

# Development of Electronic Media (E-Media) - Guiding Practical Simulation Lab (Virtual) as Supporting lectures and Practical Basic Electronics II For The Department of Physics

Hans Wagania<sup>1</sup>, Alfrits Komansilan<sup>2</sup>, Jeane Tumangkeng<sup>3</sup>, Treisje Mandang<sup>4</sup>

<sup>1,2,3,4</sup>Department of Physics Education, Faculty of Mathematics and Nature Science, Manado State University, Indonesia  
(<sup>2</sup>alfritskomansilan@unima.ac.id)

**Abstract-** The readiness of lectures/teachers in preparing innovative teaching media is one important factor in organizing fun lecturing/learning, foster respect for differences and that foster students ' creativity. Purpose and special needs to reach the target of this research is to develop electronic media (e-media) of practical guided based on virtual laboratory that feasible to uses in increasing basic electronics of effectivities lecturing at the department of Physics. This research used *Research and Development* (R & D) methods, to adaptation model of development four-D models developed by Thiagarajan. The variables of this study are the business feasibility of electronic media developed through this research. The instrument used for collect data of this research is in the form of: (a) the Note validation from reviewer/expert, (b) a questionnaire, that be filled by peers, (c) a questionnaire response that be filled by students in the class trial, and (d) the tests used to assess the effectiveness of the use of electronic media in the classroom learning test.

**Keywords-** *Research and Development, Electronic Media (E-Media), Practical Simulation (Virtual Laboratory), Scientific Approach, Basic Electronics*

## I. INTRODUCTION

These Practical activities are important activities that are an integral part of the process and associated range of courses of study in physical education courses of engineering. Student involvement in practical work, as well as result and quality implementation will determine the effectiveness of practical coursework. Through practical activities, either practical or simulated rill practical (virtual lab), creativity of students can be developed. Reflection on the lecture on Physics of engineering courses and learning at school shows have not been optimal process of developing students competence of engineering physics study program through lectures and practical work. It also reflects the achievement of the Mission of the Unima as the umbrella strategic plan i.e. yielded high competitive power and characteristic in contributing to development (especially education) in North Sulawesi. It also becomes a challenge to the Mission of the physics courses i.e. embodies the holding of courses and expand the integration

activities of the tridharma, as well as the utilization of the feedback results in organizing activities and associated costs.

Specific strategies developed through this research are complementary means of supporting the process of lectures and practical work, one of which is in the form of electronic media (e-media) practice simulation tutorial-based (virtual lab). This strategy is useful, among others, in terms of: (1) increase the efficiency and productivity of student learning, (2) fostering students ' creativity in designing e-learning device including media guide practical simulation (virtual lab), (3) contributing to quality improvement activities students follow courses in/carry out PPL, composing thesis, etc. According to Asnawir and Usman [1], the use of electronic media at the stage of learning orientation will greatly help the effectiveness of the learning process as well as the delivery of the message and the content at that time. In addition to improving the quality of the results of the study, electronic media can also help increase understanding, presenting interesting and reliable data, eases data interpretation, and condense information.

This research aims to develop to get electronic media (e-media) virtual laboratory-based practical guide that is considered viable for use by lecturers and students in improving the effectiveness of the Organization of the lectures and practical courses on basic electronics physics education. The availability and use of e-media are tested disqualified, not only serves to increase the student's ability to master the concept of learning materials that has been learn, but also encourage students to develop his creativity in finding alternative solutions to problems relating to practical lab.

The urgency of research related to:

-Reality perceived through the lectures on physics courses that still lacks the means of laboratory teaching equipment so that student learning results is nothing less encouraging and development of students ' creativity through activities of the laboratory experience barriers (Wagania) [2,3]. It is also related to the fact that observed that creativity physics teachers in middle school to find suitable solutions to the problems of practical laboratory is still low (wagania) [4]. The capacity and experience of teachers is becoming a serious challenge in the implementation of the curriculum 2013 (Medellu et al.) [5].

Physical education courses have hosted the Mission of education for the younger generation and play an active role in research and public service in the field of physics education. Students in this process is in need of subject lectures demanding full involvement in lectures and practical work is effective to increase the productivity of learning students achieve competencies mastered the learning materials suitably demands the curriculum.

-Experience using electronic media-based virtual lab practical-tutorial, will encourage students to develop his creativity in finding alternative solutions to practical problems. This requirement needs to be supported, among others, with the use of electronic media guide practical work-based and desktop-based virtual lab that can be used by lecturers in organizing lectures and practical, and can be used by students to carry out practical work independently, and gives the opportunity to try again anywhere and anytime.

Findings/innovation at once close to the target of research is electronic media (e-media) guiding practical simulation (virtual lab) that is considered viable for use by lecturers and students in lectures and practical basic electronics on physical education courses. Classed as a groundbreaking findings because e-media involves the use of information and communication technology (ICT), and is a form of alternative solutions that are appropriate for use when the necessary lab equipment is not or has not been available but the practice can still be carried out in a virtual form.

### I. RESEARCH METHODS

Because of the method used for this study is a model of research and development (Research & Development Model), i.e. *four-D models* developed by Thiagarajan (Sugijono) [6], then the stages and research flow adjusts to that model.

This research was carried out in Physical education courses of Faculty of Mathematics and Nature Science, Manado State University, and will use the facilities available that can be used, either learning space, the space laboratory, and an LCD projector.

The subject of research is the physics education course students of Faculty of Mathematics and Nature Science, Manado State University semester IV (basic electronics II lecture participants).

The instruments used to collect the data of this research is in the form: (a) the Format of the Functional Test, (b) the validation by an expert lecturer sheet material and media expert, (c) the response question form sheet filled out by the student on a class test, and (d) the test used to assess the effectiveness of the use of e-media in study on the test class. Data analysis using quantitative and qualitative analysis of the issues, information and dependent variable are examined.

### II. RESULTS AND DISCUSSION

Based on: (1) the results of the functional testing the operation of running a prototype design of packaging E-Media solution specifically conceived simulation practice (virtual lab), (2) the results of the validation record expert Professor material and media expert, (3) the results of the responses students grade test, (4) the test results of the effectiveness of the use of E-Media prototype design through class rill (field test), (4) the results of the responses of students on class field test, and (5) the results of the associate's friends, then it can be expressed as the following things:

1. Based on functional test data of e-media in particular practical simulation used in any part of the materials lab course (virtual lab) as seen in (table-1), a design of a prototype e-media developed it can be run and function properly. Seen that 100% of the image series of simulations that are used properly or not is incorrect. Likewise, the 100% truth table obtained from simulation results correspond to the expected truth table in theoretic. In accordance with the criteria used, the degree of feasibility of e-media as seen from the functional simulation test lab course (virtual lab) to all parts of the material tested can be classified on categories that very decent to use. Nevertheless need to test Note test results repeated in implementation later in the lecture.

TABLE I. FUNCTIONAL SIMULATION TEST OF ASSESSMENT DATA

Types of simulation	True/not picture a series of simulations that are used		Fit/not expected truth table with the results of the simulation	
	True	Incorrect	According	Does Not Match
Logic Gate	√	-	√	-
Boolean Algebra	√	-	√	-
Multiplexer	√	-	√	-
Demultiplexer	√	-	√	-
Encoder	√	-	√	-
Decoder	√	-	√	-
Flip Flop	√	-	√	-
Multivibrator	√	-	√	-
The counter	√	-	√	-
Register Slide	√	-	√	-

2. Based on data validation by the validator, either in general or data validation data validation expert Professor material and data validation of a lecturer who can be recognized as a media expert, then the feasibility of e-media developed it can be explained as follows:

2.1 By observing the data validation in General for a prototype design (table 2), there are eight aspects are observed. The eight aspects are expected as listed in the table, get a record scoring in the category either (7 = 87.5%) and aspect (1 aspect = 12.5%).

TABLE II. GENERAL ASSESSMENT DATA REVIEWER/VALIDATOR

No.	The observed aspect/scrutiny	Note
1	Innovative Rate	Good
2	The Level Of Creativity	Good
3	Originality	Good
4	Functional	Good
5	The Level Of Effectiveness Of The Use Of	Good, but needs to be tested repeatedly
6	The Efficiency Of The Use Of	Good
7	Aesthetics	Good
8	Benefit for majors (join gives solutions to problems faced by the Department/Program of study)	Very Good
Other notes	This media packaging and dissemination test need to repeatedly recurring in subsequent lectures in order to obtained new input that may be useful to do revision and further refinement.	
<b>Recommendation:</b> Can be used as a means of supporting Basic electronics courses are effective and engaging in Physical education courses by instructor expertise in lectures materials and skillful use of the supporting application programs required		

Appropriate eligibility criteria used, as seen from the data validation in General that is commonly used to rate a product in the form of prototype, then the eligibility level of packaging e-media can be classed in the category of good or decent to use. However to note another note from validator which is listed in the table above. Recommendations the validator indicates that the packaging of e-media will be eligible to use effectively and attract mainly by professors who expertise in lecture material and skillful use of the supporting application programs as necessary.

2.2 Having regard to the expert validation data material, then from four main indicators assessed, retrieved hsil assessment as follows:

(a) for indicators of "Connectedness with learning materials" (with 3 rounds of assessment), 1 grain is graded SB or Excellent (item 2, 4) and 2 point rated B or good (rounds 1 and 3, 6). There are no items in the category K (less) and SK (much less). Total percentage score in the category of SB and B is 100%. Appropriate eligibility criteria, indicators were assessed very worthy category belongs.

(b) For the indicator "values education" (with 3 rounds of assessment), 1 grain is graded SB or Excellent (item 6, score 4) and 2 point rated B or good (rounds 4 and 5, 6). There are no items in the category K (less) and SK (much less). Total percentage score in the category of SB and B is 100%. Appropriate eligibility criteria, indicators that this belongs on the category judged was very decent.

(c) to the indicator "Conformity with experiments" (with 2 point assessment), 1 grain is graded B or Good (item 7, a score of 3) and 1 grain of rated K or less (item 8, score 2). There are no items in the category SB and SK. Total percentage score in the category B is 50% and 50% K category. Appropriate eligibility criteria, indicators that this belongs on the category judged less.

(d) to the indicator "Practical Guide" (with 3 rounds of assessment), the third of these grains are rated B or Good (item

9, 10, 11, score 9). There are no items in the category SB, K and SK. Total percentage score in the category B is 100%. Appropriate eligibility criteria, indicators that this belongs on the category were judged worthy.

Additional data from the Validator:

a. Says "Yes" to the question "what is the practical guide to simulation (virtual lab) which form part of packaging e-media has created this can assist students in understanding the concept of basic electronics in accordance with the lecture?"

b. Stating "Yes" to the question "are there any advantages of guiding practical simulation (virtual lab) which form part of packaging e-media has made this?"

c. To the question "what is the lack of a guiding practical simulation (virtual lab) which form part of packaging e-media has created this?" gives answers : *the effectiveness of the use of packaging e-media, can only guaranteed when used by lecturers over matter lectures and application program supporters*

d. To the question "is there any advice or hope about the development of guiding practical simulation (virtual lab) which form part of packaging e-media has created this?", gives the answer : For each title part practical , need to be more simplified, especially on the part of the underlying theory

e. Provide a selection of conclusions, guiding practical simulation (virtual lab) in the form of packaging e-media this can be used with the revision on parts where necessary.

f. The Validator is also assessing the packaging design prototype e-media can help students understand the basic concepts of electronics, has advantages, but it also has disadvantages. The drawback is that *the effectiveness of the use of packaging e-media, can only be guaranteed when used by lecturers over matter lectures and application programs his supporters.*

2.3 Further validation of the data by observing the lecturer who is recognized as a media expert, then from 3 to 20 indicators assessed, get an assessment as follows:

(a) for the aspects of the "Linguistic" (with 2 point indicators), both of which are rated by category the value of 4, with a total score of 8). There are no grains of the indicators in the category value 5, 3, 2 and 1. Total percentage score in the category value 4 is 100%. Appropriate eligibility criteria, linguistic aspects indicate that e-media packaging developed these votes belongs in the category.

(b) to the aspect of "software engineering" (with 11 rounds of the indicators), 1 indicator is assessed with a category value 5, 8 indicators by category 4 values by the number of score 32), two indicators judged by category the value of 3. There are no grains of the indicators in the category value 2 and 1. Percentage score in the category value 5 is 9.1%, and in the category value 4 is 58.2%, in the category of value 3 is 9.1%. Total percentage in the category value 5 and 4 was 67.3%. Appropriate eligibility criteria, aspects of software engineering indicates that e-media packaging developed this assessed belongs on the category deserves and quite decent.

(c) for the aspects of the "visual and audio Display" (with 7 rounds of indicators), 5 indicators assessed by category the value of 4 with a total score of 20, 2 indicators by category the value 3 with number 6). Percentage score in the category value 4 is 57.14%, and in the category value 3 is at 17. Appropriate eligibility criteria, aspects of the "visual and audio Display" indicates that the e-media packaging developed this assessed belongs on the category deserves and quite decent.

Additional data comments and suggestions from the Validator:

1) Packaging E-Media requires more detailed usage instructions so that users (especially students) can be faster and easier to use it

2) The selection of background music attempted to not interfere with the concentration of the students when to use this packaging. We encourage all music later is an instrument without words

The choice of an alternative conclusion of the Validator:

Guiding practical simulation (virtual lab) in the packaging of e-media like this can be used with revisions as necessary.

Of additional comments and suggestions concerning the 3 main aspects aforesaid, and alternative conclusion given validator, packaging e-media teaching simulation tutorial (virtual lab) this developed can be used with revisions as required, by providing a more detailed usage instructions, and by choosing the music later estimated could not disturb the concentration of students when using the e-media packaging developed through this research.

3. According to the results of a test class, student responses with the 10 aspects of the response, then the feasibility of e-media developed it can be explained as follows:

(a) for aspects of the response "interest in the use of packaging e-media guide to practical simulations (virtual lab) as an alternate in doing the practical work", retrieved the description for 2 test grades A and B, 47.8% strongly agree (SS), and 52.2% agree (S). None selecting categories less Agreed (KS) and Disagree (TS). Total frequency of catches in category S an SS is 100%. Appropriate eligibility criteria, then this aspect of first response above, rated belongs on the category deserves appropriate Equalization and is well worth a percentage figure is obtained.

(b) for aspects of the response "the difficulty of carrying out practical-use packaging e-media", retrieved a picture for 2 test grades A and B, 100% choose the responses Agree (S). Nobody chooses the category other responses. Appropriate eligibility criteria, then that aspect of the second response above, rated belongs on the category worthy.

(c) for aspects of the response "no difficulty carrying out practical work, with the use of packaging e-media", retrieved a picture for 2 test grades A and B, 88.6% agree (SS), and 11.4% agree (S). None selecting category SS, and TS ... Appropriate eligibility criteria, then the third aspect of the response above, rated belongs on the category worthy and

decent enough appropriate equalization percentage figures are obtained.

(d) for aspects of feedback "uses the packaging of e-media in carrying out practical work, designed well, can do all the indicators that will be observed", retrieved a picture for 2 test grades A and B, 88.6% agree (SS), and 11.4% agree (S). None selecting category SS, and TS ... Appropriate eligibility criteria, then the fourth response aspect above, rated belongs on the category worthy and decent enough appropriate equalization percentage figures are obtained.

(e) for aspects of the response "menggunakan e-packs this medium gives rise to the desire to learn electronics more vibrant", retrieved a picture for 2 test grades A and B, 6.8% strongly agree (SS), 88.6% agree (S) and 4.6% less Agree). None selecting categories do not agree (TS). Total frequency of catches in the category of SS and S was 95.4%. Appropriate eligibility criteria, then the fifth response aspect above, rated belongs on the category quite worthy, worthy and very decent fit equalization percentage figures are obtained.

(f) For aspects of the response "the use of packaging e-media is challenging to develop creativity as a student", retrieved a picture for 2 test grades A and B, 100% choose response Agree (S). Nobody chooses the category other responses. Appropriate eligibility criteria, then the sixth response aspect above, rated belongs on the category worthy.

(g) For aspects of the response "compelled to learn because it is more easily understood elektronika with the aid of simulation of virtual pratikum packed in the form of e-media", retrieved the description for 2 classes A and B test, 6.8% strongly agree (SS), and 93.2% agree (S). None selecting categories less Agreed (KS) and Disagree (TS). Total frequency of catches in category S an SS is 100%. Appropriate eligibility criteria, and then that aspect of the response above, rated seventh belongs on the category deserves appropriate Equalization and is well worth a percentage figure is obtained.

(h) For aspects of the response "belajar electronics with the help of packaging e-media was more easy and fun", retrieved a picture for 2 test grades A and B, 61.4% Very Agree (SS), and 38.6% agree (S). None selecting categories less Agreed (KS) and Disagree (TS). Total frequency of catches in category S an SS is 100%. Appropriate eligibility criteria, then that aspect of the response to the above, rated eighth belongs on the category deserves appropriate Equalization and is well worth a percentage figure is obtained.

(i) For aspects of the response "experience carry out practical electronics in the form of a virtual lab as it is packaged in the form of e-media like this, very helpful in carrying out practical work, electronics, and rill in designing/creating tools/kit practical electronics", retrieved a picture for 2 test grades A and B, 40.9% strongly agree (SS), 52.3% agree (S) and 6.8% less Agreed (KS). None selecting categories do not agree (TS). Total frequency of catches in the category of SS and S was 93.2%. Appropriate eligibility criteria, then the ninth response aspect above, rated belongs on the category quite worthy, worthy and very decent fit equalization percentage figures are obtained.

(j) For aspects of the response "belajar electronics with the help of packaging e-media is encouraged to attempt to have a personal computer/labtop", retrieved a picture for 2nd grade test A and B, 43.2% strongly agree (SS), and 56.8% agree (S). None selecting categories less Agreed (KS) and Disagree (TS). Total frequency of catches in category S an SS is 100%. Appropriate eligibility criteria, then the tenth response aspect above, rated belongs on the category deserves appropriate Equalization and is well worth a percentage figure is obtained.

Based on the results of the processing and interpretation of the data and discussion concerning the ten aspects of the responses above, where overall obtained 20.7% choose the aspect category of responses strongly agree (SS), 75.9 choose aspect category response Agree (S), or 96.6% as the percentage number of aspects of the response categories SS and S, then the corresponding eligibility criteria used, packaging e-media guide to practical simulations (virtual lab) who developed this can classified in the categories eligible for use.

4. Based on the test results of the effectiveness of the use of packaging e-media at both the class test (table 3), then the feasibility of e-media developed this in terms of the results of these effectiveness tests data processing, can be explained as follows:

TABLE III. EFFECTIVENESS OF THE USE OF TEST RESULTS DATA PACKAGING (FOR CLASS A = 23 STUDENT AND CLASS B = 21 STUDENT)

Category Value Of Test Results	Class A (23 student)				Class B (21 student)			
	frequency		%		frequency		%	
The Value Of A	3	22	13.0	95.7	2	16	9.5	76.1
The Value Of B	19		82.7		14		66.6	
The Value Of C	1		4.3		1		4.8	
The Value Of D	-		0		3		14.3	
The Value Of E	-		0		1		4.8	

The percentage frequency of test results with values in the category A for the second grade test, each 13.0% for the class A and class B for 9.5%. While the test results with values in the category of B, each of which 82.7% for class A and class B for 66.6% combined. the percentage of the value of A and B, the value retrieved 95.7% for class A and class B 76.1%. Rest only 4.3% who earn a grade of C for class A and 4.8% who earn a grade of C for class b. While the percentage frequency that obtains the value D, 0% for class A class B, while for their amounted to 14.3% (3 students) had difficulty in setting up a personal computer. To obtain the value of E, 0% for the class A and 4.8% (1 students) to class B because the question did not actively follow the lecture.

Based on the results of the processing and interpretation of the data as well as the discussion concerns the effectiveness of the test results the use of e-media packaging developed as reflected in the figures shown above, then fit the eligibility criteria used packaging, e-media guide to practical simulations (virtual lab) who developed it can be classified in the categories eligible for use.

Research results and explanations as expressed above gives a clue that the use of packaging e-media teaching simulation tutorial (virtual lab) developed through this research help and facilitate students ' physical education courses in understanding the concepts and principles of basic electronics materials. This is in line with the research report that among other things expressed by Roediger & Karpicke (2007), which reported that ICT-based e-media can be used by students as a means of independent study to be able to repeat the back outside of teaching activities in college. The importance of repeating the lesson can make students capable of storing memories longer known (*long-term memory*). The impact caused the final effect on students in the form of increased achievement in learning. In line with that Iswanto [7] which refers to the report of the Belcher (2005) reported that the use of multimedia learning-based device will be able to improve the efficiency of learning independently on the part of students throughout available computer to run it. Utilization of electronic media independently can also increase student responsibility in planning and implementing their own students as well as how to learn can improve the learning achievements of students. (Francis & Flanigan) [8]. with independent study through this media by electronic group, the student can repeat again that practical work is done as often as possible. Likewise, Wagania [4,9] reported that the use of CD presentation materials physics simulation/animation-aided in learning physics is quite effective for being able to enable students in the learning process that is scientifically and being able to improve student learning outcomes. This is in line with the report of the results of the study are, among others, propounded by Latif et al. [10]. The third researcher reported that the use of the virtual laboratory using a logic simulator DSCH2 in courses of electronics II in the form of e-laboratory pertained well enough and generate learning practical independently without assistance Assistant. Akpan [11] obtained the fact that computer simulation has the ability to present realistic images and visualization and can create a constructive learning environment so as to improve the learning results student. Similar Results were reported by Kociyancic and O'Sullivan [12], which concluded that the integration of the data acquisition experiments with computer simulations have proven to be very effective. The issue is not which is better, real or virtual lab laboratory; both are mutually supportive and complementary. Another advantage of implementing virtual labs is that they can reach experiments in a range that with low cost infrastructure compared with ordinary laboratory use, as reported by Rodrigo et al.[13]

### III. CONCLUSION

Based on processing and interpretation as well as discussion and arguments that have been put forth above, namely by observing: (1) the results of the testing functional the operation of running a prototype e-packaging design media developed it, (2) The results of the assessment notes (validation) by expert lecturers validator material and media expert, (3) the results of student feedback on 2 class limited field test, and (4) the test results of the effectiveness of the use of e-media packaging developed at both the test class, so it can

be expressed that the packaging design prototype e-media electronic teaching basic Simulation Tutorial 2 for physical education courses developed through this research: a) can be run and function properly, b) can be considered fulfilling terms as a prototype of the design in the category of good c) is seen fulfilling the eligibility criteria based on expert Professor validation material in the average category of good, d) are seen fulfilling the eligibility criteria based on validation of a lecturer in media expert the average good categories, e) are seen fulfilling the eligibility criteria based on student responses to aspects of the class field test is limited, f) is seen fulfilling the eligibility criteria based on the results of a test of the effectiveness of the use of packaging e-media guide practical simulation (virtual lab) in the category of average worth was used.

On the basis of things that has been mention above, then it can be inferred that the packaging of e-media guide to practical simulations (virtual lab) developed through this research are seen worth to be used as a means in lecturing proses and Basic electronics lab course 2 on physical education courses.

#### REFERENCES

- [1] Asnawir and M. Basyiruddin Usman. Learning Media. 2002. Jakarta: Ciputat press.
- [2] Wagania H. 2015. Pengembangan Beberapa Kit Praktikum dan Lab Virtual Penunjangnya Sebagai Pelengkap Sarana Praktikum Elektronika Digital pada Jurusan Fisika, Proyek DIPA, LEMLIT UNIMA.
- [3] Wagania. 2016. Pengembangan Simulasi Praktikum (Lab Virtual) Elektronika Bahan Ajar, Flip-Flop, Multivibrator, Register dan Counter dalam Kemasan Multimedia untuk Jurusan Fisika
- [4] Wagania. H. 2011. Pengembangan CD Praktikum Maya Elektronika Dasar II". Laporan Penelitian. Proyek IMHERE, Jurusan Fisika FMIPA.
- [5] Medellu, Ch.S, Komansilan A, Raturandang J., Lumingkewas S. 2014. Model tugas tematik untuk merespons pemberlakuan kurikulum 2013 dan membangun demokratisasi belajar. Laporan Penelitian kompetitif nasional – skim UPT, Lemlit Unima.
- [6] Sugijono. 2008. Penddikan Research Methods (Quantitative, qualitative Approach, and R & D). Badung: Alfabeta.
- [7] Iswanto H, 2005. "Teknologi Informasi untuk Pendidikan dan Problematiknya" *Seminar Nasional Pendidikan Fisika 2005*, Jurusan Fisika FMIPA UNJ, Jakarta.
- [8] Francis, Alisha & Flanigan, Abraham. 2010. "a self-directed Learning and Higher Education Practices: Implication for Student Performance and Engagement." *International Journal of the Scholarship of Teaching and Learning*. Vol. 7, no. 3, pp. 1-18.
- [9] Wagania. 2012. "Upaya Meningkatkan Efektivitas Pembelajaran Fisika (Bahan Ajar Momentum dan Impuls) Melalui Penggunaan Perangkat Ajar Digital dengan Strategi Pembelajaran Inkuari Terbimbing pada Kelas XI SMAN I Tondano". *Laporan Penelitian*, PGMIPABI FMIPA UNIMA
- [10] Latif Amalia Nova , Muchlas dan Ishafit, 2009. "Pengembangan e-laboratory untuk praktikum elektronika pada mahasiswa pendidikan fisika Universitas Ahmad Dahlan", *Prosiding seminar nasional penelitian, pendidikan dan penerapan MIPA*", Fakultas MIPA, Universitas Yogyakarta.
- [11] Akpan, J.P. (2002). Which Comes First: Computer Simulation of Dissection or a Traditional Laboratory Practical Method of Dissection. *Electronic Journal of Science Education*, Vol. 6 No. 4. <http://unr.edu/homepage/crowther/ ejsev6n4.html> ejse .
- [12] Slavko KOCIJANCIC and Colm O'SULLIVAN. 2004. Real or Virtual Laboratories in Science Teaching - is this Actually a's Dilemma? Slovenia: University of Ljubljana, Faculty of Education Kardejeva pl. 16, SI-1000 Ljubljana, *Journal in Education*, 2004, vol. 3, no. 2, 239 – 250
- [13] Rodrigo o. Fernandez, Elisabeth c. Kinguti, Francisco j. Fernandez-Ramirez (2002). A Virtual Laboratory to Perform Electronic Experiments by Internet. *Innovations in Virtual and Remote Laboratories*. August 18 – 21, Manchester, U.K.