

The Implementation of Integrated Courseware Pneumatic Valve to Improve Student's Learning Outcome in Vocational Schools

Purnawan¹, Haryadi¹, Sumarto², Wahyudin³, W. Munawar¹

¹Department of Mechanical Engineering Education, Faculty of Technical and Vocational Education

²Department of Electrical Engineering Education, Faculty of Technical and Vocational Education

³Department of Mathematic Education, Faculty of Mathematic and Science Education

Universitas Pendidikan Indonesia, Bandung, Indonesia

purnawan@upi.edu

Abstract— The aim of this research was to get empirical experience of the application of Integrated Course Ware (ICW) Pneumatic Valve in Vocational Schools. Quasi-experimental method with non-equivalent control group design was employed. In addition, 330 students from four different vocational schools were involved as sample. The result of this research showed that the implementation of ICW Pneumatic Valves was empirically effective in improving learning outcomes. It able to improve student learning outcomes on average by 45%. Likewise, the best result was gathered to be applied as the following orders: Presentation media, Printed media, Interactive media. Hence, as a presentation media, ICW was able to improve student learning outcomes on average by 50% and it best to be used in for these consecutive programs: Mechanical Controlling, Mechatronics, Aircraft Technology and Machinery Engineering.

Keywords: ICW, pneumatic, vocational

I. INTRODUCTION

Pneumatic Control System (PCS) is controlling and working media systems which employ air. The natural characteristics of air; availability, environmental friendliness, cleanliness, easily stored and transported, consents air as the best media to be used. As the consequences, to improve the quality of human resources in PCS, some efforts are being made through both formal and non-formal education and training. In formal education and training, PCS is learnt in vocational school (SMK), particularly in industrial engineering to certain programs, such as mechatronics, mechanical controlling, automotive, aircraft technology, mechanical engineering and else.

The PCS learning objective is to train students to have ability in designing, implementing, maintaining and repairing its systems. To effectively and efficiently design the system, basic knowledge of PCS elements: media producing element, controllers and actuators has to be acquired. Those three elements are represented in standardized symbols based on Deutsches Institut für Normung (DIN) International Organization for Standardization (ISO) 1219 and DIN ISO 5599, "Circuit symbol for fluid equipment and system". Croser (1994:34) stated that each symbol has to characterize a complex features including its functions, activate and deactivate methods,

number of holes, number of position, general working principles and simple overview of the signal flow.

The graphical symbols usage with verbal explanation causes boundaries in learning process. Students are difficult to understand the abstract, complex and dynamic concept represented in symbols. Based on the research (Purnawan: 2006) those verbal standardized symbols theoretically are not adequate to represent real concept of pneumatic system; thus, it is inaccessible to students. It causes less learning experience.

Furthermore, research related to the development and the application of multimedia in computer assisted learning has been done by lot of researchers. Surjono (1995: 96) developed CAI for electronical engineering learning. Idris (2008: 48) developed multimedia PBK in Technology of Multimedia Education. Nuryanto et al (2011) developed Problem Based Learning with PBK in Measuring (a subject) for vocational school students. Munadi et al (2007) developed a computer assisted contextual constructivist learning module in Machining (a subject). Taufik (2010) defined that the result mean of PBK using Mastercam software was considered higher than those who used EDV 754 and conventional learning method in CNC Milling programme.

Meanwhile, relevant research conducted abroad has been done by Bayraktar, S. (2001), Camnalbur, M. & Erdoğan, Y. (2008), Domagk, S., Schwartz, R.N. & Plass, J.L. (2010), Sosa, G.W. et al.(2011), and others. In course ware interactive multimedia designed by Zhang et al (2001) showed that multimedia learning might be integrated with the traditional one to increase the flexibility and interativity in multimedia teaching. The design process of interactive multimedia course ware has been presented, its structure has been analyzed and discussed, the policy and realization have also been presented. In further due, two-way interaction in teaching process needs to be comprehened more, so this modern learning method might create better learning outcome.

Boucher et al. (1999) stated that the use of traditional lecturing method was as effective as CAI when both were used as methodology to teach some material related to TMJ (biomechanics). However, Basturk (2005) argued with quasi-experimental design, proven that higher score average of midterm and final examinations were performed by sample

taught with Lecture-plus-CAI compared to the normal lecture. The result of the research shows, for some extend, varsities' ability employing CAI regularly in introductory statistic subject is enhanced. In addition, Sosa et al (2001) believed from 45 experimental studies with controlled condition, the instruction using statistical computer gave significant advantages ($d=0.33$).

Research about the effectivity of computer assisted was also employed through meta-analysis. Bayraktar,S. (2001), proved that the implementation of CAI gave effect size 0.273. He also argued that CAI effectivity was positively correlated to the ratio between students and computer, CAI mode and time. Moreover, Cannalbur and Erdogan (2008) compared the effectivity of instruction assisted with computer to traditional lecturing using quantitative research. The result showed that measurement effect of learning method assisted by computer toward academic achievement is 1.048. The measurement was considered high (Thalheimer and Cook, Cohen, Welkowitz and Ewen, 2000).

In pneumatic field, Triyono (2008:1) summarized: (1) varsities pneumatic ability taught though complete strategy is higher compared to demonstration only, (2) varsities with high-analytical ability taught through complete strategy tend to have higher ability than those through demonstration strategy, (3) varsities with low-analytical ability taught through demonstration tend to have higher ability than those through complete strategy (4) interaction between learning strategy and analytical ability toward pneumatic occurs. Purnawan et al (2013: 206) argued that in semi-individual learning setting, the outcome enhancement of students using separated animated media and printed media is lower than students taught through printed media only in classical learning setting. Hidayah, N and Hasbullah (2014:56) stated that the use of interactive multimedia as learning aid provided positive result in which students reaching minimum middle category are 83% of samples.

While in this study, ICW equipped with interactive evaluation can be implemented in different functions is as interactive media, media presentations, and print media. As an interactive medium, ICW is the teaching material that is applied to the independent student learning using computer assistance. As media presentations and print media, ICW is a teaching aid for teachers who applied to classical learning. The application as a presentation medium using computer assistance and projectors, while the application ICW as prinedt media is packaged in a module.

II. RESEARCH METHOD

Quasi-experimental method with non-equivalent control group design was applied. First variation function applies ICW pneumatic valve in learning as presentation media, interactive media and printed media. Second variation is the diversity of programs: Aircraft Technology, Mechanical controlling, Mechatronic and Mechanical Engineering. In general, the design of the study are shown in Table 1 and table 2 as follows.

TABLE I. RESEARCH DESIGN THE APPLICATION OF ICW ON DIFFERENT FUNCTIONS

Group	Pre test	Implementation ICW as :	Posttest
E ₁	√	Interactive media	√
E ₂	√	Presentation media	√
E ₃	√	Printed media	√

TABLE II. RESEARCH DESIGN THE APPLICATION OF ICW AS A PRESENTATION MEDIA ON DIFFERENT EXPERTISE PROGRAM

Group	Expertise program	Pre test	Implementatio n ICW as :	Posttest
E ₁	Aircraft Technology	√	Presentation media	√
E ₂	Mechanical Controlling	√		√
E ₃	Mechatronic	√		√
E ₄	Machinery Engineering	√		√

The enhancement outcome was measured by calculating the result of the instruments (pre-test and post-test). The instruments were self-complied. They consist of 40 multiple choices questions with 5 options. Every number of the instrument had been validated with 0.86 reliability. They were categorized high with normal distribution for index of difficulty, although it tends to difficult level. In addition, distinguish-level was also normally distributed toward good level.

Scores of pre-test and post-test, also N-Gain were used to be analysed. In detail, pre-test scores analysed respondent prior-knowledge of symbol and operational ways of pneumatic valve. Meanwhile, score of post-test analysed respondents' ability after the experiment. N-gain showed the enhancement of outcome scores. N-gain score, based on Hake (1998), was formulated by subtracting post-test scores by pre-test scores and divided by maximum score in which subtracted by pre-test score. And the criterion is <0.3; between 0.3 to 0.7; and >0.7 for low, mid and high consecutively.

Statcal Pagage for Social Sciene (SPSS) 16 was used to process and analyse the data. Two to four group of different data were compared to measure the test using one way Anova K independent samples test.

III. FINDING AND DISCUSSION

A. Different Application of ICW

This test aimed to identify different result of learning outcome caused by different operations of ICW pneumatic valve. This test also identified which operations resulting highest learning outcome. The result of this test is provided in the graph 1. It shows that the use of ICW as presentation media to learn pneumatic valve gets highest average learning outcome. While the use of ICW as printed media becomes the seconds higher followed by ICW as interactive media.

ANOVA test shows that $F_h (26,927) > F_t (2; 186; 0,05) (3,00)$, so it means that H₀ is rejected. Those three groups have different enhancement averages as the learning outcome. It can be concluded that there are significant different of learning outcome enhancement in learning pneumatic valve between the group using ICW as presentation media, interactive media and printed media. The implementation of ICW pneumatic valve as presentation media assumes to have effect to the highest enhancement of learning outcome compared to other media implementation.

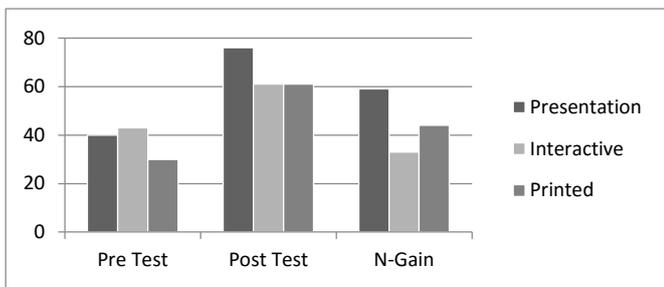


Fig. 1. Different average result of ICW for different function

B. The implementation of ICW as presentation media to different programs

This test aimed to identify different result of ICW as presentation media toward students' learning outcome of different programs. The result is provided in Graph 2.

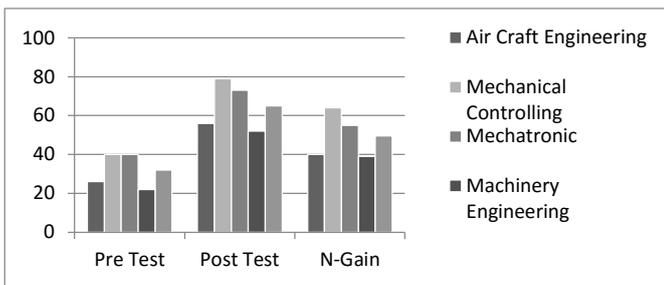


Fig. 2. The different average of ICW implementation toward different programs in vocational school

It is proven that different N-gain for different programs in vocational school sequentially from the highest to the lowest; Mechanical Controlling, Mechatronic, Aircraft Technology and Mechanical Engineering. Based on N-gain, the enhancement average of learning outcome for those four programs are in mid-category ($0.30 < 0.50 < 0.70$)

Meanwhile, ANOVA testing shows that $F_h(22,090) > F_t(3; 125; 0,05)(2,68)$, so H_0 is rejected. It is proven that those four different programs enhance differently in terms of learning outcome average. It can be concluded that the implementation of ICW pneumatic valve as presentation media affects differently to each different program in vocational school. Through Multiple Comparisons Tamhane, it shows that different range of average from the biggest to the smallest consecutively: Mechanical Controlling, Mechatronic, Aircraft Technology, and Mechanical Engineering. It might be taken as conclusion that the implementation of ICW pneumatic valve as presentation media affects the enhancement of learning outcome of different programs. The most enhancing program is Mechanical Controlling, and consecutively followed by Mechatronic, Aircraft Technology and Mechanical Engineering.

IV. RESEARCH DISCUSSION

Learning achievement presenting as learning outcome is very much depended to its learning process. Undeniably, the decent learning process produces decent learning outcome, and vice versa. Learning process plays as a communication process (Sadiman, 2008) is an interaction between human and learning

material to gain positive changes moderately. The quality of interaction affects unswervingly to the information quality from its learning material in which it is observed by the brain resulting a chance. The interaction quality is surely affected by, especially, not only by the quality of sensor but also the connection between new knowledge and the prior knowledge along with its noise/barrier. Since they are intrinsic factors, in learning circumstance, to increase the quality can only be done by moderating noise/barrier using teaching aids. The appropriate teaching aid for the certain contexts theoretically and empirically has a higher chance to increase learning experience, so the probability to achieve the learning goal is also higher.

The research results showed that the application of computer-assisted animation media in the learning process better than the application it as the print media. It has become common knowledge and in accordance with the results of previous studies. But learning patterns with the application of animation media was also affecting a significant increase in learning outcomes. Studied at vocational schools, an increase of higher learning results obtained when applying animation media as a media presentation in classical learning settings than apply it as interactive media in independent learning setting. This indicates that the computer assisted learning in vocational schools, media animation is more effective if it functioned as a learning aids. While it is a source of learning still comes from the teacher. It also shows that vocational school students learning independence still needs to be improved.

Learning pneumatic valve using developed ICW is one of multimedia learning aid. It includes text, graph, picture and animation. The implementation of ICW as presentation media has more benefit compared as printed media. Some of its benefit is by providing various colour for each valves. Moreover the animated operational of pneumatic valves is also provided. This ICW presentation media entrances students to learn; it gives students a new model of learning that motivates them. By which, this media offers concrete operational process of the valves, it gives students broad experience related to it. These benefits of ICW as presentation media gives higher learning outcome compared to ICW applied as printed media.

Based on the research finding, it can be concluded that ICW pneumatic valves has achieved the expectation. This ICW can be applied as presentation media, printed media and interactive media. The various implementation of ICW pneumatic valves have been proven that they increase the learning outcome. It can be said that this ICW learning media is considered effective. Several research toward the implementation of this product to different learning setting enriches empirical finding, especially to computer assisted learning and its effects.

The implementation of ICW pneumatic valve has to be adjusted with the supported facilities of the school/education institution where this ICW is employed. The use as presentation media is highly recommended compared to its implementation as printed media or even interactive media. It has several benefits compared to the others.

Several benefits of implementing this media are: firstly, the sufficient facilities in every school/institution to implement this computer assisted media as teaching aid; secondly, the use of computer as teaching aid has relatively been applied for quite

some time in most schools, so long term adaptation is not needed, schools/education institution just need to keep using it as habit and to keep improving its quality; thirdly, computer literate, particularly its implementation in Computer Aided Learning (CAL) for teachers and students, can be relatively considered good, as the result, the implementation of this ICW Pneumatic valves as presentation media is going to enrich teachers' and students' experience in CAL. Undoubtedly, this experience enrichment in CAL will increase the quality of process and result of learning; fourthly, the source of information in this learning process changes into multi resources: teacher and ICW pneumatic valve, also other media. By having two resources or more, when the delivered information is similar, it strengthens. Because of that, the quality of information received by students is more valid so it braces students' concept of learning and also their learning outcome. To synchronize the information, teachers need to learn in advance about the delivered material in ICW before learning process is held; fifthly, teachers can directly explain the pneumatic valve material and can evaluate it without explaining how to use ICW beforehand, so effective learning process is achieved; sixthly, the implementation of ICW pneumatic valve as presentation media costs relatively inexpensive. In class learning only requires one computer and a projector, the electricity for both computer and projector and fixed cost CD with ICW pneumatic valve plus the teacher. With the offered benefits, it is not only the quality of learning process and learning outcome will increase, but also it increases a chance of having inexpensive pneumatic learning for the society. As the consequences, it is hoped that the human resource, especially in pneumatic learning, with higher acceleration can be achieved.

V. CONCLUSION

Based on the data analysis and discussion toward the research aims, some conclusions are found:

1. The implementation of ICW pneumatic valve with different functions in vocational school affects different average enhancement toward learning outcome in which the result from the highest to the lowest is preserved as following: as presentation media, as printed media and as interactive media.

2. The implementation of ICW pneumatic valve as presentation media in different vocational school programs resulting enhancement in moderate category, although their enhancement average is different. The enhancement from different programs is as follow, from the highest to the lowest: Mechanical Controlling, Mechatronic, Aircraft Technology and Mechanical Engineering.

REFERENCES

- [1] Basturk, R., (2005). The effectiveness of computer-assisted instruction in teaching introductory statistics. *EDUCATIONAL TECHNOLOGY & SOCIETY*, 8(2), pp.170–178.
- [2] Bayraktar, S., (2001). A Meta-analysis of the Effectiveness of Computer-Assisted Instruction in Science Education. *Journal of Research on Technology in Education*, 34(2), pp.173–188. Available at: <http://library.oum.edu.my/oumlib/ezproxylogin> [July 1st 2015]
- [3] Boucher, B., Hunter, D. & Henry, J., 1999. The effectiveness of computer-assisted instruction in teaching biomechanics of the temporomandibular joint. *Journal of Physical Therapy Education*, 13(2), pp.47–51. Available at: <http://search.ebscohost.com/login.aspx?direct> [July 1st 2015]
- [4] Camnalbur, M. & Erdoğan, Y., (2008). A meta analysis on the effectiveness of computer-assisted instruction: Turkey sample. *Kuram ve Uygulamada Eğitim Bilimleri*, 8(2), pp.497–505.
- [5] Croser, P. (1989). *Pneumatic Basic Level TP 101, D-7300 Esslingen :Festo Didactic*
- [6] Hake, Richard R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses.[Online]. Tersedia: www.physics.indiana.edu/~sdi/ajpv3i.pdf [June 2nd 2012).
- [7] Hidayah, N. &Hasbullah. (2014). “Upaya Peningkatan Pemahaman Siswa Terhadap Prinsip Kerja Pneumatik Berbantuan Perangkat Lunak Multimedia”. *Jurnal Pendidikan Teknologi Kejuruan: INVOTEC*, 10, (1), 47-56.
- [8] Idris, H. (2008). “Pengembangan Multimedia Pembelajaran Berbantuan Komputer”. [Online], Tersedia: <https://jurnaliqro.files.wordpress.com/2008/08/05-husni-48-57-final.pdf> [Agustus, 20, 2013]
- [9] Munadi, S. (2007). Pengembangan Modul Pembelajaran Konstruktivistik Kontekstual Berbantuan Komputer (Modul Elektronik) Dalam Matadiklat Pemesinan. [Online]. Tersedia: http://eprints.uny.ac.id/4020/1/Sudji_Munadi.pdf [September, 12, 2013]
- [10] Nuryanto,A., Wagiran, dan Purnomo.E. (2009). Pengembangan Pembelajaran Model Problem Based Learning Dengan Media Pembelajaran Berbantuan Komputer Dalam Matadiklat Measuring Bagi Siswa SMK.[Online]. Tersedia: staff.uny.ac.id/.../Apri%20Nuryanto [September, 12, 2013]
- [11] Purnawan. (2006). “Desain Model Komponen Pneumatik untuk Media Pembelajaran Mekanisme Komponen Pneumatik”, *Jurnal INVOTEC*, Vol.3, (2), 157 – 164.
- [12] Purnawan, Permana, E., Ristianoro. (2013). “The Implementation Of Animation As A Mechanism of Pneumatics Component Learning Media”, *Proceeding of the 2 ndUPI International Conference on Technical and Vocational Education and Training*, Vol.2, (1), 202-207.
- [13] Sadiman, A.S. et.al. (2008). *Media Pendidikan: Pengertian, Pengembangan, dan Pemanfaatannya*. Jakarta : Raja Grafindo Persada.
- [14] Sosa, G.W. et al., 2011. Effectiveness of Computer-Assisted Instruction in Statistics: A Meta-Analysis. *Review of Educational Research*, 81(1), pp.97–128.
- [15] Surjono, H. (1995). “Pengembangan Computer-Assisted Instruction (CAI) untuk Pembelajaran Elektronika”.*Jurnal Kependidikan*. [Online], Vol. 25, (2), 95-106. Tersedia: <http://eprints.uny.ac.id/6317/> [August, 20, 2013]
- [16] Taufik, M. (2010). Pengaruh Pembelajaran Berbantuan Komputer Menggunakan Software CAD/CAM dan Motivasi Berprestasi terhadap Hasil Belajar Memprogram Mesin Frais CNC.*Jurnal Teknologi dan Kejuruan*,[Online], Vol.33, (1), 29-42. Tersedia: <http://karya-ilmiah.um.ac.id>. [August,20, 2013].
- [17] Triyono, M.B. (2008). “Pengaruh Strategi Pembelajaran dan Kemampuan Analitik Terhadap Keterampilan Pneumatik Mahasiswa Teknik Mesin UNY”. *Jurnal Penelitian dan Evaluasi Pendidikan*. [Online], Vol. 9,(1), 1-10. Tersedia: [http://repository .ui.ac.id/dokumen/lihat/5705.pdf](http://repository.ui.ac.id/dokumen/lihat/5705.pdf) [August,20, 2013]
- [18] Zhang, Z. et al., (2011). The exploration of key technology about interactive multimedia courseware design. In 2011 International Conference on Multimedia Technology, ICMT 2011. pp. 838–844.