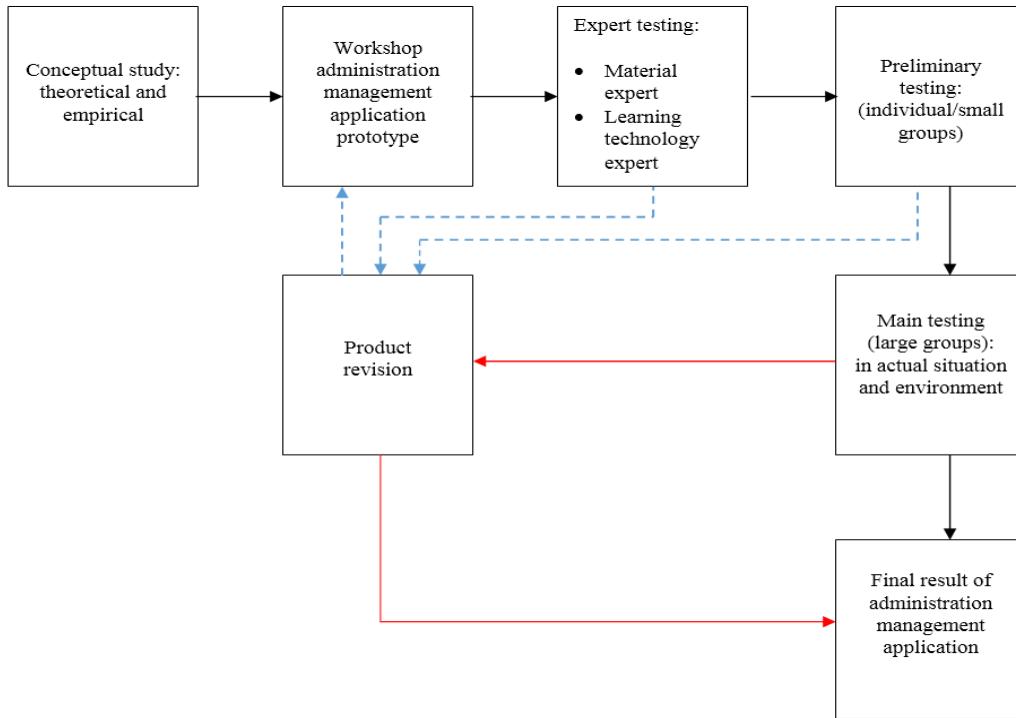


Figure 1: Product development design stages of ICT-based administration management application learning materials [10].

Validation is performed to determine the feasibility of the learning media that were developed and to get suggestions relating to media and materials that have been developed. There are three criteria in reviewing the application quality, which are purpose and content quality, functional application aspects and interface/display application aspects [9][11][12].

Students that were tested in this study were the students who attend the workshop management subject in the Mechanical Engineering Department. The number of samples for products evaluation (testing) can be seen in Table 1.

Table 1: Product development evaluation stage [11][13][14].

No.	Evaluation stage (testing)	Number of samples
1	Individual evaluation	(1-3) person
2	Small groups evaluation	(8-15) person
3	Large groups evaluation	30 person

Data analysis techniques were used in analysing quantitative data from questionnaire score ratings for learning technology experts and material experts, and small groups by calculating the percentage of responses. The basis of the decision to revise the workshop/laboratory administrative management application teaching material in the workshop management subject were the qualification criteria adapted from the assessment reported by Arikunto [15] as shown in Table 2.

Table 2: Percentage analysis validity criterion [15].

Percentage level	Criterion	Description
76 - 100	Valid	No revision
56 - 75	Quite valid	No revision
40 - 55	Less valid	Part revision
<40	Invalid	Total revision

RESULTS

Material Expert Validation Result Analysis

Material expert (ME) validation of the mechanical engineering workshop administration management application in the workshop management subject is as shown in Table 3. Aspects evaluated by material Expert 1 and material Expert 2 consist of: 1) purpose and content aspects; and 2) encouragement and motivation aspects.

Table 3: Material expert validation results.

No.	Evaluated aspect	Percentage	Validity
1	Purpose and content aspects	92.50	Valid
2	Encouragement and motivation aspects	87.50	Valid
	Material experts validation result	90.00	Valid

Material expert validation results (Table 3) from the two aspects in the validation showed a high percentage at an average of 90.00%, and this indicates that the material is valid and can be used for learning.

Learning Technology Expert Validation Result Analysis

The results of the validation from learning technology experts (LTE 1 and LTE 2) are presented in Table 4. Aspects evaluated by the learning technology experts relate to: 1) functionality application; and 2) of interface or display application.

Table 4: Media (learning technology) expert validation results.

No.	Evaluated aspect	Percentage	Validity
1	Application functionality aspect	89.06	Valid
2	Application interface or display aspect	84.37	Valid
	Media expert validation result	86.71	Valid

Learning technology expert validation results (Table 4) of the two aspects in the validation showed a high percentage at an average of 86.71%, and this indicates that the learning technology is valid and can be used for learning.

Small Groups Testing Data Analysis and Interpretation

Three aspects were assessed on small groups testing, i.e. 1) purpose and content; 2) functional application aspects; and 3) interface/display application aspects. The small groups testing was conducted with 10 students from the Mechanical Engineering Department in the Engineering Faculty at Universitas Negeri Malang in 2016.

Table 5: Small groups testing analysis results.

No.	Indicator	Percentage	Validity
1	Purpose and content	90.83	Valid
2	Functional application	84.37	Valid
3	Interface/display application	83.33	Valid
	Small groups testing result	85.94	Valid

The analysis of the results of small groups testing (see Table 5) based on three aspects in the validation showed a high percentage at an average of 85.94%. This indicates that the results of small groups testing analysis can be declared valid and be used for learning.

Field Testing Results

Field testing is usually called main testing or large groups testing, conducted with the 30 students who were part of the workshop management subject in the first semester of the 2016/2017 academic year. Three aspects were assessed in field testing, i.e. 1) purpose and content; 2) functional application aspects; and 3) interface/display application aspects. Field test data results are presented in Table 6.

Table 6: Field testing analysis results.

No.	Indicator	Percentage	Validity
1	Purpose and content	90.64	Valid
2	Functional application	8979	Valid
3	Interface/display application	91.04	Valid
	Small groups testing result	90.57	Valid

Field testing analysis results (Table 6) of three aspects in the validation showed an average of 90.57%, and this indicates that the large groups testing analysis results can be declared valid and be used for learning.

DISCUSSION

Validation of the workshop management subject teaching material in the form of *workshop administration management application based on ICT*, which consists of small groups testing (pre-testing), and field testing (primary testing or large groups testing) produced a high validity and can be categorised as valid or without revision for a result greater than 76% [15]. This means that the teaching material can be used in the student's learning process in the Mechanical Engineering Department of the Engineering Faculty at Universitas Negeri Malang. With this teaching material, it is expected that students should be able to improve their ability to follow the subject, so their learning result achievement will increase. It means that by using these materials graduates will have improved ability in technological fields, particularly in the management workshop subject.

Mukhadis [16] states that educational technology is able to prepare a workforce that is capable of winning in a competitive environment and has high endurance. The technological education (vocational) has an ability known as emulation capability in the field of technology. By using teaching material that has a high level of validity, it is expected to provide transformation development and behavioural change that includes intellectual and cognitive areas, motor skills and responsibility in affective areas. Degeng [17] stated that in the learning process, teaching materials should be able to increase students' accuracy to describe things, increase interaction, improve specific abilities possessed and increase motivation in the learning process.

The development of workshop management subject teaching materials will help the effectiveness of: 1) the self-learning system; 2) the face-to-face learning system; and 3) a combination learning system. According to Suparman [13] teaching materials should provide convenience to both students and teachers in the learning process independently, face-to-face, as well as with a combination learning system.

In terms of the specific skills, which are expected, it is stated in the Kurikulum Program Studi Pendidikan Teknik Mesin Fakultas Teknik UM: ...*Being able to apply the area of expertise of vocational education in mechanical engineering and utilize science, technology, and/or art in the field of engineering education, and be able to utilize science and technology that is relevant to mechanical engineering education's scope to design, manage, facilitate, supervise and evaluate the feasibility and achieve sustainable guidance in the practical implementation of mechanical engineering education* [1].

CONCLUSIONS

Based on the results of the development workshop management subject teaching material in the form of *ICT-based workshop administration management application*, the following conclusions were obtained:

- The teaching materials produced are in the form of a mechanical engineering workshop/laboratory administration application. They are among the teaching materials that can be used to overcome the problems of the workshop management system in the Mechanical Engineering Department of the Engineering Faculty at Universitas Negeri Malang.
- The teaching materials of the *ICT-based workshop administration management application* had been valid after students were tested as users of teaching material either in small groups or large groups.
- The *ICT-based workshop administration management application* can be declared feasible for use and can be produced in large quantities to disseminate to users, such as students (majors: mechanical engineering, automotive engineering, industrial engineering, heavy engineering, electrical engineering, chemical engineering, and the like) at universities/institutes/high schools, and also can be developed in other vocational educational institutions, such as technological SMKs, and including the vocational institution/training centres in the field of industrial and technology.

SUGGESTIONS

Based on the results of the development of teaching materials in the form of a mechanical engineering workshop administration management application, the developers can offer some suggestions, as follows:

- To the lecturers in the management workshop subject - teaching materials developed in the form of mechanical engineering workshop administration management application can be expected to be used as one of the media in teaching the management workshop subject.
- To students - teaching materials developed in the form of mechanical engineering workshop administration management application have been validated and declared to be useful in learning activities. It is expected that these materials could be used as often as possible to support the learning of the management workshop subject in addition to textbooks that have been developed. However, students are still expected to learn from other relevant sources to enrich the material being studied.
- To the Mechanical Engineering Department - the development of teaching materials in the form of the mechanical engineering workshop administration management application is expected to serve as support material for

workshop management subjects teaching materials used in the Mechanical Engineering Department. Additionally, the mechanical engineering workshop administration management application should be applied in the Mechanical Engineering Department. With these workshop administration applications, storage system of materials and other tools can be more organised and secure. Likewise, lending/return systems of equipment, materials and other tools can be controlled easily.

- To developers and researchers - researchers could be expected to carry out further research and development in the form of these workshop administration applications from a different angle.

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BIOGRAPHY



Dr Yoto was born in Tulungagung, East Java, Indonesia, on 10 December 1962. He qualified as Doctor of Vocational Education Study Programme in 2015 at Universitas Negeri Malang. Since 1986, he has been a lecturer at the State University of Malang, engaged in areas of expertise in the teaching of mechanical engineering. His subjects are: management of vocational education, vocational education curricula, workshop management and engineering mechanics. His research interest is in the field of technology and vocational education. Besides being active as a lecturer, he is also an author/presenter at various national and international seminars.