5th ICRIEMS Proceedings
Published by Faculty Of Mathematics And Natural Sciences
Yogyakarta State University, ISBN 978-602-74529-3-0

Developing Set of Physics Learning Based on Elaboration Learning (EL) to Increase Concept Comprehension and Scientific Attitude

Yosaphat Sumardi[1)], Asti Dwi Kusumawati [2)]

[1]*Department of Physics Education Sarjanawiyata Tamansiswa University of Yogyakarta, Indonesia*
[2]*The Former Student of Post Graduate Program Yogyakarta State University, Indonesia*

[1)]yosaphat.sumardi@ustjogja.ac.id

Abstract. This research's aim is to develop the set of physics learning based on elaboration learning (EL), especially concerning with simple harmonic oscillation. The set of physics learning is applied to increase the concept comprehension and the scientific attitude of senior high school students. This research is belonged to the research and development (R & D), follows seven steps out of the ten steps of Borg and Gall's model. The steps are research and information collection, planning, develop preliminary form of product, preliminary field testing, main product revision, main field testing, and operational product revision. In the step of main field testing the set of physics learning is applied in classrooms to test the increment of concept comprehension and scientific attitude of senior high school students. The instrument of research consists of lesson plan evaluation sheet, handout evaluation sheet, concept comprehension test, and scientific attitude evaluation sheet. The conclusions of this research and development are (1) Developing set of physics learning based on EL in this study fit for use in learning with very good categories, based on the assessment CVR of experts and practitioners with an average value of 0.8 to 1 (2) Developing set of physics learning based on EL in this study to increase concept comprehension and scientific attitude of Senior High School students based on the average score on a test N-gain concept comprehension for the control class of 0.40, and the experimental class of 0.56. On average scientific attitude score of N-gain for the control class of 0.33 and the experimental class of 0.44. (3) The results of Manova test showed that the value of the F significance □ 0.05. Based on the hypothesis, if rejected then there is the influence of the use learning based on EL with concept comprehension and scientific attitudes of students

Keywords: Elaboration Learning, Concept Comprehension, Scientific Attitude

INTRODUCTION

KTSP and K13 curricula require the student centered approach, not the teacher centered approach. In these curricula students are proposed to be active so that their competence and learning objectives can be achieved. The joyful learning should be created in teaching and learning process. The atmosphere of such learning can be realized by selecting an appropriate model, strategy, and method.

As matter of fact, not all schools have implemented those curricula. Students still have problems to understand the concept comprehension of physics [1]. In many schools the teaching and learning process of most subjects, physics included, are still teacher oriented. Lecture method are still dominate in teaching learning process. In this method it is difficult to develop students' scientific attitude. Therefore, it is required to solve this condition so that the mandate of KTSP and K13 can be realized.

Elaboration Learning (EL) is an model in teaching and learning process. It can explain the construction sub processes in learning [2]. Therefore, it can be implemented to respond the challenge of KTSP and K13. It can make students to be active and joyful. Students can be expected to achieve their competences in accordance with the progress of science and technology so that they are able to compete in the future. They are not only trained to evolve by themselves independently, but also be able to collaborate with colleagues. They need organize and manage new information in order to remember it easily and to utilize it effectively.

EL can significantly improve students' achievement [3]. The capabilities that will be developed in this study is concept comprehension and scientific attitude. Problem Based Learning Approach, is also an effective way to teach concepts that are often encountered in daily problems [4]. Those capabilities appropriate with the demands of the curriculum that still prevails in Indonesia, which focus to the student's centered learning. We often encounter at schools, students still often have misconception in studying physics. It can be seen when students have to answer the high thinking level test, which need to understand and to apply the physics concepts, and to analyze daily physics phenomena.

The scientific attitude of students is basically similar to the other skills, i.e. cognitive, social, process, and psychomotor skills [5]. Based on research, there was a positive and significant relationship between the scientific attitude and the student's knowledge [6]. The student's achievement was significantly correlated with scientific attitude [7]. The student's scientific attitude can be grown by using learning models that corresponds to the indicators of scientific attitude itself. EL is an model that can increased the student's scientific attitude. EL can also expected to improve the student's concept comprehension in physics.

Products, attitudes and processes is an important part of learning physics [8]. The most important elements of learning are student learning, teacher, teaching materials, and the relationship between teachers and students [9]. EL is a learning model that emphasizes the student's independence and meaningfulness in the learning process. Thus, this study can produced the EL model on physics learning, especially in an simple harmonic oscillation. In this model we create the learning physics by preparing a set of learning material that consists of a syllabus, lesson plans, handouts, worksheets and the test of concept understanding. It will be expected that the EL model can be used to improve concept comprehension and scientific attitude.

To realize this model in the learning activities necessary to develop set set of physics learning based on EL. These set include Lesson Plan, Handout, Student Activity Worksheet, Concept Comprehension Test, and Scientific Attitide Evaluation Sheet.

The set of physics learning used in this study is lesson plan, handout, student activity worksheet, and concept comprehension test.

The Set of Physics Learning Based on EL

1. Lesson Plan

Lesson plan is a plan that describes the procedures and organization of learning to achieve a basic competence. Lesson plan is translated from the syllabus [10]. It has two functions, namely the function of planning and execution functions. Planning function aims to encourage teachers to be ready to implement learning activities. As an execution function, lesson plan should be in accordance with the needs of the environment, schools and districts [11]. It consists of identification of subjects, standard of competence, basic competence, indicators of achievement, the purpose of learning, teaching materials, the allocation of time, the teaching methods, the learning activities, assessment of learning outcomes, and learning resources [12].

2. Handout

The functions of the handout, that are (1) helping students relieve their note, and (2) as companioned explanation from the teacher [10]. Learning process need instructional materials. One of the instructional materials that can be used in physics education is handout. The word of handout comes from English that means information, news or letter sheets. It is sourced from some of the relevant literature on basic competencies and subject matter being taught to students. The instructional materials is given to students in order to facilitate them while attending the learning process.

3. Student Activity Worksheet

Student Activity Worksheet is printed instructional materials in the form of a sheet containing the task that contains the instructions, the steps to complete the task. It consists of matter, summary, and tasks related to the material. The purposes of making worksheet include (1) helping teaching and learning activities, (2) providing knowledge, attitudes and skills that need to be owned by the students, (3) check the level of students' understanding of the material being studied and (4) develop and implement a subject matter which is considered difficult to be learned by the students.

4. Concept Comprehension Test

Test is a measurement for samples from individual's behavior which is taken from systematic process [13]. Based on the form of the question, is divided into essay test and objective test. Essay test is a test with a bunch of question which needs analytical answer. Essay test is good for measuring the realm of cognitive understanding, application, analysis, synthesis, and evaluation. Objective test is a test which has alternative answer. It is good for measuring the realm of cognitive knowledge, understanding, application, and analysis [14].

In this study, we called the test as a concept comprehension test. It is used to measure student's understanding after joining learning process. It is build based on indicator of test result's achievement which is an elaboration from standard competencies.

A. Elaboration Learning (EL)

EL is a model of the sort of learning new ideas based on what students know before [15]. It is the process of sorting the ideas of new information, so that learning will become more meaningful [16]. It is quite helpful for students who have no prior knowledge more, but for students who have prior knowledge in below average grade need assistance more than a teacher [17].

The EL learning theory uses the seven components of strategy: (1) the order of elaborative for the main structure of teaching, (2) the order of the prerequisites of learning, (3) summary, (4) synthesis, (5) analogy, (6) cognitive strategy activator, (7) control of learning [18]. Based Merrill and Twitchell (1994: 80) The EL learning strategy has several advantages as (1) there is a sequence which includes the whole making it possible to increase motivation and meaningfulness, (2) giving the possibility to the students to experience different things and decide the order of the learning process in accordance with her wishes, (3) to facilitate students in developing the learning process quickly, (4) integrate a variety of approaches in accordance with the design variables theory[19].

B. Concept comprehension

Concept comprehension is the ability to capture and control more than a number of facts that have a connection with a specific meaning. The understanding in learning physics is much more dominant than rote elements [20]. Concept comprehension itself is one of cognitive domains. They are grouped into seven categories and cognitive processes: (1) to interpret, (2) pointed out, (3) classifies, (4) summarizes, (5) concluded, (6) compare and (7) explains. Based on the seven categories that exist in this study will be limited to only six categories, they pointed out, classifying, summarizing, inferring, comparing, and explaining [21].

C. Scientific attitude

Scientific attitude is one part of the nature of learning physics covering the processes, products and attitude. Scientific attitude of students is very influential in student learning outcomes. This is one form of intelligence possessed by each individual. In this study, we restrict four dimensions of scientific attitude that is curiosity, the attitude of respect for the facts, critical thinking attitude and the attitude of open thinking.

METHODS

A. Types of research

This study belongs in the realm of research and development (R & D). The main objective of this research is to develop set of physics learning based on EL to increase concept comprehension and scientific attitude.

B. Time and Place of Research

Research conducted in Stella Duce 1 Yogyakarta of Senior High School in the first semester of the academic year 2015/2016 with the subject of Simple Harmonic Oscillation.

C. Research subject

Research subjects in a limited test phase consisted of 34 students of class XI Stella Duce 1 Yogyakarta MIPA 3 Senior High School. Samples from this study took two classes through random cluster sampling technique. Subject research sample consisted of 35 students of class XI MIPA 2 as an experimental class and 35 students of class XI MIPA 1 as the control class.

D. Procedure

The procedure of research conducted in this study was eight off ten steps in research and development [22]. Research steps include (1) a preliminary study, (2) planning, (3) development of an early form of the product, (4) limited testing, (5) the revision of the results limited testing, (6) the research trials, (7) the revised results research trials and (8) dissemination.

E. Data, Instruments and Data Collection Techniques

Data collected in the study include (1) the data feasibility of the product by two experts (lecturers) and 2 practitioners (teachers), (2) data concept comprehension which is measured using a test form about multiple choice and (3) data scientific attitudes were measured using questionnaires and observation.

F. Data Analysis Technique

1. Data Feasibility Products

Assessing the feasibility of the product is calculated using the Content Validity Ratio (CVR). CVR is used to assess whether set device that rated valid or not valid for research. CVR should be calculated using the following formula 1.

$$CVR = \frac{\left(Ne - \frac{N}{2}\right)}{N/2} \tag{1}$$

with Ne is the number of validators who had agreed (to give the same score) and N is the number of the validator. Based on Table 1, the items have value CVR > 0 are used.

Table 1. Criteria CVR value [23]

No	CVR Value	Criteria
1	-1 < CVR < 0	Not Good
2	0	Good
3	0 < CVR < 1	Very Good

2. Implementation of Lesson Plans

Analysis the implementation of Lesson Plans by calculating the average of score given by the observer and transform into criteria based on the conversion actual score. Percentage implementation of Lesson Plans are determined using the following formula 2.

$$R = \left(1 - \frac{A-B}{A+B}\right) \times 100\% \tag{2}$$

R is percentage implementation of Lesson Plans, A is a higher score than the observer and B is a lower score than observers. The instrument has a good score if the instrument has a value R > 75% [24].

3. Response Questionnaire Students

Student questionnaire responses given in the experimental class. The purpose of this questionnaire to assess the student's response to the device and the implementation of physics based on EL material Simple Harmonic Oscillation. The questionnaire data analysis using the following formula 3.

$$\%\ response\ score = \frac{\sum answer\ \ "Yes"}{\sum Students} \times 100\% \tag{3}$$

4. Concept Comprehension Data and Scientific Attitude

To determine the effect of the use of EL physics based learning model towards an improved concept comprehension and scientific attitudes of students used a statistical test that multivariate data MANOVA included in parametric statistical tests. Data that is tested is Gain concept comprehension and scientific attitudes of students. The Gain calculation is done using the formula 4 normalized Gain.

$$< g >= \frac{\%posttest - \%pretest}{100 - \%pretest} \quad (4)$$

The categories of normalized gain value is shown in Table 2.

Table 2. Categories of value Gain normalized [25]

Average Value Gain normalized	Categories
1.0 > (⟨g⟩) > 0.7	High
1.0 > (⟨g⟩) > 0.7	Moderate
0.3 > (⟨g⟩) > 0.0	Low

Manova test aimed to examine the relationship between learning based on EL with concept comprehension and scientific attitudes. There are four types of statistical tests first multivariate Pillai's Trace, second Wilks'Lambda, third and fourth Hotelling's Trace is Roy's Largest Root. In this study Manova test is done with the help of SPSS for windows version 21, with a significance level (α) is 0.05. The hypothesis can be stated as follows.

H_0: No effect of the use learning based on EL with concept comprehension and scientific attitudes of students.

H_a: There is the effect of the use learning based on EL with concept comprehension and scientific attitudes of students.

Decision-making criteria are: If the significance value ≤ α then H_0 rejected and if the significance value ≥ α then H_0 accepted.

This research was conducted in Menoreh Hills which is administratively included in Kokap District, Kulon Progo Regency, Yogyakarta Province, Indonesia. The selection of research sites in Menoreh Hills Kecamatan Kokap due to the research area including areas experiencing environmental problems are very high that is the degradation of land due to erosion and landslide events. Through this research is expected land use directives conducted in accordance with the ability of a land, so that land degradation that has occurred can be reduced. The location of the study is presented in Figure 1.

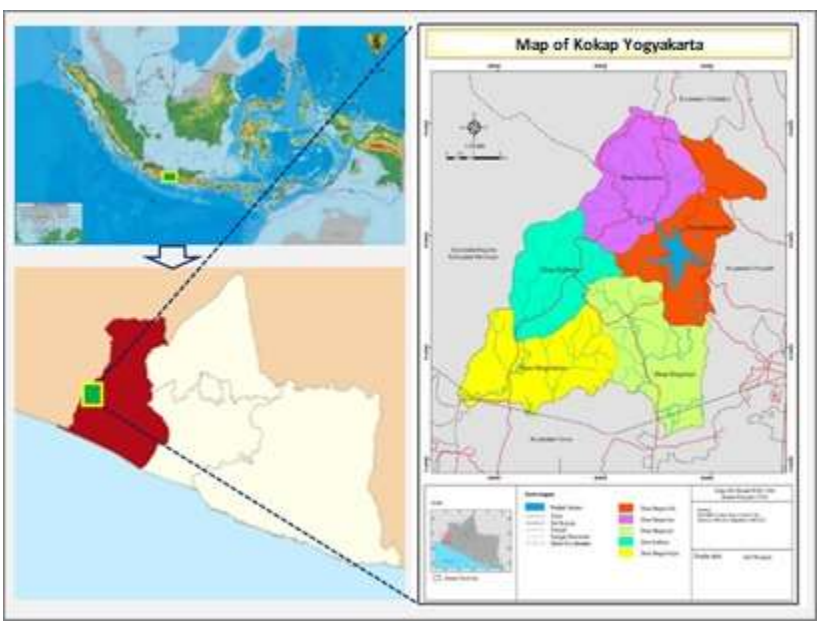

Fig 1. Study Area

Data

In accordance with the purpose of research, then the first step is to determine the level of erosion hazard. Determination of erosion hazard by using erosion prediction model [12], with the formula:

$$A = R \cdot K \cdot L \cdot S \cdot C \cdot P$$

Explanation:
A : erosion (ton/hectare/year)
R : rainfall erosivity factor
K : soil erodibility factor
L : slope length factor
S : slope inclination factor
C : crop management factor
P : land management factor

The predicted erosion (A) predicted results with subsequent USLE models with a thick solum approach are used to determine the level of erosion hazard. The results of large erosion calculations by thick solum approach are then matched with the erosion hazard classification table as presented in Table 1.

Table 1. Classification of Erosion Hazard Level

Thick Solum Soil (cm)	Erosion (ton/hectare/year)				
	I < 15	II 15 - 60	III 60 - 180	IV 180 - 480	V > 480
> 90	SR	S	S	B	SB
60 – 90	R	B	B	SB	SB
30 – 60	S	SB	SB	SB	SB
< 30	B	SB	SB	SB	SB

Explanation: SR=very low, R=low, S=moderate, B=weight, SB=very weight
Source: Hardjowigeno dan Widiatmaka (2011)

Table 2. Classification of Land Capability

Factors	Land Capability Class							
	I	II	III	IV	V	VI	VII	VIII
1. Slope	L_1	L_1	L_2	L_3	L_1	L_4	L_5	L_5
2. Erosion Sensitivity	KE_1, KE_2	KE_3	KE_4, KE_5	KE_6	(1)	(1)	(1)	(1)
3. Erosion	e_0	e_1	e_2	e_3	(2)	e_4	e_5	(1)
4. Effective Depth of Soil	k_0	k_1	k_2	k_3	(1)	(1)	(1)	(1)
5. Top Layer Texture	t_1,t_2,t_3	t_1,t_2,t_3	t_1,t_2,t_3,t_4	t_1,t_2,t_3,t_4	(1)	t_1,t_2,t_3,t_4	t_1,t_2,t_3,t_4	t_5
6. Lower Layer Texture	sda	sda	sda	sda	(1)	sda	sda	sda
7. Permeability	P_2,P_3	P_2,P_3	P_2,P_3	P_2,P_3	P_1	(1)	(1)	P_5
8. Drainage	d_1	d_2	d_3	d_4	d_5	(2)	(2)	d_0
9. Gravel/Rock	b_0	b_0	b_1	b_2	b_3	(1)	(1)	b_4
10. Flood	O_0	O_1	O_2	O_3	O_4	(2)	(2)	(1)
11. Landslide	LS_1	LS_2	LS_3	LS_3	(2)	LS_4	LS_5	LS_5

Source: Arsyad with modifications (2012)
Explanation: (1) = can have any properties (2) = not applicable LS = modified factors

Having obtained the level of erosion hazard, the next is to determine the classification of land capability. The classification of land capability is to group land based on the ability and characteristics of the land for a particular purpose of use. The relationship with land conservation planning is that the land use class will be considered for referrals in land use in accordance with the natural capacity of the land. Classification of land capability used is classification according to Arsyad and added with a factor of occurrence of a landslide in research area [1]. The land capability classification is presented as in Table 2.

The next step is to determine the priority of land conservation based on the level of erosion hazard (Table 3) and land capability (Table 4). The classification of land conservation priorities is presented as Table 5.

Table 3. Erosion Hazard Level Score

No	Level of Erosion Hazard	Score
1	Very Low	50
2	Low	40
3	Moderate	30
4	Weight	20
5	Very Weight	10

Table 4. Field Capability Score

No	Land Capability Class	Score
1	I	80
2	II	70
3	III	60
4	IV	50
5	V	40
6	VI	30
7	VII	20
8	VIII	10

Table 5. Classification of Land Conservation Priorities

No	Priority Score	Priority Classification	Potential Degradation
1	20,00 – 56,90	I	High
2	57,00 – 93,90	II	Moderate
3	94,00 – 131,00	III	Low

RESULTS AND DISCUSSION

This research aims to develop products such as physics learning based on EL. Learning model developed aims to produce set of physics learning based on EL are eligible for use in learning to increase concept comprehension and scientific attitude. Learning model developed poured in the form of set such as lesson plans, handouts, student working sheet and concept comprehension test, observation lesson plans, observation sheets scientific attitude, scientific attitude questionnaire sheets and sheets student questionnaire responses. There are four validators in this research, two experts and two practitioners. Results of the assessment of set products based on the CVR is as follows.

Table 3. Assessment CVR

No	Set	Score ***X***	Category
1	Lesson Plans	1	Very Good
2	Handout	1	Very Good
3	Student Working Sheet	0.96	Very Good
4	Concept Comprehension Test	0.8	Very Good
5	Scientific Attitude Questionnaire	1	Very Good
6	Observation Scientific Attitude	1	Very Good
7	Student Questionnaire Responses	1	Very Good
8	Observation Lesson Plans	1	Very Good

Based on Table 3 set has an average value of the CVR of 0.8 to 1. From the scores obtained, the set that have been assessed as eligible are used for limited testing with very good categories.

Implementation of Lesson Plans were analyzed using descriptive statistics with the average score. Implementation of lesson plans outcome data are shown in the Table 4.

Table 4. Data implementation of lesson plans

Meeting	O1	O2	R (%)
1	22	23	97.78
2	23	23	100.00
3	23	22	97.78

Description O1 is the first observer, the observer O2 is 2 and R is the percentage implementation of lesson plans. Result from first meeting, second meeting and third meeting implementation of lesson plans has a value R > 75%. We can conclude that good implementation of lesson plans.

Response Questionnaire Students outcome data are shown in the table 5.

Table 5. Data Response Questionnaire Students

No	Response	Percentage (%)
1	Attention	85.56
2	Relevance	89.09
3	Confidence	77.62
4	Satisfaction	80.00

Based on the Table 5 of four responses that have the highest percentages of relevance responses 89.09% and the lowest percentage response is confident of 77.62%.

Based on the results presented pretest and posttest score of N-gain concept comprehension and scientific attitudes to the control class and experimental class.

Table 6. Score **N**-gain Concept Comprehension

Class	Category						N-gain	
	Low		Moderate		High		High	Low
	Amount	%	Amount	%	Amount	%		

Control	11	60.00	21	60.00	3	8.57	0.89	0.21
Experiment	0	0.00	31	88.57	4	11.43	0.79	0.33

Based on Table 6 it can be seen that in the experimental class the number of students who fall into the category medium and high with the number of 35 students more than in the control class with the number of 24 students.

Tabel 7. Score N-gain Scientific Attitudes

Class	Category						N-gain	
	Low		Moderate		High		High	Low
	Amount	%	Amount	%	Amount	%		
Control	11	60.00	21	60.00	3	8.57	0.89	0.21
Experiment	0	0.00	31	88.57	4	11.43	0.79	0.33

Based on Table 7 it can be seen that in the experimental class the number of students who fall into the category medium and high with 28 students more than in the control class with the number of 21 students.

Manova test used to determine differences an increased concept comprehension and attitudes between the experimental class and control class is included in the significant category. Test results at the (α) 0.05 significance level are presented in Table 8.

Table 8. Test Results of Manova

No	Effect	F	Significant values are calculated
1	Pillai's Trace	6.475	0.003
2	Wilks'Lambda.	6.475	0.003
3	Hotelling's Trace	6.475	0.003
4	Roy's Largest Root	6.475	0.003

Table 6 shows that the value of F to Pillai's Trace, Wilks'Lambda, Hotelling's Trace and Roy's Largest Root significance ≤ 0.05. Based on the hypothesis, if H_0 rejected then H_a accepted. Thus it can be concluded that there is the influence of the use learning based on EL with concept comprehension and scientific attitudes of students

CONCLUSION

The conclusions of this research and development are (1) Developing set of physics learning based on EL in this study fit for use in learning with very good categories, based on the assessment CVR of experts and practitioners with an average value of 0.8 to 1 (2) Developing set of physics learning based on EL in this study to increase concept comprehension and scientific attitude of Senior High School students based on the average score on a test N-gain concept comprehension for the control class of 0.40, and the experimental class of 0.56. On average scientific attitude score of N-gain for the control class of 0.33 and the experimental class of 0.44. (3) The results of Manova test showed that the value of the F significance 0.05. Based on the hypothesis, if rejected then there is the influence of the use learning based on EL with concept comprehension and scientific attitudes of students. Advice can be given for further product development is the product tested on more material so that it can reflect that the EL based learning model can improve concept comprehension and scientific attitudes of students in general.

ACKNOWLEDGMENTS

We thank to Antonius Haryanto and Linus Karyanto, teachers at Stella Duce 1 Yogyakarta Senior High School for some discussions. This research was supported by Post Graduate Program of Yogyakarta State University.

REFERENCES

1. S. Salmiza, *The Level of B.Sc.Ed Students' Conceptual Understanding of Newtonian Physics* (International Journal of Academic Research in Business and Social Sciences, 1, **3**, 2011).
2. L.M. Schroeder, Cultivation and the Elaboration Likelihood Model: A Test of the Learning and Construction and Availability Heuristic Models (Journal of Communication Studies 56, **3**, 2005), pp. 227–242.
3. N Ding., R.J. Bosker and G.E Harskamp, Exploring gender and gender pairing in the knowledge elaboration processes of students using computer-supported collaborative learning, (Journal of Computers & Education 56, 2011), pp. 325–336.
4. Y Aydin, The effects of problem based approach on student's conceptual understanding in a university mathematics classroom (Procedia Social and Behavioral Sciences 152, 2014), pp.704 – 707.
5. Fakhruddin, Eprina Elva and Syahril, Sikap Ilmiah Siswa Dalam Pembelajaran Fisika Dengan Penggunaan Media Komputer Melalui Model Kooperatif Tipe Stad Pada Siswa Kelas X.3 SMA Negeri I Bangkinang Barat (Geliga Sains 4 (1), 2010), pp.18-22.
6. Olasehinde Kayode John and Olatoya Rafiu Ademola, *Scientific Attitude, Attitude to Science and Science Achievement of Senior Secondary School Students in Katsina State, Nigeria* (Journal of Educational and Social Research MCSER Publishing, Rome-Italy Vol. 4 No.1 January 2014).
7. Hale Bayram and Arif Comek, Examining the relations between science attitudes, logical thinking ability, information literacy and academic achievement through internet assisted chemistry education (Procedia Social and Behavioral Sciences 1, 2009), pp. 1526–1532.
8. Sutrisno, *Fisika dan Pembelajarannya* (Universitas Pendidikan Indonesia, 2006).
9. Suparno, Paul, Metodologi Pembelajaran Fisika Kontruktivistik dan Menyenangkan (Yogyakarta, Universitas Sanata Dharma, 2003).
10. Departemen Pendidikan Nasional, Undang-Undang No.20 TH.2003, "Sistem Pendidikan Nasional", Jakarta, 2003.
11. BSNP, Permendiknas No.22 Tahun 2006, "Standar Kompetensi Lulusan untuk Satuan Pendidikan Dasar dan Menengah", Jakarta: Depdiknas, 2006a.
12. BSNP, Permendiknas No.22 Tahun 2006, "Standar Kompetensi Lulusan untuk Satuan Pendidikan Dasar dan Menengah", Jakarta: Depdiknas, 2006c.
13. Brown, A.L.and Page, A., "Elements of Functional Analysis", Butler & Tanner Ltd. Frome and London Cronbach, Lee. 1970.
14. Gronlund, N.E., *Constructing Achievement Test* (USA: Prentice-Hall, Inc, 1977).
15. Ormrod, J. E., *Human Learning* (United States of America: Pearson Education, Inc, 2011).
16. Kalyuga Slava, "Knowledge elaboration: A cognitive load perspective", Learning and Instruction 19: pp.402-410, 2009.
17. Blankenstein Floris et. al, "Elaboration during problem-based group discussion: Effects on recall for high and low ability student", Journal of Adv in Health Sci Educ 18: pp.659–672, 2013.
18. Reigeluth, Charles M. and Stein, F.S., "The Elaboration Theory of Intruction. Instructional design theories and models: An Overvie of their Current Status", Edited by Charles M. Reigeluth. Hillsdale, New Jersey: Lawrence Erlbaum Associates Publishers, 1983.
19. Merril, M. D., and Twitchell, "Instructional Design Theory", New Jersey: Englewood Cliffs, 1994.
20. Sutadi Novitasari, "Pemahaman Konsep Listrik Arus Searah dan Kemandirian Belajar Siswa SMK melalui Pembelajaran Science Literacy Circles", Prosiding Pertemuan Ilmiah XXVIII HFI Jateng & DIY, Yogyakarta, 26 April 2014 ISSN : 0853-0823.
21. Anderson, L.W. and Krathwohl, D. R,, "A taxonomy for learning, teaching and assessing, a revision of bloom's of educational objectives," New York: David Mckay Company, Inc. 2002.
22. Borg, W.R., and Gall, M.D., Educational research: An introduction. (4th ed). New York & London: Longman. 1983.
23. C.H. Lawshe, A Quantitative Approach To Content Validity. A paper presented at Content Validity [1, a conference held at Bowling Green State University, 1975 PHRSONNHL PSYCHOI.OGY.INC 1975, 28, pp 563-575
24. Borich, Gary D. (1994). *Observation Skills for Effective Teaching*. The University of Texas: USA
25. Hake, R.R., "Analyzing Change/Gain Scores", Dept. of Physics Indiana University, 1999.