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Development of Teaching Materials Media on Robotic System Control Lessons at SMKN 2 Lamongan

Ahmad Januar Darmawan¹, Nurmida Catherine Sitompul², Hartono³

Teknologi Pendidikan, Sekolah Pascasarjana Universitas PGRI Adi Buana, Surabaya, Indonesia^{1,2,3}

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ABSTRACT

This study aims to produce teaching materials controlling robotic systems that can help students understand, learn, and solve problems in learning to control robotic systems for class XI Industrial Electronics Engineering SMKN 2 Lamongan. The development model used in the development of teaching materials was adapted from the Dick and Carey's model on the consideration that this model was developed systematically with sequential steps in product development. The development model consists of three phases: pre-development phase 1, development phase 2, and post-development phase 3. The results showed that (1) the individual test resulted in 92.44% indicating that the teaching materials were in very good qualification so they did not need to be revised. (2) the small group test resulted in 91.78% indicating that the teaching materials were in very good qualification so they did not need to be revised. (3) The field test resulted in 85.41% indicating that the teaching materials had good qualifications, so they did not need to be revised.

Keywords: *Development, Instructional materials, Robotic System Controller, Vocational School*

EMAIL

poenyayanuar2@gmail.com
nurmida.catherine.s@unipasby
hartono@unipa.ac.id

PENERBIT

LPPM- Institut Teknologi Adhi
Tama Surabaya
Address:
Jl. Arief Rachman Hakim
No.100,Surabaya 60117,
Telp/Fax: 031-5997244

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ABSTRAK

Penelitian ini bertujuan menghasilkan bahan ajar pengendali sistem robotik yang dapat membantu siswa dalam memahami, mempelajari, dan memecahkan masalah dalam belajar pengendali sistem robotik kelas XI Teknik Elektronika Industri SMKN 2 Lamongan. Model pengembangan yang digunakan dalam pengembangan bahan ajar ini diadaptasi dari model Dick dan Carey (2001) atas pertimbangan bahwa model ini dikembangkan secara sistematis dengan langkah langkah secara berurutan dalam melakukan pengembangan produk. Model pengembangan terdiri dari tiga fase: pra-pengembangan fase 1, pengembangan fase 2, dan fase 3 pasca-pengembangan. Hasil penelitian menunjukkan bahwa (1) uji perorangan menghasilkan 92,44% menunjukkan bahwa bahan ajar berada pada kualifikasi sangat baik sehingga tidak perlu direvisi. (2) uji kelompok kecil menghasilkan 91,78% menunjukkan bahwa bahan ajar berada pada kualifikasi sangat baik sehingga tidak perlu direvisi. (3) Uji lapangan menghasilkan 85,41% menunjukkan bahwa bahan ajar pada kualifikasi baik sehingga tidak perlu direvisi.

Kata kunci: *Pengembangan, Bahan Ajar, Pengendali Sistem Robotik, SMK*

INTRODUCTION

Vocational High School (SMK) is a formal educational institution which in the learning process does more practicum activities, to support the learning process it is necessary to have learning media [1]. The use of school equipment in the learning process has a great influence on students in learning and understanding the material presented by the teacher. Therefore, every vocational high school (SMK) must have facilities and infrastructure that can support the learning process.

The goal of vocational secondary education can be achieved by increasing learning efficiency, because the learning process plays a very important role in producing or producing quality graduates. The learning process aims so that students are able to master the material both conceptually (theoretically) and applied (practice), where application is the practical application of concepts. The process of applying a concept requires the help of media or educational devices so that the learning process takes place according to its objectives. The role of this media is to provide information about learning materials from sources, both teachers and other sources, which can encourage students to understand them quickly.

From the results of preliminary field observations obtained data on the situation and conditions of learning robot system controllers at SMKN 2 Lamongan. The author's conclusion relates to the lack of interest in student learning, by using academic textbooks as a reference, especially the Robotic System Control subject in class XI Industrial Electronics Engineering [2]. Due to the lack of interest and motivation of these students, the ability to understand concepts, especially odd semester documents, is very lacking so that it has an impact on students' scores below the KKM. The lack of understanding of the concept of electro-pneumatic material emerged from the results of interviews with class XI productivity teachers who provided additional material for preparation for the proficiency exam. According to him, when asked about pneumatic circuits [3], students were silent because they forgot the names of the circuit parts and their operating principles. Likewise, books on controlling robotic systems are not yet available in the market. So the references that students use are only teacher information, teacher notes and browsing the internet. If given homework, most of the results are the same, meaning that students also lack initiative in learning.

Based on the author's observations and interviews with several productive teachers and several students of SMKN 2 Lamongan, so far learning to control robotic systems, especially students of class XI Industrial Electronics Engineering have never used teaching materials that suit student needs. Students are not available module books in the library, while teachers only get information from browsing on the internet. Meanwhile, for browsing on the internet also requires a fee. Based on the needs analysis, it can be seen that at SMKN 2 Lamongan the teachers, especially the productive teachers of industrial electronics engineering, do not yet have teaching materials that are relevant/according to the needs and characteristics of students that are designed/designed with systematic steps using the dick and carey development model.

The development of teaching materials is one of the steps that can be taken to improve and improve student learning outcomes, especially in subjects controlling robotic systems. The knowledge and skills acquired by students are not the result of remembering but the results of finding themselves through observation, experimentation and exploration. Based on this background, it is necessary to develop teaching materials which are later expected to contribute to the learning process of robotic system controller subjects. The contribution in question is that it can increase student learning motivation so that it also improves learning outcomes.

LITERATURE REVIEW

Development of Teaching Materials in Learning Technology

Development is the process of translating design specifications into physical form/product [4]. Learning development is the process of developing procedures and using them to create new learning in a particular context. Learning skills are ethical research and practices that promote learning and increase productivity through the creation, use, and management of workflows and resources. This definition contains several key elements, namely:

1. The study, of theoretical understanding, as in the practice of educational technology requires the construction and continuous improvement of knowledge through research and reflection on practice, which are included in the term study.
2. Practical ethics, which refers to practical ethical standards as defined by the AECT Ethics Committee regarding what Education Technology practitioners should do
3. Facilitation. The paradigm shift towards greater learner ownership and responsibility has changed the role of technology from controller to facilitator.

4. Learning. The definition of learning today has changed from several decades ago. Learning is not only related to memory, it is also related to understanding.
5. Upgrade. Improvements relate to product improvements, which lead to more effective learning, changes in capabilities, which have an impact on real-world applications.
6. Performance. Performance is related to the learner's ability to use and apply the newly acquired abilities. theory and practice of the design, development, utilization, evaluation and management of resources and processes for learning.

Instructional Media

Learning media according to Susilana in [5] is anything that allows a message to be sent and disseminated to a source in a planned manner to create a learning environment in which recipients can carry out the learning process effectively and efficiently. Learning media according to Kemp and Dayton in their book [6] states that learning media can fulfill 3 main functions if the media is used for individuals, groups, or large groups of listeners, namely motivating interest or action, conveying information, and giving instructions. The function of learning media according to [7]:

1. The function of learning media as a source of learning, in some learning media can replace the function of the teacher.
2. Semantic function, the ability of the media to add to the vocabulary whose meaning or intent is really understood by students.
3. Manipulative function, this function is based on general characteristics, namely: the ability to record, store, preserve, reconstruct, and transport an event or object.

Teaching materials

Teaching materials have various functions, goals, and benefits to support success in achieving a learning goal. According to the Ministry of National Education in [8], Curriculum material serves as a guide for teachers and students who will guide all activities in the learning process and as a means of assessing learning achievement/outcomes. It was further explained that the curriculum materials were prepared with the aim of providing student-centered curriculum materials for each curriculum so that students could obtain alternative textbooks other than textbooks which were sometimes difficult to obtain. , and make it easier for teachers to learn. In addition to the functions and objectives of the teaching materials above, teaching materials also have various benefits. According to the Ministry of National Education [8], if teachers can develop their own textbooks, there are many benefits, including ensuring that they meet the curriculum requirements and learning needs of learners who are no longer dependent on sometimes difficult textbooks. Teaching materials are enriched because various links can be used to enrich the knowledge and experience of teachers who develop and write teaching materials, and through teaching materials effective educational communication can be established between teachers and students.

Teaching materials

The development of learning materials is carried out with procedures of course in accordance with the development model set by the developer. The use of the development model is carried out systematically and in accordance with the theory to ensure the quality of the product development results of learning materials. The learning system design model can be classified into three groups. the division of the classification of the learning system model is based on the orientation of the use of the model, namely; (1) Classrooms oriented learning development model; (2) product-oriented learning development model (product oriented model); (3) The system-oriented learning development model (system-oriented model) [9].

METHOD

The development model used in the development of teaching materials is adapted from the Dick and Carey model [10]. The selection of this model was based on the consideration that this model was developed systematically with sequential steps in product development. The development model consists of three phases: pre-development phase 1, development phase 2, and post-development phase 3 as described in figure 1.

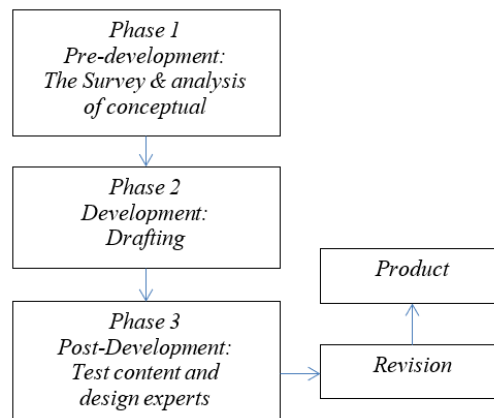


Figure 1. Development model adapted from Dick and Carey [11]

The stages of development in this teaching material consist of three stages, namely: **Phase I Pre-development**, survey and conceptual analysis; data on student learning outcomes for the 2019/2020 school year and a peer survey was carried out at the pre-development stage and conceptual analysis of the needs of SMKN 2 Lamongan students for the robotic system controller subject that underlies the development of robotic system controller teaching materials for students of SMKN 2 Lamongan class XI Industrial Electronics Engineering semester 1. **Phase II Draft development**, At this stage, the drafting of Robotic System Controller teaching materials for Class XI Semester I students is carried out, taking into account the following matters; (1) Title, (2) learning objectives, (2) learning materials, (3) practice questions and problem solving, (4) worksheets [12]. **Phase III Post-Development**, Product testing and experts; At this stage, conduct a formative evaluation by revising the development product with product trials which include responses from content experts, design experts and learning media, individual trials, small group trials and field tests. The test subjects in the development of teaching materials are:

1. Content or material expert is an Electrical Engineering Lecturer / colleague / MGMP who has a minimum qualification of master's level in the field of Electrical Engineering and has knowledge and skills in the field of controlling robotic systems.
2. Learning design experts are TEP/colleagues/MGMP lecturers who have a minimum qualification of S2 level, have broad knowledge and skills about learning design and have the ability to carry out assessments of learning development development.
3. Individual test represented by 3 students. Determination of the subject based on the criteria, one student represents a student with good ability, one student with moderate ability and one student with low ability. Then the researchers evaluated the students in turns.
4. Small group test represented by 6 students. Determination of subjects was carried out randomly representing each of the three participants' criteria which were included in the high, medium and low categories.
5. The field test was taken from students of one class, namely class XI Industrial Electronics Engineering on the grounds that the class category is a homogeneous class.

Data analysis

Analysis of the data used to process the results of the development are descriptive qualitative analysis and descriptive statistical analysis. Qualitative descriptive analysis was used to process data from questionnaires by content or material experts, design experts and questionnaires for students. The results of qualitative descriptive analysis are used as a reference for revising the product of

teaching materials in the form of the level of accuracy, effectiveness and attractiveness of the product or the results of development in the form of teaching materials.

This descriptive statistical analysis was used to process the data obtained through a questionnaire in the form of a descriptive percentage. The formula used to calculate the percentage of each subject is:

$$\text{Persentase} = \frac{\sum(\text{Answer} \times \text{Weight of each option})}{N \times \text{highest option}} \times 100\% \quad (1)$$

Note:

$\sum$ = Sum

N = The total number of item numbers

Furthermore, to calculate the percentage of the overall subject used

formula: Percentage = P/N X 100%

Note:

P= Total percentage of all subjects

N = Many subjects

To be able to give meaning to numbers and make decisions at the level of accuracy, feasibility and attractiveness, the conversion level scale of achievement is used as follows:

Table 1. Conversion of Achievement Levels with a 5 Scale

Achievement Level (%)	Qualification	Description
90-100	Very good	No revision needed
75-89	Good	No revision needed
65-74	Enough	Revision
55-64	Less	Revision
0-54	Very less	Revision

RESULTS AND DISCUSSION

From the results of the research which were analyzed descriptively qualitatively and descriptive statistical analysis showed that the results of the assessment of the content/material expert TEST the level of achievement of teaching materials 90% were in very good qualifications, the media expert TEST the level of achievement of teaching materials was 88.33% were in good qualifications, TEST Design experts, 90% of teaching materials attainment levels are in very good qualifications, Peer Tests 91.63% are in very good qualifications, so these teaching materials do not need to be revised. To follow up comments and suggestions from expert tests, individual tests, small group tests relating to teaching materials, revision of teaching materials is carried out. The written comments and suggestions of the expert test are taken into consideration to improve the teaching materials. From the results of individual trials, it can be seen that the average percentage of teaching materials is 92.44%, indicating that teaching materials are in very good qualification. , Field trials can be seen that the average percentage of teaching materials is 85.41% indicating that the teaching materials are in good qualification so that from a series of trials of these teaching materials there is no need to revise, only comments and suggestions from students as materials for improving these teaching materials.

CONCLUSION

This teaching material product has a different color from other teaching material products, even though they both use the Dick & Carey model. The resulting teaching materials will provide challenges for students to learn (challenge), not just receive information (reception). The existence of examples of questions that are equipped with solving methods is an explanation to make it easier for students to understand the content of the material. Experimental activities are also included in this teaching material with the aim of inviting students to better understand and understand the

content of the material. Independent assignments and competency tests are useful for measuring the extent of student competence in learning the content of the material.

The teaching materials in question are teaching materials that are systematically arranged so that they are easy to learn by students independently (self guided learning). Based on the results of a series of trials conducted, it can be seen the advantages and limitations of the development of teaching materials (1) The development of teaching materials for controlling robotic systems is designed based on the characteristics and needs of students, so that it is expected to increase students' ability to learn to control robotic systems, (2) This development uses the Dick & Carrey development model, (3) This development is only in the scope of SMKN 2 Lamongan which was developed based on the characteristics and learning needs of students, so the results cannot meet the needs outside of SMKN 2 Lamongan, (4) The research instrument used in This research is only suitable for this research in the form of a questionnaire. Based on data analysis from the content expert test, 90%. Based on the percentage of scores from the content/material expert test, this teaching material has very good qualifications and does not need to be revised.

The results of the learning design expert test on teaching materials are 90% indicating that these teaching materials are in very good qualification and do not need to be revised. From the results of individual trials using a questionnaire, the author got quite a lot of input and after being revised, it was continued with a small group test through a questionnaire. The average percentage obtained from the individual test is 92.44% indicating that this teaching material is in very good qualification and does not need revision, the small group test is 91.78%, indicating that the teaching material is in very good qualification and does not need revision. Field test obtained a percentage of 85.41% indicating that this teaching material is in good qualification and does not need revision.

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