PAPER NAME

Journal Art & Humanities 2018_compressed.pdf

AUTHOR

Pak Kamil

WORD COUNT

4231 Words

CHARACTER COUNT

23610 Characters

PAGE COUNT

8 Pages

FILE SIZE

180.7KB

SUBMISSION DATE

Nov 17, 2022 3:46 PM GMT+8

REPORT DATE

Nov 17, 2022 3:46 PM GMT+8

Development of Virtual Laboratory in Electric Engines Practicum Subject

L. M Kamil Amali[1]

ABSTRACT

This study aims at developing the virtual laboratory for electric engine practicum subject. This study is development research that refers to the 4D model as proposed by Thiagarajan, Semmel and Semmel, which consisted of four stages namely, define, design, develop, and disseminate. The limited trial of the developed product is administered toten students, whereas the field trial is conducted on 22 students. This study shows that the developed virtual laboratory is categorized as very appropriate based on the validation result, it has also gained positive responses from students. During the limited and field trials, the student's process skills are above 85 points. Classically, the students' learning result is within the high category with the average score of 87.5 for a limited trial, and during the field test, the students' learning result is very high with the average score of 92.5.

Keywords: 4D Model, Electric engines, Practicum subject, Virtual laboratory.

1. Introduction

Practicum in higher education, in general, is aimed at developing the concept and validating the knowledge gained through relevant learning within the class. In relation to learning within the class, practicum activities are neededin order for students to gain concrete knowledge experience and as means to confront misconceptions of the new knowledge (Hodson, 1996:5). Through the implementation of practicum, students will have experience. Hence, they will gain memory of the event, a description of their experience with long-lasting effect (White and Mitchell, 1994).

Regardless, that formally, practicum has become a fixed component in science-technology learning in higher education, it has yet to be optimally done to achieve the learning objectives as mandated by the curriculum, considering that practicum implementation sometimes needs a budget, time, and manpower in its preparation.

Universitas Negeri Gorontalo (henceforth will be called as UNG), especially the engineering faculty has integrated laboratory for all majors, including electrical engineering major. The electrical engineering major also has its separate laboratory. For electrical engines subject, the practicum should be done in Energy Conversion Laboratory, however, as UNG has yet to have the Energy Conversion Lab and on the other hand this is a core subject, then the practicum for this subject is implemented in

[1] Universitas Negeri Gorontalo, Indonesia. Email: lmkamil.amali@gmail.com

Electrical Engineering Power Lab, with all its limited facilities and tools. This has impacted on the implementation of the practicum, where students find it hard to carry out the practicum, which as a consequence, their knowledge and process skill in electrical engines practicum subject to become low.

As the solution for this situation, currently, there is a software-based application that is often called as a virtual lab. This virtual lab is one of the computer-based learning media. Usage of computer media in learning, lecturer, plays a significant role as facilitator to increase the learners' understanding of the topic being taught (Kutluca, 2010). In addition, computer media usage can also support science teaching and learning (Liu, 2015).

According to Sutrisno (2011), virtual practicum means that students conduct experiments using the available software on the computer where students are virtually experimenting just as in real practicum. The usage of the virtual lab can help students in higher education institutions where facilities are limited, and this virtual lab still enables students to have a scientific attitude in discovering the concept without having to work in a real lab (Sunarno 2009). In addition, the virtual lab can bring the sense of safety on the students during the experiment; they can relate the experiment with their daily experience; they have the opportunity to investigate macro-molecule dimension and the symbolic dimension of the experiment (Tatli & Ayas, 2012).

In its application, although technological factors are "enabling tools" 'for a VLab, students grant more importance to human factors and pedagogical factors. Teacher and their interaction with students through the communication environment is v3 (Blázquez et al., 2009). Thus, the skills of teachers and students in operating the laboratory become important in the application of virtual lab therefore the assessment of students' responses in the development of virtual lab is an important part to be considered. As the results of research Yuniarti et al., (2017) which suggests that students give the positive responses, it means students can operate and simulate the experiment of planting and painting bacteria easily.

Some researches indicate that the use of laboratory can improve the students' responses and learning outcomes, as research Herga and Dinevski's (2012) research which suggests that the use of virtual lab effectively improves students' learning outcomes compared with traditional learning. This is supported by the research of Bajpai and Kumar (2015) which states that it is easier to improve conceptual understanding of photoelectric effect materials by using a virtual lab rather than using a real lab.

In various levels of education, virtual lab is considered effective in improving students' learning outcomes as the research of Tarng et al., (2014) which suggests that virtual lab can improve students' learning outcomes. This is supportoed by the results of Herga et al's (2016) study which states that virtual lab effectively improve students' conceptual abilities. This is supported by research.

Based on this description, the development of virtual laboratory for electrical engines practicum subject will be developed. Within the development of this virtual lab, it has to be interactive, dynamic, animative, not boring, and supported the user willingness to learn and understand the topics (Jaya, 2012)

2. Research method

This study is a research development type of research by using the Four D design as proposed by Thiagarajan, Semmel, and Semmel (Trianto, 2009), which consists of four stages namely: define, design, develop and disseminate. The developed product in this study is the virtual lab learning media for electrical engines practicum subject. This study is carried out for one year from March 2017 to March 2018. The trial stage is conducted in Electrical Department of UNG with ten subjects, and the field trial is also implemented in the electrical department with 22 students as its subject. The stages in this study are presented in table 1 below.

Table 1: Research stages

Stages	Activities
Define	a. *front-end analysis*
	The objective is to find the basic problems in electoral engines practicum subject that needs a new innovative solution.

	b. Students Analysis
	Students' characteristics analysis comprises (1) level of ability or intellectual development. (2) individual skills or social skill that the students currently have and can be further developed to achieve the set learning objectives
	c. Task analysis
	Task analysis is carried out by identifying the electrical engineer students' skills based on the analysis of the program in the developed electrical engines practicum subject and the characteristics of the electrical engines topics.
	d. Concept Analysis
	The concept analysis in this study is (1) basic competencies and core competencies analysis in the electrical engines practicum subject, and (2) learning resource analysis that is collecting and identifying the learning resources that support the implementation of the virtual-based electrical engines practicum subject.
	e. Formulating the Learning Objectives
	Formulating the learning objectives in this subject through the implementation of virtual lab-based electrical engines practicum subject by referring to the result of concept and tasks analysis.
Design	The design phase consists of determining the test, the learning media, in this case, the virtual lab and the learning format and learning tools and the instruments needed to be based on the result of the analysis. In this stage, the initial design of the developed electrical engines practicum subject that is based on virtual laboratory will be available.
Develop	In this developing stage, the following steps are taken: (1) model validation by the expert. The expert team involved in this study consist of: expert of learning technology, expert of electrical engines study, expert of learning evaluation, (2) Revision of the model based on the input from the experts during the validation step, (3) limited trial during the electrical engines practicum lecture; (4) revision of the model based on the result of the limited trial, and (5) field trial
disseminate	This step aim was to share the development product in bigger group than the field test, such as other classes, other schools, or other teachers. Instruments which used in this research were learning instrument and data collecting instrument.

The instrument used in this study are: 1) validation paper for the expert to assess the validation of the virtual lab, (2) students' responses questionnaire, (3) observation sheet on the students' process skill, and (4) student learning output test

The data analysis on this study is described as follow:

1.   Validity analysis

The result of validity analysis from the expert will be analyzed through the following steps

Calculating average score from each assessment component aspects with the formula:

$$x = \frac{\Sigma x}{n}$$

Notes:

x : average score

n : Total Validator

Σx: total score for each assesses aspects

Further, this score is transformed into five scale score:

1.   Calculating the ideal average score (x_i)
2.   Calculating the deviation of ideal standard (sb_i)
3.   Determining the assessment criteria based on Table 2:

Table 2: Assessment criteria

The range of quantitative category	Category
i X +X i sb 〈 8.1	Very good
i X + i X X i sb 6.0≤ 〈+i sb 8.1	Good
i X - i X X i sb 6.0≤ 〈+ i sb 6.0	average
i X -i X X i sb 8.1≤ 〈- i sb 6.0	less
i X X ≤ -i sb 8.1	Highly less

(Widoyoko, 2009)

1) *Students' responses analysis*

The questionnaire instrument is used to test the appropriateness of the product. This instrument uses the Likert scale. The category of the responses is: highly agree (SST), agree (ST), disagree (TS), and highly disagree (STS). The responses toward the questionnaire are given the point of 4,3,2,1 for positive responses and 1,2,3,4 for negative responses. The individual score is stated using

$$P = \frac{f}{N} x 100\%$$

Sudijono (2008)

f is the currently investigated frequency, N is number of cases (number of frequency/number of the individual), and P is the percentage number.

2) Analysis of the students' process skill

Steps to analyze the observation result of science process skills were: (a) Calculating average score between two observers; (b) Summing and averaging each students' score in every science process skill aspects; (c) Changing student average quantitative score to qualitative score with five scales. Conversion criteria of the score can be seenin Table 2; (d) Calculating average score for each science process skills aspects in experiment 1, 2, 3, 4, and 5; (e) confirming based on the criteria in table 3.

Table 3: Criteria of the students' process skill

Score	Criteria
81,25% <score ≤ 100%	Very good
62,50% <score ≤ 81,25%	good
43,75% < score ≤ 62,50%	Moderately good
25% < score ≤ 43,75%	good

(Sudijono, 2008)

3) Learning outcome analysis

The learning outcome analysis consists of individual accomplishment of the students with the minimum accomplishment of 80 points, classically converted based on the criteria as shown in Table 4.

Table 4: Students' learning outcome criteria

Students' learn	Interval
Very low	0 ≤ HB < 40
Moderately low	40 ≤ HB < 60
moderate	60 ≤ HB < 75
High	75 ≤ HB < 90
Very high	90 ≤ HB < 100

(Hobri, 2010:58)

3. Findings and discussion

In Define stage, the analysis shows that the basic problem in electrical engine practicum is the lack of facilities to carry on the practicum, the lack of tools available, which the operation need high precision, due to small error can cause the damage of this practicum facility. The analysis of the students' characteristic reveals: (1) the ability or intellectual development of the students is within the average range; (2) the students who have individual and social skills that can be developed to achieve

the set learning objectives, for instance, individual skill which consists of science processing skill, and social skill such as ability to state ideas and work together in a group, and tolerance

Based on these problems and the basic skill of the students, the material analysis which consists of core competence and learning objectives in electrical engines practicum, that is the DC electric engine modeling, controlling the DC electric engines that connect to the anchor, and simulation of DC electric engine with Simulink model, and regulating the Ea anchor current in DC electric motor. The considered appropriate learning source to be developed based on the basic problem analysis, students' skill, and material characteristics is virtual laboratory learning media.

The design phase, selection, and usage of media include the description of the abstract situation according to the objective, concept, and environmental condition as well as the facility and time slot needed for learning. The created virtual laboratory program consists of materials with pictures, animation, and interactive simulation. This helps students to understand the concept. In this stage, in addition to the development of virtual lab media, practicum model is also developed along with the practicum scenario, observation sheet for students' process skill and learning output test.

In the development stage, the validation, limited trial, and field trial tests are administered. The validation is carried out by four validators: 2 experts in electrical engines learning and two experts in learning media. The validation result toward the virtual lab media, practicum module, practicum scenario, and learning output test is presented in the following table.

Table 5: Experts' validation result

No	Learning Kits	Assessment Category
1	Virtual Lab	Very appropriate
2	Practicum module	Very appropriate
3	Practicum scenario	Very appropriate
4	Process skill test	Appropriate

Following the validation, the virtual lab media and its learning kit are tested in limited trial and field trial. The trials are conducted for five practicum activities. The following is students' responses, students' process skills, and students' learning output during the limited and field trials.

1.   The analysis result on the students' responses

On the limited trial, the students' responses on the usage of the virtual lab for electric engines practicum are showed in the following graphic.

The percentage of students who strongly agree on the usage of this virtual lab on electrical engines practicum subject is 20%,and 80% said that they agree. There are no students that said that they disagree with the usage of this virtual laboratory.

During the field trial, students' responses on the usage of the virtual lab are shown in the following figure:

Percentage of students who strongly agree on the usage of this virtual lab for the electrical engines practicum is 30%, whereas 70% said that they agree. There are no students that disagree on the usage of this virtual lab for the subject. This shows that the students respond positively toward the usage of a virtual lab.

In general, a lecture that provides students with the opportunityto play a role through the usage of computer media actively will have a positive impact on the students' responses (Yusuf & Subaer, 2013), as Students prefer computer-assisted tools than the textbooks for learning purpose (Rajendran et al., 2010).
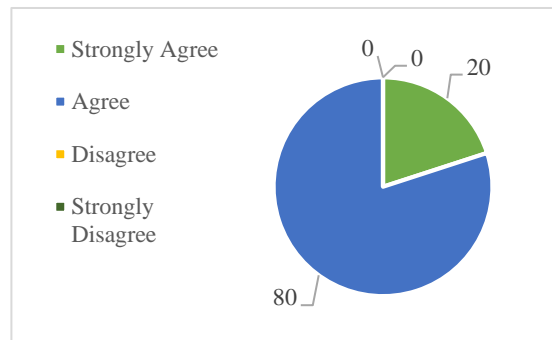

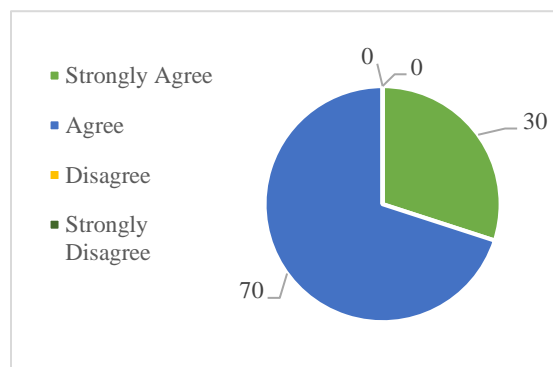Figure 1: Students' Responses during the limited trial

Figure 2: Students' responses on field trial class

Research by Henlenti et al. (2014) shows that students can have positive response toward virtual lab media used during the learning process. A similar result is also shown by a study conducted by Maulinda and IShafit (2017), in which they founded that students provided positive response for the usage of a virtual lab. This means that students do provide positive response toward the usage of a virtual lab.

2. The Result of Students' Process Skill Analysis

The observation on the students' process skill during the limited trial is presented in the following figure 3.

Further, students' process skill during field trial is presented in the figure 4 below.

Based on Figure 3 and 4, it is evident that all students' process skills during the five times electrical engines practicum subject meeting are above 85. This shows that virtual lab usage has a positive impact on the students' process skills. This is similar to Widyaningsih and Yusuf's (2016) study which showed that the students' process skills in science are within the good category when using the virtual lab media. This finding is also echoed by Riswanto and Dewi's (2017) research which revealed that through virtual lab-based learning has resulted in 85.71% of students obtain process skill in science score of ≥71. Based on these results, virtual lab usage can be recommended in electrical engines lecture to increase students' process skills.

Figure 3: Students' process skills during limited trial

3. Students' learning output

The test on the students' learning output in electrical engines practicum subject by using the virtual lab shows that classically, the students' learning output is within the high category with the average score of 87.5 and during limited trial and field trial, the average score is 92.5. Below is the graphic of average students' score.
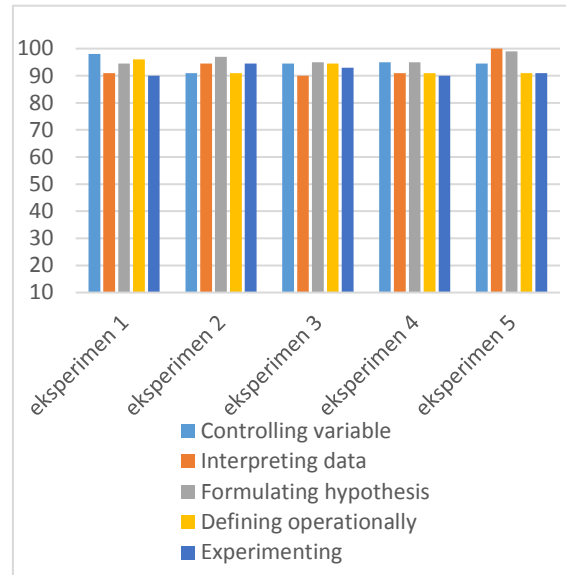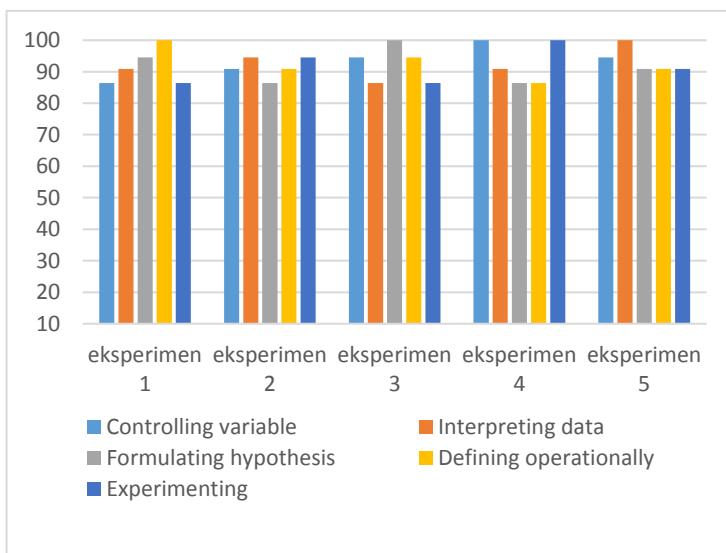

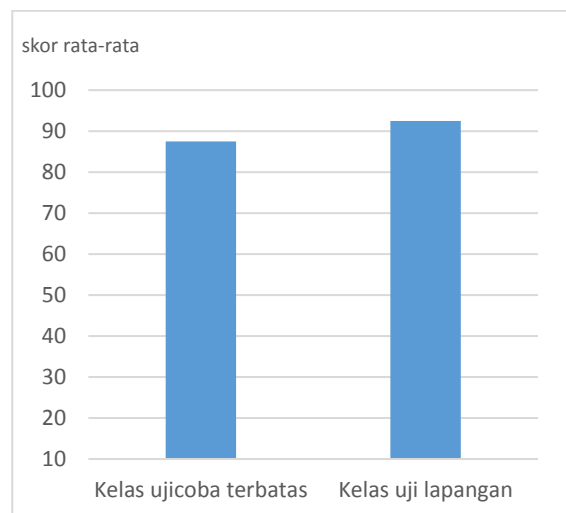Figure 4: Students' process skill during the field trial

Figure 5: Average students' learning output score

Figure 5 above indicates that the usage of the virtual lab has made the students' learning output score within the high and very high categories. The test of the students' learning output implemented in this research shows that the usage of the virtual laboratory can increase the students' understanding of the concept, as their learning output shows their concept mastery before and after the learning activity. This result is consistent with the result of a study conducted by Atmojo (2012) which stated that conceptual understanding would be better if the students involved actively in the learning process. Through the usage of this virtual lab, students can be actively involved. Hence it can

increase their conceptual understanding. This result is also backed up by Anisah et al. (2013) who stated that virtual laboratory is the implementation of technology to increase the conceptual understanding of the learners. Similarly, Permana et al. (2016) also stated that virtual laboratory could increase students' conceptual understanding. The improvement would be better than the students who passively or just listening to the teacher explanation (Yuniarti et al.: 2012). The increase of conceptual understanding of the students shows their ability in solving various problems, either using the concept or implementation of that concept in new situations.

4. Conclusion

Several conclusions are reached based on findings and discussion above. Those are: (1) virtual laboratory developed in this study is within a very good category based on the result of the validation, (2) the usage of virtual laboratory in electrical engines practicum subject has gained positive responds from the students, where during the limited trial 20% of the students strongly agree while the rest 80% agree with the usage of this virtual laboratory. Meanwhile, during the field trial, 30% of the students are strongly agreeing and the rest 70% of the students agree with the usage of this virtual lab in learning, (3) in average students' process skill during the limited trial and field trial is above 85 points, (4) classically, the learning output of the students are within the high category with the average score of 87.5 during the limited trial and very good category with the average score of 92.5 points during the field trial.

References

Anisah, E., Mantini, R.S., & Subroto, T. (2013). Keefektifan Virtual Laboratory terhadap Hasil Belajar Siswa Materi Larutan Penyangga dan Hidrolisis/effectiveness of virtual laboratory toward students' learning output in buffer solution and hydrolysis. *Chemistry in Education (CIE)*, 2(1), 1-6.

Atmojo, S. E., (2012), Profil Keterampilan Proses Sains Dan Apresiasi Siswa Terhadap Profesi Pengrajin Tempe Dalam Pembelajaran IPA Berpendekatan Etnosains/profile of students' science process skill and students appreciation toward the profession of the Tempe maker in natural science learning through ethnoscience approach , *Jurnal Pendidikan IPA Indonesia (JPII)* 1 (2): 115 – 122.

Bajpai, M., & Kumar, A. (2015). Effect of Virtual Laboratory on Students' Conceptual Achievement in Physics. International Journal of Current Research 7 (2), 12807-12813.

Blázquez, J. P., Joancomartí, J.H., and Roldán, A.E. (2009). A Virtual Laboratory Structure for Developing Programming Labs. *iJET* 4 (1), 47-52.

Henlenti., Syamsurizal., &Asyhar. R. (2014) Pengembangan Media PraktikumLaboratorium Virtual untuk Pembelajaran Optika Kelas VIII SMP Negeri 1 TungkalUlu/development of virtual laboratory media practicum for Optics Learning in Grade VIII of SMP Negeri 1 TungkalUlu. Edu-Sains3 (2). 57-63.

Herga, N. R., & Dinevski, D. (2012) Virtual Laboratory in Chemistry – Experimental Study of Understanding, Reproduction and Application of Acquired Knowledge of Subject's Chemical Content. *Organizacija* 45 (3), 108-116.

Herga, N.R., Cagran, B., & Dinevski, D. (2016). Virtual Laboratory in the Role of Dynamic Visualisation for Better Understanding of Chemistry in Primary School. *Eurasia Journal of Mathematics Science and Technology Education* 12 (3), 593-608.

Hobri. 2010. Pola Pengembangan Pendidikan Berbasis Sekolah./Development Pattern of School-Based Science Education   Yogyakarta : IRCiSoD.

Hodson, D. (1996) Practical Work in School Science : Exploring Some Directions for Change, *Journal of Chemical Education* 18(7) : 755-760.

Jaya, Hendra. (2012). Pengembangan Laboratorium Virtual untukKegiatanPraktikum Dan Memfasilitasi Pendidikan Karakter di SMK/Development of the Virtual lab for practicum activity and facilitating character building in Vocational High School. *Jurnal Pendidikan Vokasi* 2 (1): 326-334

Kutluca, T. (2010). Investigation of Teachers' Computer Usage Profiles and Attitudes toward Computers *International Online Journal of Educational Sciences* 2 (1), 81-97

Liu, D., Diaz, P. V., Riofrio, G., Sun, Y.M., &Barba, R. 2015. Integration of Virtual Labs into Science E-learning. Procedia Computer Science 75: 95-102.

Maulinda, K. R., dan Ishafit. (2017). Pengembangan Laboratorium Virtual Rangkaian RLC Seri berbasis LabVIEWuntukPembelajaranFisika SMA./development of a virtual laboratory for RLC series based on Lab-VIEW for Physics Learning in High School. *Journal of Research and Physics Education Studies (JRKPF UAD)*, 4 (2): 90-94.

Permana, N.A,. Widiyatmoko,. &Taufik, M. (2016). Pengaruh *virtual laboratory* berbasis*flash animation* terhadappemahamankonsep dan keterampilanberpikirkritispesertadidiktemaoptikkelas VIII SMP/T the influence of flash animation-based virtual lab on the conceptual understanding and critical thinking skill of the learners in Optical theme in grade VIII of Junior High School. *unnes science education journal.* USEJ 5 (3) (2016)

Rajendran, Lavanya, Veilumuthu, Ramachandran, & Divya. J. (2010). A study on the effectiveness of virtual lab in Elearning. *International Journal on Computer Science and Engineering (IJCSE)*, 2 (6): 173-2175

Riswanto dan Dewi. N. A. K. (2017). Peningkatan Keterampilan Proses Sains Melalui Pembelajaran Berbasis Laboratorium Untuk Mewujudkanpembelajaran Berkarakter/improvement of scientific process skills through lab-based learning toward a character learning. *Journal of Research and Physics Education Studies (*JRKPF UAD), 4(2): 60-65.

Sudijono, Anas. (2008). Pengantar Statistik Pendidikan/introduction to educational statistics. PT Raja GrafindoPersada: Jakarta.

Sutrisno. (2011). Pengantar *Pembelajaran Inovatif Berbasis Teknolog iInformasi & Komunikasi/introduction to IT and Communication-Based Innovative Learning Jakarta*: GP Press

Tarng, W., Cheng,Y., Lin. C., Lee, C., & Liou, H. (2014).Design of a Virtual Laboratory for Analyzing Nanoscale Magnetic Materials. *The International Journal of Multimedia & Its Applications*6 (1), 17-32.

Tatli, Z., & Ayas, A. (2012). Virtual Chemistry Laboratory: Effect Of Constructivist Learning Environment. *Turkish Online Journal of Distance Education*, 13 (1): 183 – 199

Trianto. (2009). *Mendesain Model PembelajaranInovatif- Progresif/* designing an innovative-progressive learning model. Jakarta: KencanaPerdana Media Group.

Widoyoko, E. Putro. (2009). *Evaluasi Program Pembelajaran/evaluation of learning program*. Yogyakarta: Pustaka Pelajar.

Widyaningsih, S. W., & Yusuf, I. (2016). Keterampilan Proses Sains Mahasiswa Melalui Penggunaan Media Laboratorium Virtual pada Mata Kuliah Fisika Dasar Universitas Papua/scientific process skill of the students through the usage of virtual lab media in Basic Physics subject of Universitas Papua. *Pancaran*5 (3): 99-110.

White, R.T., & Mitcell (1994). Metacognition and the quality of learning. *Studies in Science Education,* 2: 21-37.

Yuniarti. F., Dewi. P., & Susanti. R. (2012). Pengembangan Virtual Laboratory Sebagai Media Pembelajaran Berbasis Komputer Pada Materi Pembiakan Virus/development of virtual lab as computer-based learning media on virus breeding topic. Journal of Biology Education. 1 (1).

Yuniarti, A., Yeni, L.F., and Yokhebed. (2017). Development of Virtual Laboratory Based on Interactive Multimedia on Planting and Painting Bacteria. Journal of Physics, 1-7

Yusuf, Irfan, & Subaer (2013). Pengembangan Perangkat Pembelajaran Fisika Berbasis Media Laboratorium Virtual Pada Materi Dualisme Gelombang Partikel di SMA Tut Wuri Handayani Makassar/development of virtual lab-based physics learning tools in wave particle dualism topic in Tut Wuri Handayani High school of Makassar. *Jurnal Pendidikan IPA Indonesia (JPII)*2 (2): 189-194.

● **3% Overall Similarity**

Top sources found in the following databases:

- 3% Publications database
- Crossref Posted Content database
- Crossref database
- 0% Submitted Works database

TOP SOURCES

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	Stephani Diah Pamelasari, Melor Md Yunus, Fidia Fibriana, Andin Vita ... Crossref	<1%
2	I U Wusqo, S D Pamelasari, M Khusniati, A Yanitama, F R Pratidina. "Th... Crossref	<1%
3	A Yuniarti, L F Yeni, Yokhebed. "Development of Virtual Laboratory Bas... Crossref	<1%
4	Anis Mawati. "Factors Influencing Failure of Reading", Register Journal... Crossref	<1%
5	R Adawiyah, M Simorangkir, Nurfajriani. "The Analysis of Natural Scie... Crossref	<1%
6	Arifah Putri Kurniawati, Zuhdan Kun Prasetyo, Insih Wilujeng, I. Gusti P... Crossref	<1%
7	E D Jannati, A Setiawan, P Siahaan, C Rochman. "Virtual laboratory lear... Crossref	<1%