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Development of Interactive Multimedia Learning to Improve Analytical Thinking Ability of Elementary School Student on Water Cycle Material

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Abstract

Development of interactive multimedia is an alternative solution for learning in elementary schools that are not optimally delivered through direct observation, more precise for science learning on water cycle material that has difficulty delivered in the classroom to facilitate the achievement of basic competence that has the same achievement with 21st century competence that is analytical thinking ability. Based on this urgency, this research has a purpose to know the procedure of developing interactive multimedia learning that can improve analytical thinking ability on the water cycle material and know the effectiveness of interactive multimedia developed to improve analytical thinking ability of the elementary student. The method is research and development of Lee and Owens model (assessment and needs analysis, design, development and implementation, and evaluation). The research result was: (1) interactive multimedia learning to improve analytical thinking ability on water cycle material reached standard on validation of three experts (material, media, and language) and four practitioners (all validators in each aspect or 100% validators approve interactive multimedia product to be implemented in learning) as well as student review in the limited group trial of interactive multimedia developed is positive (the percentage gain of each aspect is in excellent interpretation), (2) interactive multimedia learning developed effectively to improving analytical thinking ability of elementary school student.

Keywords: *interactive multimedia learning, analytical thinking ability, the student of elementary school, and the water cycle.*

Introduction

The rate of information technology development invited Indonesia's education innovation at an urgency level. Teachers as educational practitioners who are directly concerned with students are expected to utilize information technology as an intermediary to create successful learning. That is can be an emphasis solution because of every new and emerging technology in a society open opportunities for teachers to develop innovative learning planning and help students to achieve competence through learning intermediaries (Rosado, Arguero, and Rojas, 2014).

The result of observation and interview revealed that the education unit in Pulogadung has a computer information technology equipped with computer/laptop, Liquid Crystal Display (LCD), projector, and speaker used for Information and Communication Technology (ICT) learning needs, administration, and extracurricular activities. Other data from the interview result indicate data that the learning media used in IPA study is presented in the form of drawings provided by the school, manual images written on the board with a limited information base from a limited source/module book or presentation impressions displayed on the projector screen. The available media have not been able to solve the students' difficulties in achieving the science-learning competence with a complex concept and difficult to bring to class to observe. Characteristics of the concept of IPA is owned by the concept of water cycle material. According to Ahi (2017), water cycle material belongs to a complex topic, making it difficult for teachers to deliver to students in the classroom.

Commonly used learning media have not been able to facilitate the characteristics of elementary school students. The characteristic is to enjoy playing and demonstrating itself / directly and starting to have independent skills (Soemantri, 2015). According to Piaget (Crain, 2007), the characteristics of the media that have been used have not been able to facilitate the character of students in thinking concretely with the thought is

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more organized in a mental foundation (began to explore the ability to think), more specifically the ability of analytical thinking as mandate of basic competence that must achieved on the water cycle topic.

Analytical thinking ability acts as the basis of a person toward high-level thinking skills that are expected to improve because according to the Research Center of Education Research and Development Agency, the results of Indonesia's participation in Trends in International Mathematics and Science Study (TIMSS) in 2015 positioned the students' is below the prescribed standard with a score of 26 from a standard value of 44. Bloom (Montaku, Kaittikomol, and Tiranathanakul, 2012) states that analytical thinking ability in detail serves as the ability to check information to gain reinforcement by identifying causes, making inferences, and looking for evidence to support a specified conclusion.

The results of the assessment and needs analysis are also obtained from the questionnaires of teachers and students. Teacher questionnaire results show that data tend to require media that accommodate the achievement of learning objectives. The results of student questionnaires show data that 100% of students tend to require media that can be used alone, 95.24% tend to want science learning using computer-based media, and 81.87% tend to expect computer-based media displayed in the form of a video or a clear image.

Based on the data obtained from the assessment and needs analysis that has been implemented, the development of interactive multimedia learning IPA is an appropriate alternative to meet the needs that have been identified. Multimedia belongs to the second level after direct observation according to the theory of Dale's Cone of Experience capable of presenting a concept that can not be directly observed into a concrete learning experience through a model or simulation of a direct experience (Dale, 1946).

Multimedia developed is accompanied also with interactive packaging. Interactive in question is the user can enter and manipulate data directly as needed in the multimedia that is being used as an intermediary in the achievement of learning competencies (Aldalalah and Ababneh, 2015).

Developed interactive multimedia also has a novelty value, namely the overall design of interactive multimedia is developed oriented to facilitate the characteristics of elementary school students and improve students' thinking ability analysis. More explicitly, the development is implemented in two research objectives, namely to know the procedure to develop interactive multimedia science learning to improve the thinking ability of analysis on the water cycle material and to know the effectiveness of interactive multimedia developed in improving the thinking ability of elementary school students.

Method

The development of interactive multimedia science learning to improve the thinking ability of elementary school students analysis on water cycle material is based on research and development method of Lee and Owens model. This model is guide in conducting research to develop multimedia-based products (Lee and Owens, 2004).

There are four stages implemented to develop a multimedia product, namely assessment and needs analysis, designing, developing and implementation and evaluation. The four stages must be implemented in order.

Assessment and needs analysis phase is detailed into the needs assessment and analysis activities. Both stages are implemented to pursue and determine the products needed and will be developed.

The second stage is designing. At this stage the preparation of elements of products to be developed including determining collaborators and schedules.

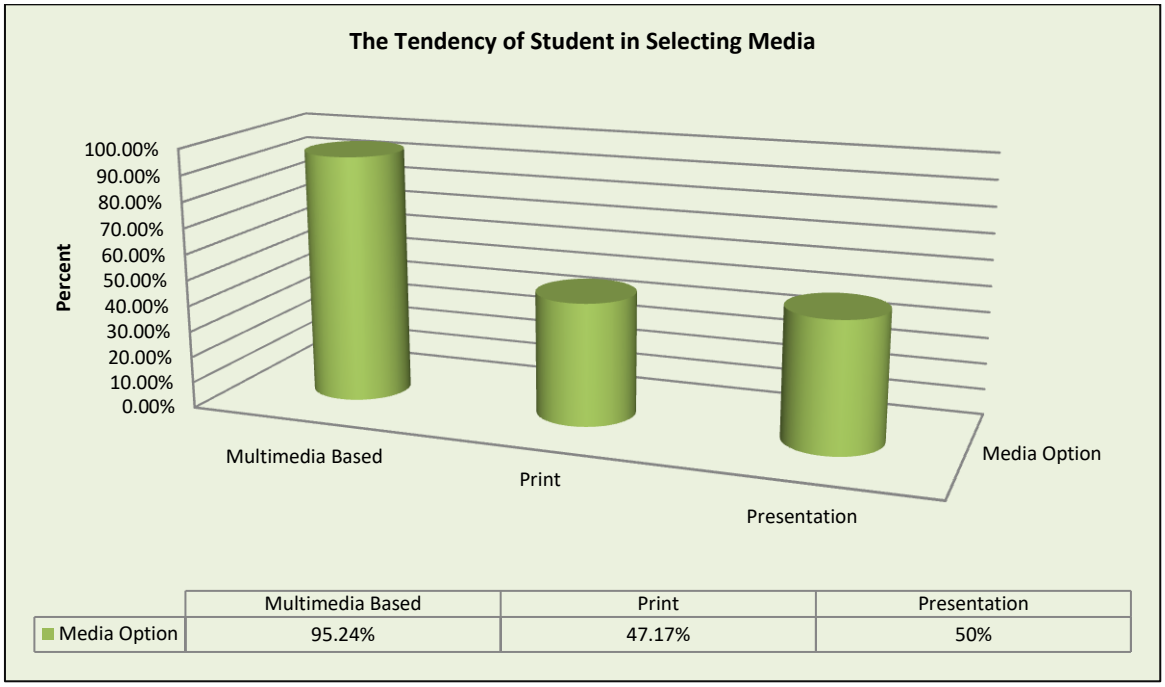
The third stage is the stage of development and implementation. At this stage, there are two major stages that must be implemented, namely the process of developing and implementing. The stage of developing the form of making .exe format using Adobe Flash CS6 application and validation conducted by three experts (material, media, and language) along with four practitioners, while the implementation stage is the application of interactive multimedia that has been valid in the process of learning group trials limited or the whole group. The subjects who conducted the trial were the students of grade V SD Al Azhar 13 Rawamangun and Islamic Elementary School At-Taqwa Rawamangun.

The last stage is the evaluation. Evaluation in this research was conducted three validation, that is face content (material expert, media, and language accompanied by 4 practitioners) and test item validity (material and language expert accompanied by 4 practitioners) as measured by questionnaire. The success criteria of interactive multimedia products developed must meet a minimum percentage of 80% (four of the five validators give their approval of each aspect of the assessment indicator) are then analyzed in descriptive form. As for the improvement of students' thinking ability analysis is measured from the average difference of pretest and posttest result of the students using Paired Samples Test statistic assisted by SPSS 16.0 for windows program with significance level $\alpha = 0,05$.

Results

1. Procedures for Developing Interactive Multimedia Learning Science that Can Improve Analytical Thinking Ability of Elementary School Student

Based on the results of the questionnaire and needs analysis data filled by students, explaining that students are very interested in all matters related to computers, as well as computer-based media (multimedia) that can be directly interacted by them. This is evident with the acquisition percentage obtained based on students' choice of multimedia is 95.24%, greater than the choice of print media of 47.17% and presentation choices by 50%. More clearly can be seen in Figure 1.



	Multimedia Based	Print	Presentation
Media Option	95.24%	47.17%	50%

Figure 1 Percentage of Student Trades Selecting Media

Student questionnaire results also show data that the water cycle material is the concept of science material in class V is most considered difficult. The student's opinion is proven by the percentage gain of 50.63%, greater than the material of heat transfer of 29.94% and the substance (single and mixed) of 40.26%. The results of interviews and teacher questionnaires show data that the product developed should be able to facilitate all the learning components and characteristics of students. Thus, it can be concluded that the product to be developed is interactive multimedia learning on the water cycle material to improve the basic competence mandate in it, namely the ability to think analysis.

Interactive multimedia is developed using Adobe Flash CS6 application and stored in .exe format. Interactive multimedia also meets every element that has been prepared in storyboard-aided program Microsoft Office Powerpoint 2007.

Interactive multimedia products that have been finished and stored in .exe format will then be validated in its entirety by an IPA material expert, a media expert, a linguist, and four practitioners through test items, content, and face validity and a review of five students in limited group trials. Four practitioners were involved to validate the interactive multimedia products along with the questions contained in it. Validation results conducted by experts and practitioners then tested to students as many as 5 people to know the response of students to interactive multimedia for later given follow-up if there are still parts that have not been appropriate.

Validation results obtained through experts and practitioners in every aspect (material, media, and language) reach 100% percent with each indicator of the assessment is on the scale of choice agreed and strongly agree. The results of a limited trial conducted by 5 students reached a maximum percentage (100%), which means students provide a positive assessment of the development of interactive multimedia learning science. Based on the validation and review results obtained it can be concluded that the product is valid to be implemented in learning to improve analytical thinking ability.

2. The effectiveness of Interactive Multimedia Learning Developed in Improving Thinking Ability of Elementary School Student Analysis

The effectiveness of interactive multimedia developed in improving analytical thinking ability can be seen from the difference of mean result of pretest and posttest of the student. The students' pretest result obtained an average of 35.01, while the posttest result obtained an average of 72.57 with an N-gain gain of 0.58. The improvement of analytical thinking ability after implemented interactive multimedia-based science teaching was also confirmed by p-value obtained from Paired Sample Test statistic test as shown in Table 1.

Based on the information listed in Table 1 it can be seen that the p-value obtained is 0.000. This means that p-value <0.05 or H0 is rejected, so it can be concluded that there is a significant increase in thinking the ability of student analysis.

Table 1 Result of Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-37.47067	11.07383	1.65079	-40.79761	-34.14372	-22.699	44	.000

Discussion

1. Procedures for Developing Interactive Multimedia Learning that Can Improve Thinking Ability of Elementary School Student Analysis on Water Cycle Material

Procedures in developing interactive multimedia science lessons that can improve students' thinking skills in class V analysis of the water cycle refer to the development research stages of Lee and Owens. This model has been proven to be used as a research guide for developing interactive multimedia on the material of the human respiratory system (Akbar, 2016).

The first activity undertaken to develop interactive multimedia in improving analytical thinking skills is to analyze the products needed to be developed. The interactive multimedia of IPA learning is identified as the required product and will be developed through questionnaires given to teachers and students as well as interviews with teachers. Based on the results of needs analysis, interactive multimedia required and will be developed must have the following elements.

1.1 Five teachers as respondents stated that the media that has been used has not been able to facilitate learning to improve students' thinking ability, so that interactive multimedia product teachers developed must be able to facilitate meaningful science learning and be able to achieve the expected competence (not only focus on the knowledge aspect but must be able to develop the ability to think and have life skills). Djumhana (2009) emphasized that science learning should be able to open opportunity and facilitate the students to explore and cultivate the curiosity of scientific procedures and to assist students in understanding various phenomena as evidence of students' thinking ability to develop.

1.2 The interactive multimedia product presents the concept of water cycle because 50,63% tend to be determined by teacher and student have difficulty characteristic delivered in class because this concept has obstacles if packed with direct experiment. Teachers and students tend to conceptualize the water cycle in harmony with the results of Ahi's research (2017) which reveals that the water cycle material belongs to a complex topic, making it difficult for teachers to deliver to students in the classroom. The difficulty in conveying the concept of the water cycle on the learning process of pursuing the development of multimedia products should have the function of providing a concrete learning experience through simulation of direct experience. The simulation of direct experience as a form of interactive multimedia developed is an alternative solution that can be used for learning characteristics that cannot be presented by direct observation, as Dale (1946) states that multimedia is at the second level after direct observation (multimedia can be implemented when the concept cannot be packaged using direct observation, so that it is presented through the help of a model or simulation of a direct experience that can provide a concrete learning experience).

1.3 100% of students tend to want to use the media directly, so the developed multimedia concept should be able to facilitate the needs of grade V elementary school students, such as the needs of students to play, direct interaction / direct use of media used in learning, but not ignore the competencies that must achieved students as the basic competence mandate on the concept of water cycle, namely the ability to think analysis. Overall needs of grade V elementary school students are facilitated through the development of interactive multimedia learning of science. It is according to Ariani and Haryanto (2010) that multimedia characteristics that have the ability to accommodate user responses, facilitate students to be independent, and able to facilitate students to control the rate of learning.

1.4 The developed interactive multimedia is composed of clear images, videos, texts, and animations, corresponding to the concept of the water cycle, and facilitates student activities based on analytical thinking indicators. This is done because 95.24% of students tend to choose multimedia-based media as an intermediary learning. All interactive multimedia components will then be presented through tutorial formats, exercises, simulations, experiments, and games. According to Rusli and Atmojo (2015), the packaging of interactive multimedia through the overall format presented facilitates in conveying information messages or instructions making it easier for students to achieve competence in this study that is the improvement of students' thinking ability analysis.

1.5 The five teachers as respondents revealed that the learning medium that has been used does not meet all the learning components including the evaluation, so they give their opinion that the media to be developed must meet all the learning components including the instrument questions. The question instrument to be presented in an interactive multimedia developed contains the concept of the water cycle and is able to measure the analytical thinking indicator analyzing,

examining, separating, filing, solving, differentiating, illustrating, summarizing, outlining, and detailing into sections.

Elements that are prepared to develop interactive multimedia according to needs analysis are not only components for the product, but all instruments that will evaluate the product must be prepared. Assessment instruments prepared in the form of statements is to be presented in a questionnaire. The statements should be able to evaluate the material, media, and language aspects of the developed interactive multimedia. The material aspect must be able to evaluate the whole concept of the water cycle presented in multimedia as well as in the matter, the language aspect should be able to evaluate the suitability of the language used in multimedia and the problem with PUEBI, and the media aspect should be able to evaluate the multimedia capabilities in facilitating the use and facilitating the achievement of the objectives. All aspects that become indicators of assessment are expected to realize a valid interactive multimedia and meet all indicators of product success required.

All validation results reach 100% percentage (all validators express their approval of developed interactive multimedia and analytical thinking skills, even with revisions). Material aspect (interactive multimedia and problem), media aspect (interactive multimedia), and language aspect (interactive multimedia and problem) are that aspect of assessment is in good and excellent criteria.

The results of a limited trial also reached a maximum percentage which means students provide a positive assessment of the development of interactive multimedia learning science. Statement relating to student's pleasure towards the implementation of science learning using interactive multimedia reaches 100% percent. The percentage proves that fun and interesting learning can be facilitated when students become subject of learning directly involved in learning, especially using tools or media directly rather than as learning objects that only pay attention to the teacher's presentation. Essel, et al (2016) emphasized that multimedia can present diverse and dynamic situations, so students are more interested in learning. Multimedia can also facilitate the characteristics of students to interact directly, as Erikson stated that children in primary school age tend to react interactively (Devitt and Ormrod, 2007). In addition to happy aspects of implementing learning, developed interactive multimedia also facilitates students in improving analytical thinking skills. This is reflected from the percentage obtained from the empirical validation of students, that is 100% of students obtain ease in carrying out activities oriented meet the indicators of analytical thinking ability. Piaget (Crain, 2007) also revealed that the characteristics of elementary school students do have concrete thinking, but with more organized thinking in a mental foundation (beginning to explore the ability to think).

2. The effectiveness of Interactive Multimedia Learning Developed in Improving Thinking Ability of Elementary School Student Analysis

The effectiveness of interactive multimedia developed in improving analytical thinking ability can be seen from the difference of mean result of pretest and posttest of the student. The result of pretest of students obtained an average of 35.01, while the posttest result obtained an average of 72.57. The increase of analytical thinking ability after the implementation of interactive multimedia-based science teaching was also confirmed by the acquisition of N-gain of 0.58 and p-value obtained by 0.000, meaning p-value <0.05 or H0 is rejected, so it can be concluded that there is a significant increase in the thinking ability of student analysis.

The interactive multimedia learning IPA developed as a whole facilitates the optimal learning process, including science learning on the water cycle material. According to Ahi (2017), water cycle material is a difficult topic when delivered using direct observation, complex topics to convey in the classroom (a scourge of difficulty for teachers to convey and students to receive information, so modeling or simulating a direct experience which can provide a concrete learning experience). The model/simulation aid is interactive multimedia which is the second level after direct observation in Dale's Cone of Experience/multimedia theory can be implemented when the concept cannot be packed using direct observation (Dale, 1946).

The success of interactive multimedia to construct information related to IPA concepts, so as to improve student test results has been proven by Lee and Osman. According to Lee and Osman (2012), interactive multimedia can improve students' understanding and motivation on electrochemical materials. The developed interactive multimedia has the same element in the content that is discussed, the science and the students' motivation in carrying out the learning, but the concepts and competencies achieved have different. The interactive multimedia developed by Lee and Osman contains the concept of electrochemistry and is developed to enhance students' motivation and understanding, while the interactive multimedia developed in this study discusses the concept of the water cycle to improve one of the 21st-century capabilities, namely analytical thinking ability.

One of the factors of achieving competence of analytical thinking ability through the development of interactive multimedia science learning is the composition in it. This capability can be facilitated by the full presentation of information in the form of text, images, sound, video, and animation related to water cycle concept learned through the interactive multimedia product of science learning. Complete information can facilitate students in identifying the problems/conditions of various aspects, so that found the parts of the problem/condition that the source, the relationship of

the various parts, and various alternative solutions to the problems/conditions. The ability is analytical thinking ability, as Bloom (Sitthipon, 2013) explains that the ability to think analysis is the ability to identify and classify differences in some aspects of the object, story or condition into parts, so that there is a relationship between the parts, be it cause or effect or any other part to understand or see the relation of some of the things proposed.

Increased analytical thinking ability was facilitated because the overall presentation contained in interactive multimedia developed able to facilitate the characteristics of elementary school students, especially class V in the learning process. The interactive multimedia presentations developed include clear tutorials to guide students in understanding water cycle concepts, mini-experiments to clarify concepts and facilitate students to carry out live observation simulations, game drills that students can directly use and increase students' interest in learning and evaluation can be directly seen by students. It facilitates and facilitates students in responding directly to learning, facilitating the characteristics of students who enjoy playing and watching, facilitating them in obtaining information as knowledge, and facilitating students to develop the ability to be independent.

Based on all the explanations that have been described, all aspects of interactive multimedia learning IPA developed to facilitate and facilitate students in achieving the expected competencies, namely the improvement of 10 indicators ability to think ability analysis. In more detail Montaku, Kaittikomol, and Tiranathanakul (2012) explain, 10 indicators are analyzed, divine, separate, order, breakdown, discriminate, illustrate, infer, outline, and subdivide.

The interactive multimedia of IPA learning developed proves that the implementation of the learning that facilitates the students interact directly in constructing information, finding and implementing their opinion gives the expected impact, namely the increase of student achievement in the form of student interest in learning, understanding the concept of water cycle, and further students' thinking ability analysis. The condition is aligned presented Aldalalah and Ababneh (2015) in the results of his research that interactive multimedia can facilitate students in responding, and everything that can improve student achievement. Siagian, Mursid, and Wau (2014) revealed that interactive multimedia has a positive impact on the context of learning, students become active and increase student motivation in learning. All of the positive impacts described by some research results prove that the improvement of process and learning result can be pursued by the existence of an interactive multimedia development of learning.

Conclusion

First, the procedure of developing interactive multimedia learning to improve analytical thinking skills on water cycle material is stated to meet the standard / valid by three experts (material, media, and language) and four practitioners (five of all validators in each aspect or 100% validator approves interactive multimedia products to implement in learning) as well as student review in a limited group trial of interactive multimedia developed is positive (the percentage gain of each aspect is an excellent interpretation). Second, the effectiveness of interactive multimedia science learning developed in improving students' thinking skills in class V analysis is proven. It can be seen from the results of testing the difference of two average using Paired Sample Test, namely sig. p-value obtained 0.000, meaning p-value (Sig.) <0.05 or H0 is rejected, so it can be concluded that there is a significant increase in thinking the ability of student analysis.

References

[1]. Ahi, B. (2017). *Enviromental & science education*: The effect of talking drawings on five-year-old turkish children's mental model of the water cycle, **12** (**3**), 350-367.

[2]. Akbar, T. N. (2016). *Teori, penelitian, dan pengembangan*: Pengembangan multimedia interaktif IPA berorientasi guided inquiry pada materi sistem pernapasan manusia kelas V SDN Kebonsuri 3 Malang., **1**(**6**), 1120-1126.

[3]. Aldalalah, O. A. and Ababneh, Z. W. M. (2015). *Education and practice*: Standards of multimedia graphic design in education*,* 6 (**17**), 102-110.

[4]. Ariani, N. and Haryanto D. (2010). *Pembelajaran multimedia di sekolah pedoman pembelajaran inspiratif, konstruktif, dan perspektif.* Jakarta: PT. Prestasi Pustakarya.

[5]. Crain, W. (2007). *Teori perkembangan.* Yogyakarta: Pustaka Belajar.

[6]. Dale, E. (1946). *Audio-visual methods in teaching.* New York: Dryden Press.

[7]. Devitt, T. M. Mc. and Ormrod J. E. (2007). *Child development and education third edition.* United States of America: Pearson Merril Prentice Hall.

[8]. Djumhana, N. (2009). *Pembelajaran ilmu pengetahuan alam.* Jakarta: Direktorat Jenderal Pendidikan Islam Departemen Agama Republik Indonesia.

[9]. Essel, H. B., Poku, P. O., Menson, A. T., and Asare, N. A. O. (2016*). Education and practice*: Self-paced interactive multimedia courseware: a learning sipport resource for enhancing electronic theses and dissertations development,**7** (**12**), 74-84.

[10]. Lee, T. T. and Osman, K. (2012). *Procedia social and behavioral sciences*: Interactive multimedia module in the learning of electrochemistry: effects on students' understanding and motivation, 46, 1323-1327.

[11]. Lee, W. W. and Owens, D. L. (2004). *Multimedia-based instructional design: computer-based training, web-based training, distance broadcast training, performance-based solutions second edition.* San Fransisco: Pfeiffer.

[12]. Montaku, S., Kaittikomol, P., and Tiranathanakul, P. (2012). *Applied sciences*: The model of analytical thinking skill training process*,* **7** (**1**), 17-20.

[13]. Education Research Center of Research and Development Department. *Mengenai TIMSS.* http://www.TIMSS-infographic.pdf (accessed on 25 September 2017).

[14]. Rosado, D. N. V., Arguero, M. E., and Rojas, R. (2014). *Information and education technology*: An adaptive interactive multimedia system for intelligent environments, **4** (**1**), 54-58.

[15]. Rusli, M. and Atmojo, Y. P. (2015). *Education and practice*: Pointer animation implementation at development of multimedia learning of java programming, **6**(**28**), 119-127.

[16]. Siagian, S. Mursid, and Wau, Y. (2014). *Education and practice*: Development of interactive multimedia learning in learning instructional design, 5 (32), 44-50.

[17]. Sitthipon. (2013). *Procedia social and behavioral sciences*: The development of teacher training curriculum on learning management to develop students' analytical thinking in Thailand, 116, 939-945.

[18]. Somantri, M. S. (2015). *Strategi pembelajaran teori dan praktik di tingkat pendidikan dasar.* Jakarta: PT Raja Grafindo Persada.