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The Effectiveness of Simulator as Pneumatic Control System Learning Media

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***Abstract*—The purpose of this research is to know the effectivity of simulator as learning media of pneumatic control system. The research employed quasi-experiment method with pre and post-test design. The material is limited to sequential motion control using two actuators applied to the transfer of objects. Learning media training kit was used in controlled class while in the experimental class, simulator development results were applied. To measure students' ability in contriving circuit diagram to control electroplating product transfer, essay test was employed. The results showed that pneumatic simulator result of development and training kit was quite effective as a learning media for sequential motion controlling material. However, the statistical test showed no significant difference between the two groups, so it can be concluded that both the pneumatic simulator and the training kit for some extent have similar effectiveness to the result as learning media.**

Keywords—simulator; pneumatic control system; learning media

I. INTRODUCTION

Pneumatic Control System (PCS) is an air compression system for working and controlling media. The natural characteristics of air; availability, safety and environmental friendliness, easily storage and transport, make PCS as the main option in automatic industry, especially for foods, drinks, pharmacy, textile, oil and gas, and automotive. Theoretically, PCS is formed based on file main elements: media producing, input, processing, quality controlling, and working element. In developing PCS, those elements are represented by standardized symbols based on DIN ISO 1219 and DIN ISO 5599, "Circuit symbol for fluid equipment and system". Every symbol for every element has to identify a complex image covering its function, activating and deactivating method, number of holes, number of contact position, general working principal and simple image of signal current [1].

The difficulties to understand the concept which is abstract, complex and dynamic derives the issues in learning pneumatic system. Set of research done by the researcher Purnawan determines that the issues appeared as the standardized symbols used in theoretical model do not represent the realistic pneumatic concept quite well [2]. It indicates that the learning media which is being used does not optimally increase the learning result. This finding may point out that pneumatic learning has to be supported with practical learning as it might be able to integrate cognitive, affective and psychomotor skills to achieve students' better result.

The development of PCS learning media from abstract to concrete and affordable can be done with simulator. PCS simulator has better features compared to training kit pneumatic. From the quality and compatibility, PCS is more applicable, the component placement, especially actuator and censor are in the actual position, and activating censor is not only driven by actuator point. From the time effectiveness, PCS simulator reduces practical timing since some practicum steps: assembling and dissembling component from table plate can be skipped. In addition, the cost hopefully is cheaper.

II. THEORETICAL FOUNDATION

In General, teaching media is any kind of tools and media provided by learning facilitator to make learners learn. This definition conveys quite wide range of things, it covers learning tools and aids that can be in form of learning machines, film, audio cassette, video cassette, television and computer.

Meanwhile, Rowntree, Syaodih, N.S assembled learning media into five types named modes: interaksi insani, realita, pictorial, simbol tertulis and rekaman suara [3].

- Interaksi Insani (Human interaction). This media employs direct communication between people. It can be done verbal or non-verbal communication. Verbal communication works with students' cognitive development, while non-verbal with affective development.
- Realita (concrete). This media is concrete learning media like people, animals, things, events and any other things students may observe.
- Pictorial. This media shows images and concrete diagram or symbol, it can be motion or motionless images on paper, film, cassette, disk, and others. This media has lots of benefit as almost all shape, size, speed, things, creations, and events can be put inside it.
- Simbol tertulis (Written Symbols). This media is common media to serve information, but it is effective

enough. It can be text books, course books, learning program packages, modules, and magazines.

- Rekaman Suara (Voice recording). It can be used solitary or worked cooperatively with Pictorial media. Although without some pictures provided, the use of this media only is effective enough in teaching process.

As comparison, Dale stated there are 12 learning media or audio-visual aid named Cone of Experience. It is steps from abstract to concrete. The steps are (1) verbal symbol, (2) visual symbols, (3) signs, stick figures, (4) radio & recording, (5) still pictures, (6) educational television, (7) exhibits, (8) study trips, (9) demonstrations, (10) dramatized experiences; plays, puppets, role playing, (11) contrived experience: models, mock ups, simulation, and (12) direct purposeful experience.

Based on this cone of experience, the correlation between learning experience and types of learning media can be seen. The closer the media to concrete the better to increase learning experience. Thus, the development of learning media has to be as close as possible to concrete to get better students' learning experience. One of the indicator of students' learning experience excels better is less students' misconception to the given subject.

Pneumatic learning media development excels better time to time. The simplest learning media is standardized written symbol based on DIN ISO 1219 (Fluid power system and components; graphic symbol) and DIN ISO 5599 (Pneumatic fluid power; 5-port directional control valve mounting surface; general). Further, the media development to define mechanical concepts consecutively described as follow: (1) started with symbols, (2) made in working component image, (3) developed to 2D animated images, (4) manual motion 2D prototype, (5) 3D animation, (6) manual motion 3D prototype, (7) using concrete product.

Therefore, the developed learning media to describe the concept of structure system is consecutively as follow:

- Verbal symbolic media is drawn on the board and string lines to connect the channel manually. While the description is presented orally.
- Plastic/paper Symbolic media with magnet attached behind it. This media is attached to the magnetic board, and the string line is manually drawn. The description is presented by dragging the symbols.
- Computer based media. The symbols are stored in library menu. To use them, just copy the stored symbols from the library. The string line is drawn automatically by giving signs to every connected dot. The description is presented using computer through animation simulation. One of the examples for this media is Fluid SIM-P by Festo as the following pictures.

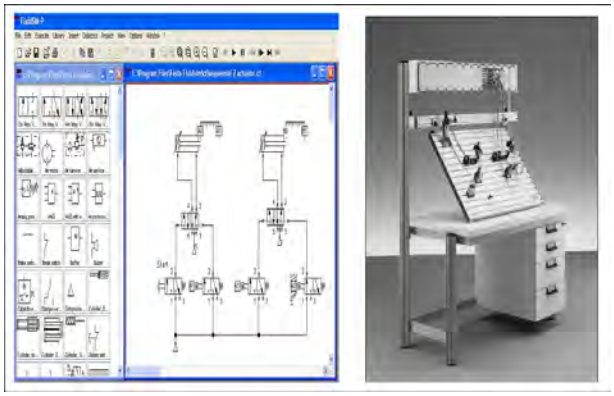

Fig. 1. Fluid SIM-P and training kit pneumatic image.

- Training Kit Media. This media uses concrete pneumatic components on a holed profile plate. Further, the profile plate and component mounting system is developed as figure 1. Working simulation can directly be observed.

The learning media 1 to 3 are comprehensive enough to learn theory focusing on cognitive aspects, yet not enough drill to psychomotor skills, particularly if the aim is to give real experience in real industry. Similar to it, Training Kit media is also comprehensive enough to learn pneumatic system, although based on the research some foibles appear; less portable, time consuming, showing not actual censor position and so on. Not only researcher Purnawan, another researcher also is developing the simulator. Ahyar employs pneumatic system media using PLC [4].

Based on the previous description of learning media, the importance of which to be connected to developing learning strategy is core to successful learning. In short, learning strategy is the application of delivering material, and learning media is a tool to effectively and efficiently delivering it to students. In a previous research PCS simulator has been assembled as learning media. This media is chosen as simulator is categorized to "realita (concrete)" and closer to direct purposeful experience.

III. METHODOLOGY

This research employs quasi-experimental method with pre and post-test design [5]. Before sequential controlling motion material was given to the both classes (experimental and control), pre-test had been conducted. The pre-test consists of essay question to plan a controlling system for two actuators of sequential pneumatic that is applied on electroplating transmitting tool. Whereas, in experiment class PCS simulator was used as learning media, and training kit pneumatic in control class. After the learning process finished, post test was conducted. Based on the pre and post test scores, the effectiveness of developed PCS media is taken to derive the conclusion.

The PCS design used and electroplating transmitting tool image as the test material are shown in the figure 2.

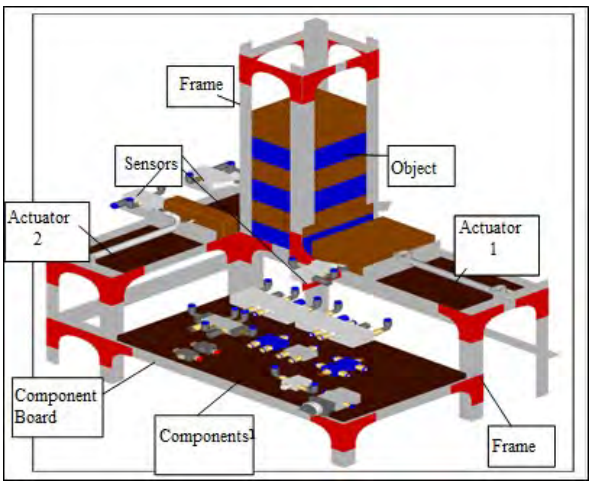

Fig. 2. Pneumatic simulator design.

IV. Result and Discussion

Pretest is used to identify the initiate respondents' ability in control and experimental class, while posttest is to identify both classes ability after the treatment. The data is shown in table 1. The sum of statistical test is shown in table 2.

TABLE I. Pre and Post Test Score, and N-Gain.

Class	Pre-test			Post test			N-gain	
	Highest Score	*Lowest Score*	*Average*	*Highest Score*	*Lowest Score*	*Average*	*Average*	*Varians (S^2)*
Experiment	83,4	7,9	36,4	91,7	30,6	66,4	0,44	0,1521
control	85,3	8,4	33,7	94,5	7,5	66,0	0,44	0,1225

TABLE II. Statistical Test Result

Data	Homogeneity test		Normalita test		Hypothesis test	
	P-Value	*Statement*	*P-Value*	*Statement*	*t-score*	*Statement*
Pre-test	0,095 > α 0,05	2 Classes Homogeny				
Post-test	0,092 > α 0,05	2 Classes Homogeny	0,4422 > 0,05	Normal		
			0,0953 > 0,05	Normal		
N-Gain	0,094 > α 0,05	2 Classes Homogeny	0,4183 > 0,05	Normal	t observe = 0 < t table = 1,675	Ho accepted HA rejected
			0,3813 > 0,05	Normal		

Based on the calculation, the initiate skills of respondent in experimental class is higher that control class before and after the treatment. Meanwhile, N-gain average for both experiment and control class is the same (0.44). After conducting F-test, both classes are homogeny with 5% degree of freedom. It falls to accepting Ho. It means that there is no significant difference between both classes statistically.

By using t-test to N-Gain, the result is tobserve = 0.0 for df= 50. And ttable = 1.675. since tobserve < ttable Ho is accepted and HA is rejected. It can be interpreted that there is no significant difference of the learning result for those respondents who used PCS simulator media compared to those who used training kit media.

PCS simulator is designed as a media to enhance the understanding of pneumatic control system plan. To build sequential motion pneumatic control system is quite difficult to be learned theoretically without simulation, as stated by Robert that simulation model is commonly one of learning strategy to offer concrete learning experience through mimicking the actual experience [6]. Arsyad agreed that the result of study is gained by concrete experience, real environment and then through model to verbal symbol or abstract [7].

With no significant different for the class employing PCS simulator and for the class employing training kit as media indicates that both media have relatively similar effectiveness as learning media. The result is also supported by the average data of N-gain scores of both classes that fall in mid category. As the result both mediums are effective enough to enhance students' skill.

However, PCS simulator has more efficient in time allotment. As during the application, students are only required to connect the line to the correspondent components based on prepared circuit diagram. Meanwhile, in using training kit, students have to choose the component, applied to the given table, and assemble them. The result of the research as in line with Ngantao research, that conclude the use of pneumatic based simulator as learning media allow positive input to hydraulic pneumatic learning quality [8].

The result of this research is proven that PCS simulator can be an alternative learning media in sequential motion control material. By enhancement and development of the research, it is hoped that students' test results are increasing.

V. CONCLUSION

Some conclusions from the research are as follow:

- Both classes average felt in mid category.
- PCS simulator media and pneumatic training kit are effective enough to be used as learning media in sequential motion control material.
- The PCS simulator media which has been developed is not superior to pneumatic training kit as learning media to control sequential motion.

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