DEVELOPING COMPUTER ASSISTED MEDIA OF PNEUMATIC SYSTEM LEARNING ORIENTED TO INDUSTRIAL DEMANDS

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ABSTRACT

This study aimed to develop learning media of pneumatic systems based on computer-assisted learning as an effort to improve the competence of students at the Department of Mechanical Engineering, Faculty of Engineering UNESA. The development method referred to the 4D model design of Thiagarajan comprising the steps of: define, design, develop, and desseminate. The results showed that the expert validation average score included in both categories was 3.54, indicating the learning application acceptable. A limited test showed effective results, namely: (a) Analysis of the data included in the category of learning was good (3.64), indicated by students' enthusiasm in the learning process; (b) Teaching learning activities were categorized as good, the students actively involved in learning, and the most dominant activity was doing tasks while discussing; (c) Learning objectives were both achieved individually and classically; (d) The students showed a positive response expressed by the students' interest, excitement, and motivation to follow the learning process.

Keywords: computer assisted learning, hydraulic pneumatic, learning media

INTRODUCTION

The rapid technological development of various production processes in the industrial world can not be adapted by educational and training institutions as the provider of labor. Recently, many advanced companies such as PT. Semen Gresik, PT. Campina, PT. Aqua, Pertamina, PT. Krakatau Steel and others apply an electrical pneumatic system to support the production process. This system has many advantages. It has simpe procedure process, easy operation, easy maintenance, and efficiency in supporting the production process. However, education and training institutions are not able to provide the same facilities with industry needs. This problem will be solved by making learning media in the form of a teaching module of computer-assisted pneumatic systems learning. This study is to answer the problems by developing computer assisted pneumatic system learning media. The expected results of this study were to bridge the competency of students in pneumatic system materials with the needs of industry which is growing rapidly. The rapid development of industrial technology and the qualification demands of the workforce in the industry will be a challenge for the educational or training institutions to always develop its learning pattern to produces qualified graduates. Referring from the development of industrial process technology in the industrial field, Mechanical Engineering Department of FT UNESA, especially in Pneumatic and Hydraulic subjects, pneumatic subject matter needs instructional media to meet the demands.

The challenge was the majority of students in Mechanical Engineering FE UNESA consider pneumatic system materials as one of the most challenging materials to foster. The lecture of Pneumatic and Hydraulic system was still dominated by the lecturer with the conventional method, in which students were passively received pictures of various types of pneumatic equipment without understanding how they work and their application in the real industrial production process. This caused the students depended on their own visualization on a pneumatic equipment in an industrial production process. The lack of learning media in pneumatic system is the main causative factor. Whereas the graduates majoring in Mechanical Engineering are required to know and understand about the pneumatic system as a provision to enter the industrialized world. Morrow and Irmawati (2013) analyzed that students have difficulty in mastering hydraulic and pneumatic systems because of the difficulty in envisioning or imagining movements of hydraulic and pneumatic system components. It was then fixed using Automation Studio applications to assist in the design of a wide range of automation, such as the combination of the hydraulic systems, pneumatic systems, electrical systems and PLC. The results showed that in general, students were greatly helped by the software.

The role of the learning media in the process of getting learning experiences for the student is very significant. It can be said that knowledge can be gained through direct experience and indirect experience. The more direct the object being studied, the more concrete knowledge acquired; and vice versa the more indirect the knowledge gained, the more abstract the knowledge obtained by the students.

Learning media developed in this study was a set of learning resources that improve student learning and learning activities. The function of learning media is to help and facilitate the lecturers in implementing the learning activities, as well as diversify the learning experience to the students in order to achieve the goals that have been set. The computer assisted learning strategy is a teaching strategy that emphasizes on the use of computers (computer based) and a learning tool (assisted learning) in teaching and learning. The use of computers as a learning medium is useful for learners to simulate the materials. The results of the computer simulation are later applied or applied to the learning media (assisted learning) that exist. So through learning strategies and computer assisted learning, it is easier for learners to understand the material and apply the concept of the material on teaching aids directly.

The purpose of this study is to develop computer assisted pneumatic systems learning media that is oriented to the needs of a growing industry an to assess its effectiveness based on the needs of the learning device, student activities, student response, and student learning completeness.

METHODS

The development of learning media in this study used a model 4-D (Thiagarajan, 1974) which consists of four stages, namely: (1) the definition phase, (2) the design stage; (3) the stage of development; (4) the stage of deployment. The subjects of this study were students of Mechanical Engineering, Faculty of Engineering, State University of Surabaya, who followed the course of learning Pneumatic and Hydraulic in the 2015/2016 academic year. In the pilot phase, it was used one group pretest-posttest design as follows:

$$\mathbf{O_1 \qquad X \qquad O_2} \qquad (1)$$

Notes :

O_1	=	*Pretest* (initial tests to determine the initial ability of the students)
X	=	The treatment (learning process using the developed media)
O_2 *Posttest*	=	(final test to determine the ability of a student after the treatment)

Data collection techniques in this study used observation, testing, and questionnaires. The type of data analysis used consisted of qualitative descriptive analysis, describing the data that have been collected from the students and lecturers during the learning process and the individuall and classical students' learning achievement.

RESULTS AND DISCUSSION

The development of this computer assisted pneumatic systems learning media was oriented to the industry demans. It consisted of teaching module equipped with pneumatic systems trainer kit.It was then validated before being used in the trials. The validation was carried out by expert lecturers. The assessors composed of experts of engineering, learning, and multimedia. This was conducted so that the developed learning application would be suitable to be used. A product can be categorized as quite good with a little revision if it get a score of $2.6 \leq SP \leq 3.5$ and it is said to be good without revision, if it achieves the average score of $3.6 \leq SP \leq 4.0$ (Ratumanan, 2003).

Based on the results of the assessment, it can be seen that the average score from three assessor was 3.54 which was included in the good category. Overall, it can be concluded that the developed media teaching module could be used with a little revision and feasible for use in the course of pneumatic and hydraulic. Observations of learning implementation were done by two observers. The observed aspects were preparation, opening, main activities, closing, time management, and the classroom atmosphere as shown in Figure 1.

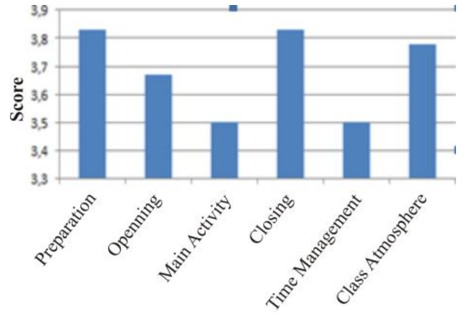

Figure 1. Learning implementation

Based on the observations, it showed that the average score of learning implementation was 3.64 categorized as good. Arikunto (2001) explains that each aspect that was observed with the average score in a range of 3.5 up to 4.00 is included in the good category. These results indicate that the lecturer has a good ability to manage the teaching and learning activities using developed learning media. The learning activities were observed by two randomly selected observers. The percentage of student activity and reliability of the instrument is presented in Table 1.

Table 1. Students' Activities

No	Observed Aspects	TLA (%)			Mean
		PI	P2	P3	
1	Listening/Paying attention to lectures	20.14	21.53	18.75	20.14
2	Reading modul	11.81	9.72	6.25	9.26
3	Relevant writings to TLA	14.58	15.97	9.72	13.43
4	Doing exercises while discussing	34.03	31.94	40.28	35.42
5	Asking questions	11.11	9.92	15.28	12.07
6	Making argument	8.33	11.11	9.72	9.72
7	Behavior that is not relevant to TLA (making jokes, noise, etc.)	0.00	0.00	0.00	0.00
	Total	100.00	100.00	100.00	100.00
	Reliability (%)	93.06	91.67	88.89	91.20

Learning activities in the form of listening or watching the lecturer's explanation, reading the module, and writing are the activites that should be done by student.The decision to use the learning activity in the form of doing tasks and discussions was based on the analysis of the concept. The activities of asking questions an expressing opinion is the the affective abilities already possessed by students that shoud be encouraged and developed. Behavior that was not relevant to the learning activities (making jokes, noises) indicated the degree of saturation or exhaustion of the students in participating the learning activities. It needed immediate action from the teacher so it will not distruct the learning process.

Table 1 shows that the most dominant student activities is doing tasks through discussion with an average percentage of 35.42% because the materials emphasize more on understanding the concept and its application so that students tend to conduct discussions in completing the tasks assigned by the lecturer. Doing tasks through discussion with peers gives students the opportunity to be more motivated to learn. The principle of learning as the direct involvement states that the knowledge will be more meaningful, last longer in the memory if they experience, observe, try, practice their own (Ratumanan, 2003). It is clear that the learning process with the direct learning model is a learning process which creates a learning environment that promotes direct experience and can lead to meaningful learning. It is also consistent with Vygotsky's theory that learners learn to handle tasks that are learned through interaction with adults or peers (Slavin, 1995). While the lowest student activity is behavior that is not relevant to learning with an average percentage of 0%.

The student in the limited test had a realibility average score of 91.20%. This means that the instrument was said to be reliable. Grinnell (1968) states that the instrument is reliable if the percentage value of reliability (R) obtained by ≥ 75%. The students' achievement in a limited test was measured using cognitive assessment sheet at each meeting in the form of cognitive achievement test. The assessment was based minimum standards in the Department of Mechanical Engineering FE Unesa. The students should achieve the mastery score of at least 60 or 60% to achieve the indiviual completeness while for classical completeness, it shoud between 60 and ≥ 85%. The achievement test in limited test products can be seen in Table 2.

A test was conducted to determine the extent to which learners can achieve the learning objectives. In this assessment, test is conducted twice: pretest (initial test) and post-test (final test) at each meeting. From the results of the initial test and the final test as shown in Table 2, it can be seen that the results of student learning increased. The average results of the initial test of 33.13 increased to 84.38. Based on Table 2, the average yielded limited test of learning activities and learning activities from 1 to 3 shows that in the pretest all the students did not pass while at posttest time all students pass. For the classical completeness pretest learning activities 1 through 3 learning activities amounted to 0% while the posttest was at 100%.

Efforts to improve learning outcomes in this course can be done by using repetitions independently by students and guided by lecturers. Ngadiyono (2009) stated that the students were pleased with repetitive approach. The level of cooperative skills of students could be good, because most of the students had the initiative share and discuss the completion of the task. Pneumatic skills of students who treated a higher repetition learning strategy in terms of retention and learning achievement are better than students who do not have learning strategy of repetition.

Table 2. Recapitulation of Student Achievement

No	Name	TLA **1**		TLA 2		TLA 3		Mean	
		U1	U2	U1	U2	U1	U2	**U1**	U2
1	Hari Cahyono (14050423002)	30	80	20	80	25	85	25.00	81.67
2	Budi Septi K (14050423005)	30	80	25	85	25	80	26.67	81.67
3	Arif Rahman (14050423006)	50	85	20	80	20	85	30.00	83.33
4	Hilman Dwi L (14050423010)	40	90	40	80	40	90	40.00	86.67
5	Yusron Tamami (14050423011)	30	80	40	90	30	90	33.33	86.67
6	Ahsani Taqwim (14050423014)	35	80	30	85	35	85	33.33	83.33
7	Ilman Syinnaqof (14050423017	45	80	40	80	35	85	40.00	81.67
8	Kukuh Uzia B (14050423019)	30	85	45	90	35	95	36.67	90.00
Mean		36.3	82.5	32.5	83.8	30.6	86.9	33.1	84.4
The number of students who passed		0	8	0	8	0	8	0	8
The number of students who did not pass		8	0	8	0	8	0	8	0
% Classical Completeness		0	100	0	100	0	100	0	100

Note:
TLA : Teaching Learning Activity
U1 : Pretest
U2 : Posttest

Learning tool is one factor that determines whether or not the learning objectives will be achieved. Good learning tools will determine the quality of learning. The development of learning media software conducted is in accordance with social learning theory and constructivism learning theory (Vygotsky, 1978). Social learning theory suggests that most people learn through observation and considering the behavior of others. While Vygotsky (1978) states that learning occurs through social interaction, through the help of a teacher or a capable colleagues, notable consultation or scaffolding that provides support for learning and problem solving. Supports could include instructions, warnings, and encouragement, detailing the problem into steps, giving examples, or other actions that allow the student to develop independently as learners.

Student responses indicate that most students are interested (87.5%) in the developed media in the course of Pneumatic and Hydraulic. The students who assess that the lecturer deliver the information clearly and guide the stuents appropriately were 75% and 87.5% respectively. The students showed a positive response towar the developed media inicated by 87.5% of the students feel happy and motivated to follow the course of Pneumatic and Hydraulic using the developed learning tools . In addition, 87.5% of the students found that the developed learning tools facilitated the understanding of the materials better.

The results of this study were also in line with the results of a study conducted by Kurniawan and Budijono (2013) regarding the development of mechatronics computer-based learning tools. The results showed that the implementation of computer-based mechatronic learning device could improve the quality of teaching and learning, because students showed positive responses, the implementation of learning and the students' learning outcomes of cognitive and psychomotor aspects have good category individually and classically.

CONCLUSION

The results showed that the development of the learning media: (1) had good validation with an average score of 3.54, making it feasible to use, (2) the application of the developed learning media in limited trials was effective, based on: (a) the enforceability of the data analysis of learning using the developed learning tools included in a good category (3.64), (b) the students actively engaged in the learning process., (c) the students achieved learning mastery individually and classically; (d) the students were interested, excited, and motivated to follow the lectures of Pneumatic and Hydraulic using the developed learning tools (87.5%).

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