

Effectiveness the use of Virtual Laboratories in Improving Vocational Competence and Character Behavior for Students Vocational High School in Makassar

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Abstract

The purpose of this research was to determine the effectiveness of the use of virtual laboratories in improving vocational competence and character behavior for vocational high school students in Makassar. Design of virtual laboratory carried on in the Computer Laboratory of the Department of Electronic Engineering Education, Faculty of Engineering, Makassar State University in May-June, 2015. Testing was done twice at the small group trial consisted of 10 students of State Vocational High School 2 Makassar and testing of large groups of as many as 135 students consisting of 3 Vocational High School that is State Vocational High School 2 Makassar, State Vocational High School 1 South Sulawesi, and Private Vocational High School Muhammadiyah 2 in Makassar at July-September, 2015. This process is integrated in a virtual laboratory development model adapted to the elements of character development in practical activities. The results of this research are:

- a) an assessment of the fifth aspect consists of the aspect content/material, practical design aspects, aspects of the display (audio-visual), Aspects of Virtual and programming aspects obtained very good results;
- b) there are significant differences in learning outcomes of students who take a virtual laboratory-based practical learning with the learning outcomes of students who take conventional learning. Learning outcomes by using virtual labs is better, especially in the implementation of practical activities to meet the increasing needs and cognitive skills of students and keep students in understanding an abstract and complex;
- c) virtual laboratory practicum media can facilitate character education vocational high school students.

Keywords: virtual laboratory, character education

Introduction

The development of education are now entering an era marked by incessant technological innovation, so it requires alignment of education system in tune with the demands of the working world. Vocational High School is designed to prepare students or students who are ready to enter the world of work and are able to develop a professional attitude in the field of vocational and should be able to provide competencies or skills that can improve the quality of graduates to achieve success.

Success by vocational high school is not separated from the process of learning and practicum process (Yogaswara, 2011: 1) (15). Some subjects practicum in addition to having to know the basic concepts and theories supporting, also need to do experiments / trials in the laboratory to understand a particular concept or the basic theories that have been studied in order to have a broader understanding level. To carry out a practicum will require several factors, including laboratory space in accordance with the subjects practices, facilities and equipment, and a complete practice material. Djamarah & Zain (2002: 95) (2) gives the sense that the methods practicum is a learning process in which of students perform and experience it yourself, follow the process, observe objects, analyze, demonstrate and draw conclusions of an object, situation and process of the material being studied.

Vocational teaching and learning practices, good laboratory practices and workshop are characteristic of teaching and learning in vocational schools, in addition to learning theory. The role of the laboratory is very important because it is ideally equipped for experimental studies in science or for testing and analysis; place provides an opportunity to experiment, observation, or practice in the field of study (Sumadji 2003: 43) (12). Based on the shape of this laboratory is divided into two (2) types of the laboratory of real and virtual laboratory (Jaya, 2010) (4). A virtual laboratory is a device using computerized models and simulations and is also one form of learning technology that allows it to replace face to face laboratory activities. (Rebecca, 2003: 235) (10).

Reality on the ground after observing found that there are many CMS that has the equipment and materials practice are minimal, there are even schools that do not have a laboratory space, so that the lab process is not running optimally. Hope students are gaining knowledge and experience of the study results, while the teachers' expectations are practical achievement of the learning process towards changing the cognitive, psychomotor, and major changes in the character of students. Schwartz (2005) (13) suggested that character education is often used to refer to how one becomes "good" that is, those who demonstrate personal qualities desired in accordance with the community. Based on the purpose of education that education makes citizens have good character and develop personal qualities. Meanwhile, according to Thomas Lickona, is a character education is a deliberate attempt to help people understand, care about and act upon core ethical values. In his landmark book "Educating for Character", Lickona (1993: 24) (6) asserts that: "When we think about the kind of character we want for our children, it's clear that we want them to be able to judge what is right,

care deeply about what is right, and then do what they believe to be right—even in the face of pressure from without and temptation from within.” From these statements indicate that the process involving the development of knowledge, feelings, and actions, thus will providing an integrated basis. So we have to engage with children in activities that make them think critically, about morality and ethics, inspiring them to be committed to moral and ethical action, and give them plenty of opportunity to practice the moral and ethical behavior. To overcome these problems, so in this study will be developed based virtual lab models by utilizing the computer as a means of animation and 3-dimensional simulations. Therefore the purpose of of this research is to develop a model based virtual lab (Virtual laboratory) in Improving learning outcomes facilitate character education practicum and vocational students.

Research Methods

Design of virtual laboratory carried on in the Computer Laboratory of the Department of Electronic Engineering Education, Faculty of Engineering, Makassar State University in May-June, 2015. Testing was done twice at the small group trial consisted of 10 students of State Vocational High School 2 Makassar and testing of large groups of as many as 135 students consisting of 3 Vocational High School that is State Vocational High School 2 Makassar, State Vocational High School 1 South Sulawesi, and Private Vocational High School Muhammadiyah 2 in Makassar at July-September, 2015.

Virtual Laboratory consists of several parts: video tutorials, simulations, lab module and lab worksheets. Practicum virtual-based practice is a learning model that emphasizes the three-dimensional visual effects. Virtual-based media production using the software with the help authoring language (Duarte, 2001: 3) (3) and high-level programming language such as Macromedia Flash, and 3ds max. This process is integrated in a virtual laboratory development model adapted to the elements of character development in practical activities.

A description of student learning outcomes after using Virtual Laboratory done by experimental research. The results of student learning is the value pretest and posttest to the subject of logic gates, on the subjects of digital electronics class X Semester 2 at the vocational high school level. Student and teacher responses to the virtual laboratory collected through questionnaires. Further assessment of character behavior and social skills were collected through questionnaires and observations.

Research Results

Field Testing on Vocational High School of students in Makassar

Collecting data on field testing was done using an instrument in the form of an evaluation sheet, and for observation (observation) using an instrument that has been provided, it is done to obtain data about shortcomings and weaknesses or errors that may be contained in the Virtual Laboratory (Figure 1).

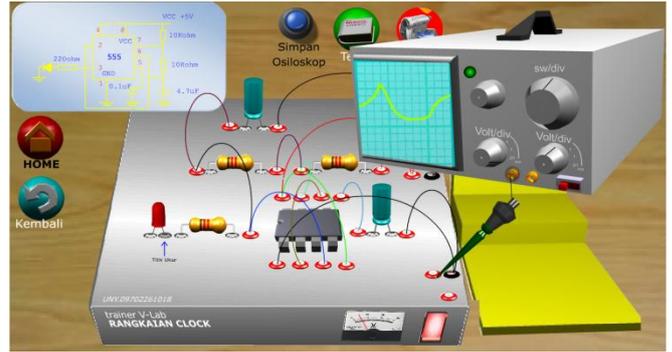


Figure 1: Display Virtual Laboratory

Based on the results of field testing of three vocational high school (State Vocational High School1, State Vocational High School2, and Private Vocational High School Muhammadiyah 2) in Makassar as many as 135 students for every aspect in virtual laboratories, a summary of the test results are presented in Table 1.

Table 1: Field Testing Results at 3 Vocational High School

Aspects Assessed	The Average score of assessment			Average	Category
	State Vocational High School2	State Vocational High School1	Private Vocational High School Muhammadiyah 2		
The content/material aspect	4, 32	4, 62	4, 29	4, 41	Very Good
The practical design aspects	4, 32	4, 41	4, 14	4, 28	Very Good
The display (audio-visual) aspects	4, 32	4, 41	4, 14	4, 28	Very Good
The Virtual Aspects	4, 37	4, 57	4, 26	4, 38	Very Good
The programming aspects	4, 41	4, 59	4, 33	4, 40	Very Good

The data in Table 1 shows the results of the assessment with a mean score very well on the five aspects of assessment indicators consisting of aspects of content/material (mean score of 4.41), the design aspects of lab (mean score of 4.28), aspect display audio/visual (mean score of 4.28), the virtual aspect (mean score of 4.38), and the programming aspects (mean score of 4.40).

Implementation Experiments

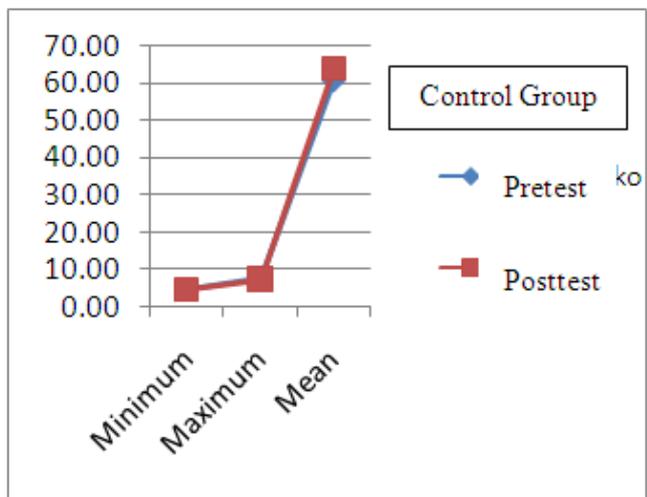
Learning Outcomes Results of Control and Experiment Group

The learning outcomes of student is the value pretest and posttest to the subject of logic gates, on the subjects of digital electronics class X Semester 2 at the vocational high school as many as 25 students. Recapitulation and brief description of student learning outcomes in control and experiment group are presented in Table 2.

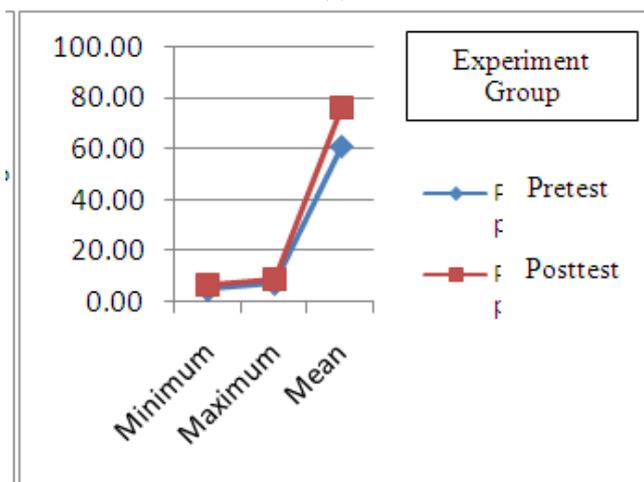
Table 2: Learning Outcomes of Student in Control and Experiment Grop

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Control Pretest	25	4, 50	7, 50	6, 0720	, 77164
Control Posttest	25	4, 70	7, 50	6, 3760	, 67840
Experiment Pretest	25	4, 70	7, 10	6, 0960	, 73114
Experiment Posttest	25	6, 30	8, 70	7, 6200	, 58808
Valid N (listwise)	25				

From Table 2 can be described that the average pretest score obtained control group 6:07, while the average posttest is 6.37. On average pretest the experimental group is 6.09, while the average posttest is 7.62. Differences in the value pretest and posttest control and experiment group can be performed as illustrated in Figure 2 below:



(a)



(b)

Figure 2: (a) The difference in the value pretest to posttest control group; (b) The difference in value pretest to posttest in Experiments group

From Figures 2a and 2b, a class that uses virtual laboratory with the use of conventional learning seems to experience the difference in average increase in posttest.

Research Hypothesis before being given treatment

Hypothesis testing is done by examining the difference in average value pretest control and experimental group. For implementing the test, the analysis prerequisites that must be met is the normal distribution of data and homogeneous. Pretest data normality test results with Kolmogorof-Smirnoff test in SPSS are presented in Table 3.

Table 3: Data Normality Test Pre Test (One-Sample Kolmogorov-Smirnov Test)

		Pretest of Control Group	Pretest of Experiment Group
N		25	25
Normal Parameters ^{a, b}	Mean	6, 0720	6, 0960
	Std. Deviation	, 77164	, 73114
Most Extreme Differences	Absolute	, 176	, 210
	Positive	, 081	, 093
	Negative	-, 176	-, 210
Kolmogorov-Smirnov Z		, 881	1, 049
Asymp. Sig. (2-tailed)		, 420	, 221

a. Test distribution is Normal.

b. Calculated from data.

From Table 3 it is known that the value Asymp. Sig. (2-tailed) pretest control group and experimental class is 0.420 and 0.221. This value is greater than the prescribed α is 0.05 so that the data are expressed in normal distribution.

Table 4: Test Results Difference Value pretest (Paired Samples Test)

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Paired Sample 1	Pretest of Control group	-, 0240	, 20672	, 04134	-, 10933	, 06133	-, 580	2, 567	
	Pretest of Experiment group								

From the test results as shown in Table 4 was obtained price sig (2-tailed) of 0.567 is greater than the prescribed α is 0.05. Thus, H_0 accepted and H_1 rejected. Meaning, there was no

significant difference in learning outcomes of student at control and experiment group before being given treatment.

Research Hypothesis after being given treatment

Hypothesis testing is done by examining the difference in average value posttest control group in the experiment. However, it must be ensured in advance that the normal distribution of data and variants homogeneous. Posttest data normality test results are presented Table 5 and homogeneity test results in Table 6.

Table 5: Test Results of Normality Test Values Post (One-Sample Kolmogorov-Smirnov Test)

		Posttest of control group	Posttest of Experiment group
N		25	25
Normal Parameters ^{a, b}	Mean	6,3760	7,6200
	Std. Deviation	,67840	,58808
Most Extreme Differences	Absolute	,175	,141
	Positive	,102	,141
	Negative	-,175	-,078
Kolmogorov-Smirnov Z		,877	,704
Asymp. Sig. (2-tailed)		,425	,704

a. Test distribution is Normal.

b. Calculated from data.

From the test results as shown in Table 5 is known that the value Asymp.Sig. (2-tailed) to posttest control and experimental group amounted to 0.425 and 0.704. This value is greater than the prescribed α is 0.05, so as to ensure that both the data is normally distributed.

Table 6: Test Results Homogeneity Value pretest (Test of homogeneity of Variances)

Posttest of control group			
Levene Statistic	df1	df2	Sig.
1,238 ^a	5	10	,361

a. Groups with only one case are ignored in computing the test of homogeneity of variance for Posttest_kontrol.

From Table 6 it is known that a significance value of 0.361 is greater than the prescribed α is 0.05. This proves that both the data has a homogeneous variant. After it was confirmed that the data were normally distributed and homogeneous variance, then the next step is to determine the significance of the difference in average value posttest control and the experimental group. Determining the significance of difference between the two average using T-test (paired samples t-test). Here is a summary of the results of testing the difference in average value pretest control and experimental group.

Table 7: Test Results Difference Value posttest

		Paired Samples Test				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	Posttest of control Posttest of experiment	-1,24400	,50997	,10199	-1,45450	-1,03350	-12,197	24,000	

From the test results as shown in Table 7 was obtained price sig (2-tailed) of 0.000; of α is determined to be 0.05. Thus, H_0 refused and H_1 accepted. Meaning, there are significant differences in learning outcomes of students who follow the practice of learning-based virtual learning outcomes of students who take conventional learning.

Character Behavior and Social Skills Assessment

Virtual Laboratory is designed to facilitate students in the development of character behavior and social skills. For more details, the researchers also complement this character assessment by observation sheets filled out by the teacher and the observer.

Table 8: Behavior Character of Vocational High School of Students in Implementing Practical Learning Based Virtual Laboratory

Indicator	Percentage(%)
Able to be trusted	72,00
Respect for others	72,80
Able to be individually responsible	62,00
Able to be socially responsible	76,00
Able to be fair	66,40
Care for others	66,00
Able to be invited to cooperate	93,00

From some of the indicators in table 8 can be seen that vocational students were able to be invited to cooperate obtained the highest percentage of 93% and the lowest was responsible individual aspects of capability that is 62%.

Discussion

Implementing of Field Testing on Vocational High School in Makassar

Field Testing involved 135 students from three vocational schools in Makassar, vocational high school election based on the level of complete equipment, less complete, and incomplete. Assessment of the aspects of Contents/material comprises several indicators, namely; indicators of the quality of the material, virtual quality and quality assessment language. Assessment of the aspects of the Design Lab consists of an indicator of consistency, clarity of purpose, lab strategies, grain drills and tests, the selection methods, the choice of language, and motivation. Assessment of the aspects

of appearance (audio visual) assessment indicator component consists of text, language, images, colors, music, layout, animation, simulation, and button. Virtual aspect consists of the indicators: assessment of explanation abstract concepts and complex, assessment of the components of real applications, assessment of the practicum component form, assessment of the completeness of components, assessment of the technical components of animation and 3-dimensional images. With the results of this program have a virtual laboratory characteristics can be used in practicum application (Padman, 2002: 111) (9). Overall aspects assessed from the results of field testing included in very good criteria, while through the observation of vocational students obtained a few responses as follows.

1. Through this virtual laboratory students can master their competence without having to real laboratory.
2. The virtual laboratory is very helpful to increase knowledge, very helpful in virtual-based learning system,
3. This program greatly helps students to practice and find out the errors
4. This program greatly assist students in understanding the lessons and can be studied at school and at home.
5. The application-based virtual practicum is very useful for students as it can be to repeat the lesson.
6. The developed program is excellent because it is very instructive in helping students to learn and study the various circuits without having to fear and doubt components used broken or not working, for example, IC components are difficult to be tracked damage.

Based on the assessment above in accordance with that expressed by Soemanto (2003: 113) (11) activities of the practice of including into learning activities, so that a person who performs an activity, exercise, or activity practice usually want to achieve certain goals in order to develop aspects or potential on students.

Implementation Experiments

Learning Outcomes Results of Control and Experiment Group

The research activities initiated from research preparation consisting of planning, implementation and evaluation. Planning of learning based virtual is the result of collaboration between researchers program with Digital Electronics teachers at vocational high school used as a research location. After the stage of development of software products (Lee, William, W. and Diana L. Owens, 2004) (5) in the form of CD-Interactive Virtual Laboratory, then the planning process is done in two stages: First, make the public administration in the form learning plans and syllabus; second, describe the lesson plans into the production process of practical learning program using virtual laboratory referred to Outline Planning Practice-Based Virtual Learning Program (virtual laboratory).

The next step is the development and writing instruments, namely; (1) preparation of preparation and strategy (syllabus and lesson plans); (2) Test and validation of evaluation instruments (tests) used as an instrument to measure student learning outcomes (3) the implementation of learning-based

virtual implemented in the experimental group and the usual conventional learning class teacher in control; (4) evaluation to measure the implementation of instructional media use virtual laboratory studied through two phases, namely pretest and posttest.

Application of learning is the actualization of the learning plan that describes the learning activities. The learning activities based practice virtual undertaken by students is determined by a student's ability to operate a computer and analyze issues in the series are available that have been presented on computer programs and simulation is a new form of learning technology that eliminates the face-to-face between the activities in the laboratory of real (Rebecca, 2003: 232) (10).

With the new method using virtual laboratory can develop independence and critical thinking of students (Zysman, 1997: 151) (16). Data obtained from the learning outcomes of learning using practicum-based virtual learning with conventional learning, it can be described that the average pretest score obtained control group 6:07, while the average posttest is 6.37. On average pretest the experimental group is 6.09, while the average posttest is 7.62. So it can be concluded that the class that uses virtual laboratory higher posttest improvement compared with the use of conventional learning. This is supported by research RetnoUtaminingsih (2009) (14), that the virtual media (media computer animation) and non-virtual media (real media) equally well in improving student learning outcomes of both cognitive and affective aspects.

Research Hypothesis before and after being given treatment

There are two hypotheses in this research, the hypothesis about the difference in the value pretest control group and the experimental group, and the difference in value posttest control group and the experimental group. There are significant differences in learning outcomes of students who take practical learning using virtual laboratory with the learning outcomes of students who take conventional learning. Learning outcomes by using virtual laboratory is better, especially in the implementation of practical activities to meet the need for increased skills, cognitive, and improve students' ability to think a high level (Cruikshank, 2002) (1) and keep the students in understanding an abstract and complex. Furthermore, the virtual laboratory can be used as a means that could replace real laboratory (substitute of real lab) if at vocational high school is not facilitated by practicum equipment and experiments can lead to things that are dangerous (Miarso, 2009: 2) (7). Virtual laboratory capable of supporting real laboratory (supplement of real lab) if it requires an explanation abstract and complex concept that is difficult to be observed, and wants to prove a theory.

Facilitating Character Behavior and Social Skills

Virtual Laboratory is designed to facilitate students in the development of character behavior and social skills (RetnoUtaminingsih 2009) (14). This is illustrated by the lesson plans have been made (Maesuri, 2009) (8). Aspects of these characters should be made explicit, it is well known that the purpose of learning is a contract between the student and teacher. In learning the nuances of the characters in this research teachers and students understand the importance of

respect and responsibility of individual characters. Appreciate and behavioral indicators of individual responsibility must be clear. In the lesson plan should helping in analytical thinking,, it also helps foster the student's character. Use of mixing the right color in the media nor the use of different fonts can identify the character of the students.

In addition to the process of training the characters must be clear, conducted an assessment of these characters must be clear. Assessment is very useful for teachers to know their students progress and become a man of character. Similarly for the students, they will become aware or realize the significance of these characters, and will help themselves to habituation-conditioning, and because it used, then formed the characters in them. In this study, considering the character is not always easily observed, the researchers tried out the self-assessment sheet that includes among other things:

- 1) to be believed;
- 2) respect for others;
- 3) could be responsible individually;
- 4) able to be socially responsible;
- 5) Fair;
- 6) a person who cares; and
- 7) who might be cooperation.

From some of the indicators in table 8 can be seen that this aspect of vocational students can be invited to work obtained the highest percentage of 93%. The assessment is based on:

- a) the current discussion group/class of students actively express ideas/opinions;
- b) During the discussion groups, student active asked the teacher/friend,
- c) when the discussion group/class students pay attention when a friend/teacher speaks, and;
- d) students always active in cooperation with members of the group/other students.

Conclusion

From the results of research and discussion that has been described, it can be concluded as follows: a) the assessment results with the average score on the five aspects of assessment indicators consisting of aspects of the content/materials, the design practicum aspect, aspect display (audio-visual), Aspects of Virtual, and programming aspects. The mean score of the assessment results obtained very good; b) there are significant differences in learning outcomes of students who take a virtual laboratory-based practical learning with the learning outcomes of students who take conventional learning. Learning outcomes by using virtual laboratory is better, especially in the implementation of practical activities to meet the increasing needs and cognitive skills of students and keep students in understanding an abstract and complex; c) virtual laboratory practicum media can facilitate character education vocational high school students.

References

- [1] Cruickshank, B. J., and Olander, J. (2002). Can problem-based instruction stimulate higher order

- thinking? *Journal of College Science Teaching* 31(6) 374-377.
- [2] Djamarah, Syaiful Bahri & Zain. (2002). *Strategi belajar mengajar*. Jakarta: Rineka Cipta
- [3] Duarte, Michael & Brian P. Butz (2001). *The virtual laboratory for the disabled*. 31th ASEE/IEEE Frontiers in Education Conference. Oktober 11-13, 1-4.
- [4] Jaya, H&Haryoko, S. 2010. Pengembangan Laboratorium Virtual di SMK Untuk Meningkatkan Kompetensi Siswa Pada Mata Pelajaran Produktif. *Proceeding Seminar Nasional FT UNESA*. ISBN: 978-979-028-359-9. Hal.231-240
- [5] Lee, William. W. & Diana L. Owens, (2004). *Multimedia based instructional design*. San Fransisco: Pfeiffer.
- [6] Lickona, Thomas. (1993). *The Return of Character Education". Educational Leadership*, Vol. 51 Number 3, p. 6-11, Nov.
- [7] Miarso, Yusuf H. (2009). *Penggunaan Laboratorium Virtual Untuk SMA*. Jakarta : Universitas Negeri Jakarta.
- [8] Maesuri, Sitti (2009). *Pengembangan perangkat pembelajaran matematika SMP berbasis ICT untuk memfasilitasi pendidikankarakter dan proses belajar mengajar bertaraf Internasional*. Hasil Penelitian. UNESA.
- [9] Padman, Vikram., & Memon, Nasir., (2002). *Design a virtual laboratory for information assurance Education and Research*. *Proceeding IEEE 2002*. New York : United States Millitary Academy.
- [10] Rebecca K. Scheckler (2003). *Virtual labs: A substitute for traditional labs?*. *Int. Journal. Dev. Biol.* 47: 231-236.
- [11] Soemanto, Wasty. (2003). *Psikologi Pendidikan*. Jakarta: Rineka Cipta.
- [12] Sumaji. (2003). *Studi efektivitas penggunaan metoda eksperimen dan metoda demonstrasi pada pengajaran konsep fisika pokok bahasan rangkaian arus searah*. *Artikel ilmiah*
- [13] Schwartz, M.J, Beatty, D & Dachnowicz, E. (21 Desember 2005). *Character Education: What Is It, How Does It Work, and How Effective Is It?* Diambil 25 Agustus 2014.
- [14] Utaminingsih. Retno (2009). *Perbedaan peningkatan hasil belajar siswa pada pemanfaatan media virtual dan media non virtual dalam pembelajaran sains di SMP negeri 2 Wanadadi Banjarnegara tahun ajaran 2008/2009*. Tesis: Program Studi Pendidikan Sains Program Pascasarjana Universitas Negeri Yogyakarta.
- [15] Yogaswara, Wawan. (2011). *Struktur kurikulum SMK dan perhitungan jumlah jam produktif*. Diakses tanggal 6 Januari 2015 dari <http://slideshare.net/wanyora/struk-kuri-smk-dan-perhitungan-jam-produktif>
- [16] Zysman., E. (1997). *Multimedia virtual lab in electronics*. *Proceedings, international conference on Microelectronics System Education*, IEEE. Switzerland.