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THE LEARNING MEDIA DEVELOPMENT OF INTERACTIVE MULTIMEDIA BASED E-LEARNING TO IMPROVE STUDENTS' LEARNING OUTCOME AND SPATIAL THINKING ABILITY OF X IIS STUDENTS IN SMA NEGERI 3 SRAGEN IN THE ACADEMIC YEAR OF 2017/2018
(Using The Subject Of Hydrosphere Dynamics And Its Impact Toward Life)

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Abstract

This research aimed to (1) determine the students' needs upon the learning media development of interactive multimedia-based E-Learning (2) develop the learning media of interactive multimedia-based E-Learning in the material of hydrosphere dynamics and its impact toward life (3) determine the appropriateness of the developed learning media of interactive multimedia-based E-Learning (4) determine the effectiveness of the learning media of interactive multimedia-based E-Learning to improve the students' learning outcome and spatial thinking ability. The method used in this research was research and development method using the development model developed by Dick and Carey. The data collection techniques used were questionnaire/needs analysis questionnaire, validation sheet of material expert, media expert, teacher, students' try out questionnaire, test, and documentation.

The results of this research were (1) the students' needs from the needs analysis result could be concluded that most students have the characteristics of visual learning style, experience/skill in using media with the category of often/skilled, enthusiasm and agreement toward media development, media colour visualization of blue, and font visualization of Comic Sans MS (2) the learning media product development of interactive-multimedia-based E-Learning used Adobe Flash program designed and interactively-presented (self-service) and equipped with supporting materials in the form of pictures, maps, videos, and texts (3) the learning media of interactive-multimedia-based E-Learning was categorized as appropriate based on the evaluation of material expert and media expert who gave the score of 5 (a very good category in the Likert scale), and also the evaluation from teacher and students' try out which had the score of 4 (good category in Likert scale) (4) the learning media of interactive-multimedia-based E-Learning was more effective to improve the students' learning outcome and spatial thinking ability based on the class mean which was higher in the pre-test and post-test results which was improved from 65,8 to 78,4 compared to the Power Point media in which the class mean of pre-test result was 64,4 and the post-test result was 75,2 while the students' spatial thinking ability was improved especially in the region aspect.

Keywords : Media Development, E-Learning, Interactive Multimedia,
Learning Outcome, Spatial Thinking Ability

A. Introduction

Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves,

society, nation and state (UU No. 20 of 2003 concerning the National Education System) [1]. According to Prihadi (2013) The purpose of education is social efficiency by providing the ability to participate in activities to fulfill the interests and welfare of the people freely and optimally [2].

In an increasingly advanced era like now, all information can be obtained easily. [3] The ease of communication is inseparable from the role of modern information and communication technology (ICT). These technological advancements have an impact in various fields including in the education sector. [4] Learners in this age are generations who live in the digital age, where they can easily get information from all corners of the world without knowing space and time and getting other conveniences through digital media. This is supported by the growing and increasingly sophisticated technology such as computer devices and supporting gadgets, so they easily get these devices to be able to access information quickly through these devices [5].

The use of information and communication technology (ICT) in the world of education has been directed to be used in the learning system in schools. This is supported by the existence of school facilities in the form of internet access, namely wireless networks (wifi) that can be used by all school members, especially teachers and students to make it easier to access various information for learning purposes. Learning with teacher control in the classroom is still dominant, students have not totally used the internet as a learning system. With the ease of internet access in the school environment, it will encourage educators to take advantage of this progress. But what is happening now, the facilities that have been provided by the school have not been fully utilized to the learning process. School facilities that have been provided such as computers and internet/wifi networks should be utilized by teachers and students in the learning process to be more effective and efficient [6].

According to Partini (2012) based on previous research, several schools have not been able to present learning media in the classroom and some have not been able to utilize the facilities available at school optimally [7]. Tanwir (2014) also revealed that in schools actually have a variety of learning support facilities but the communication built by educators in learning does not get the response of students because they have not used the available facilities [8].

Geographical subjects have very broad material but are not supported by appropriate time allocations. The lack of available time allocation sometimes also

forces the educator to explain so much material quickly and quickly. The hydrosphere material is the last material in class X even semester. The time allocation in this material is felt very lacking because it collides with the class XII exam schedule, so much time is reduced for preparation for class XII examinations. The material delivered was not necessarily all taught to students [9].

Another possibility is that students are required to study material that has not been taught independently. Learning is done sometimes only seen from the results of learning only without teaching students the ability to think, so sometimes the skills regarding things related to the room have not been well honed. The object of geography study is concrete and close to everyday life, but it will become abstract if it is not supported by clear learning media. This learning material will be more easily understood if accompanied by learning media in the form of maps, images, animations and videos to clarify it. However, if the learning material is only delivered by lecturing students can only imagine in his mind so that sometimes it becomes abstract.

This is one of the factors causing the passivity of students and the low learning outcomes of geography. In geography disciplines known as spatial thinking is a way of thinking that is used to understand meaning in a form, size, location, direction/destination of objects, phenomena or symptoms, or the relative position of various objects, processes or symptoms. The ability of spatial thinking is very important in studying the world (earth) which is related to seeing spatial analysis and visual relationships between objects, such as patterns, locations, and directions, especially to see a problem not only from one side, but also from causes and consequences will appear related to the problem. This ability is felt to be very lacking to be studied because of time constraints, the breadth of material, and the lack of learning media innovations.

The need to improve the quality of education and learning is felt to continue to increase following the development of science and technology. The solution to the problem of education and learning is by conducting research and development. This allows the development of E-Learning learning media based on interactive multimedia. This learning media will be a tool or learning tool that is more effective in delivering material and efficient in the use of time and energy. Learners can learn independently wherever and whenever. The packaged material is made as attractive as possible, such as images, videos, animations, and texts that will make it easier for students to understand and remember material. The

development of this interesting and interactive learning media is expected that students can gain new enthusiasm for learning in the hope that learning outcomes and students' spatial thinking skills can increase. Interactive multimedia-based learning atmosphere will force students to play a more active role in learning. The learning process by using interesting learning media such as E-Leaning based on interactive multimedia will not feel boring and will be more effective.

The purpose of this development research is to : 1) Knowing the needs of students towards the development of interactive multimedia-based E-Learning learning media, 2) Develop interactive multimedia-based E-Learning learning media, 3) Know the feasibility of interactive multimedia-based E-Learning media, 4) Knowing the effectiveness of interactive multimedia-based E-Learning media to improve learning outcomes and spatial thinking ability of students.

B. Materials and Methods

This development research was carried out at Sragen State High School 3 because the school had implemented the 2013 curriculum and in consideration of the availability of computer facilities and internet networks in schools. The type of research used in this study is research and development or Research and Development (R&D) which aims to develop, test the usefulness and effectiveness of the products developed. According to Sukmadinata (2007) research and development or Research and Development (R&D) is a process or steps to develop a new product or improve existing products that can be accounted for [10]. This study uses a development model designed and developed by Dick & Carey.

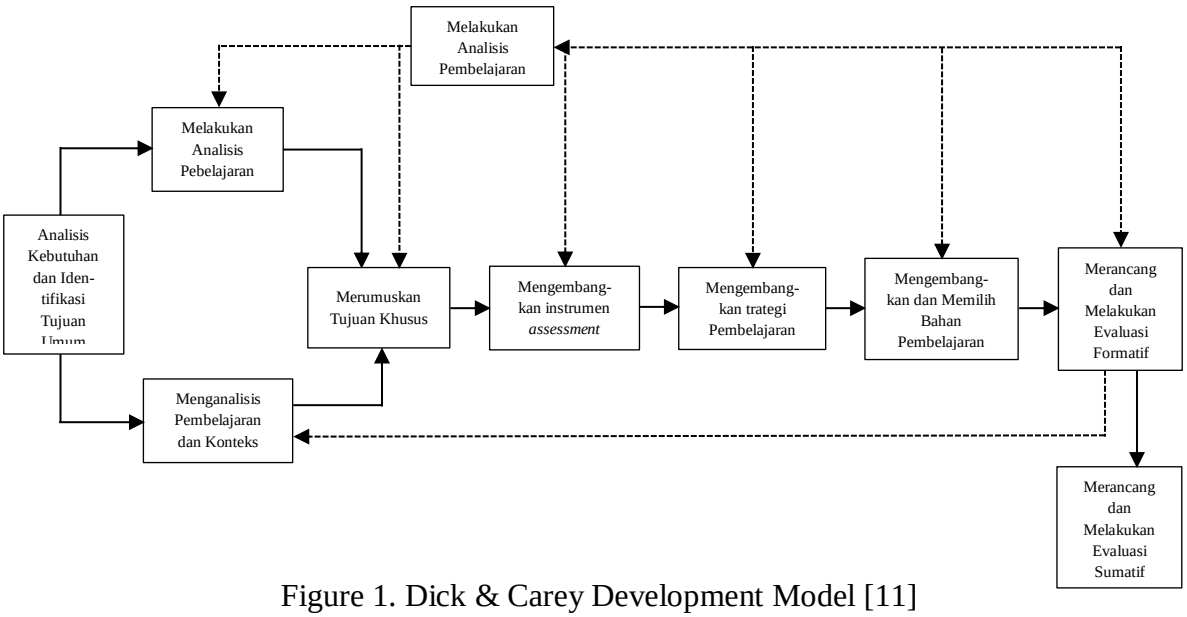

Figure 1. Dick & Carey Development Model [11]

The development steps according to Dick & Carey (2006) consist of 10 steps, as follows : 1) assess needs to Identify goals, 2) conduct instructional analysis, 3) analyze learners and contexts, 4) write performance objectives, 5) develop assessment instruments, 6) develop instructional strategy, 7) develop and select instructional materials, 8) design and conduct the formative evaluation of instruction, 9) revise instruction, 10) design and conduct summative evaluation [12].

This development research is compiled with modifications and adapted to the needs of the research without reducing the substance of the product development procedure to be more in line with the research focus. The data collected in this study are primary data and secondary data.

Primary data in this study include: a) data on student needs (characteristics of learning styles, experience of media use, enthusiasm for media development, b) media color visualization and font), feasibility validation data for interactive multimedia-based E-Learning media from material experts and media experts, educators and students, c) data on the value of the pretest and the posttest value.

While secondary data includes: list of names of students, data on student learning outcomes, syllabus, lesson plans, and other data from school documents needed. The sampling technique used was purposive sampling, a technique for determining research samples with certain considerations aimed at making the data obtained later representative. The population used was all students of class X IIS of State High School 3 Sragen, and the samples used were students of class X IIS 2 (control class), and X IIS 3 (experiment class). Data collection in this study was conducted using questionnaires, test instruments, and documentation.

The data analysis technique used is descriptive technique to describe the product development process. The process of evaluating the feasibility of interactive multimedia-based E-Learning media by analyzing the values that often appear in every aspect that has been described in several indicators using a Likert Scale.

While interactive multimedia-based E-Learning media products are considered effective if there is a difference in the average class value that is higher than the average value of the class using PowerPoint media.

C. Results And Discussion

Research was conducted at the State High School 3 Sragen located on Jalan Dr. Sutomo No. 2, Kampung Beloran Sragen Kulon, Sragen Regency, Central Java. This development research was

carried out using a development model designed by Walter Dick and Lou Carey. Broadly speaking there are 4 main steps, namely: needs analysis, product development, formative evaluation (to find out the feasibility of the product), and summative evaluation (to find out the effectiveness of the product). The following is a description of the results of this study :

1. Analysis of Student Needs

Needs analysis data obtained from questionnaires that have been distributed to 41 class X IIS students randomly. Aspects contained in the questionnaire needs analysis include the characteristics of the learning style of students, experience of using the media, enthusiasm of students towards the development of learning media, color visualization of media, and visualization of fonts. The characteristics of the dominant learning style of students are visual at 37%. This learning style is easy to understand material in visual forms such as images, graphics, and symbols.

Media development is directed to cover all existing learning styles, so that media products are designed and packaged by adding various content such as text, images, maps, and videos according to the needs of students. the experience of using media is known that most students often use and utilize technology such as computers/laptops and internet networks. In addition, students are also classified as skilled in using media even though they have different skills. so that researchers do not need to worry about the skills of students when tested using media. as a whole the students are also enthusiastic and supportive with the development of learning media on geography subjects.

Data from the media color selection analysis showed that most students preferred blue compared to other colors offered in the choice of 37%, and the type of letters most chosen/preferred by students was Comic Sans MS.

2. Media Product Development

Product design planning is carried out to provide an initial description of the product to be developed, namely by selecting basic competencies/subject matter, analyzing the needs and characteristics of students, developing assessment instruments, and making storyboards/flowcharts. Early product development researchers were assisted by programmers from the Informatics Engineering field to develop media.

The material is designed and packaged attractively and also interactively equipped with various content such as text, images, maps and videos according to the needs of students. The media is created using Adobe Flash software. The advantage of using the Adobe Flash

program is that it can display various content such as images, text, animation, videos that are packaged in an interesting and interactive manner.

Product design is designed simply with interesting visualization so students are interested and can understand the material easily. Products that have been developed are then validated by material experts and media experts before being tested at school.

3. Feasibility of Media Products

The feasibility of interactive multimedia-based E-Learning products can be known from the results of validation tests of material experts, media experts, educators, and product trials which include: one to one evaluation, small group evaluations, and field trial evaluation.

Assessment is done by giving a score using the Likert Scale parameter on the assessment sheet that has been determined according to the aspects of the eligibility criteria. Each existing indicator is assessed with a range between 1-5. The assessment criteria for each product feasibility aspect indicator use a Likert scale measurement scale with the following conditions :

Table1. Assessment Scores and Criteria

Score Criteria / Options	Score
Very Good	5
Good	4
Sufficient	3
Not Good	2
Very Poor	1

Source: Nora Mogey in Harvey (1998: 21)

Criteria for interactive multimedia-based E-Learning learning media products are deemed fit for use when obtaining a minimum mode score of 3 (sufficient category). The results of evaluations from material experts, media experts, educators, and students both critics and suggestions are used as reference materials to improve and perfect media products.

The interactive multimedia-based E-Learning media developed by researchers is declared feasible to be used in geography learning in schools because it has met the product feasibility requirements as determined by the researcher. This is based on the results of the assessment by material experts and media experts who get the mode 5 score (very good category).

Table 2. Media Feasibility Assessment

No.	Validation and Trials	Score
1.	Validation of Material Expert	5
2.	Validation of Media Experts	5
3.	Educator Validation	4
4.	One To One Evaluation	4
5.	Small Group Evaluation	4
6.	Field Trial Evaluation	4

Source: R&D Primary Data Analysis, 2018

Some evaluations from the validator that need to be improved are the font needs to be enlarged, the suitability of the media layout, the appearance of material design, navigation, and the addition of material supporting aspects of spatial thinking.

Products that have gone through all stages of assessment and improvements can be concluded that interactive multimedia based e-learning media products are feasible to be used in learning. while the general assessment of the test given by students.

4. Effectiveness of Media Products to Improve Learning Outcomes and Spatial Thinking Ability of Students

The effectiveness of interactive multimedia-based E-Learning media is known through a quasi-experimental or quasi-experimental approach, namely by looking at the comparison of learning outcomes between classes treated in learning using interactive multimedia-based E-Learning media with classes that are learning using PowerPoint media. The classes given treatment are :

a) Class X IIS 2 as a control class, using PowerPoint media.

b) Class X IIS 3 as an experiment class, using interactive multimedia-based E-Learning learning media.

The selection of the class is based on the value of the students from the pretest results who have the same ability of knowledge, skills, and understanding and do not have significant differences in learning outcomes. The ability and initial understanding of students about the hydrosphere material was assessed through a pretest in the form of multiple choices totaling 25 questions with variations of questions based on Bloom's Taxonomy and spatial intelligence, then each class was given a different treatment in learning and at the end of the posttest to find out the results learning and spatial thinking skills of students. The following is the average value of the pretest and posttest class X IIS 2 (control class) and class X IIS 3 (experiment class).

Table 3. Average Pretest and Posttest Values

Class	Average Value	
	Pretest	*Posttest*
Control Class	64,4	75,2
Experiment Class	65,8	78,4

Source: R&D Primary Data Analysis, 2018

Classes that get treatment using interactive multimedia-based E-Learning learning media is class X IIS 3. Based on the table it can be seen that the average grade at pretest is 65.8 and the value of students at posttest has increased with a mean grade of 78.4. Based on the value data it is known that there is an increase in learning outcomes and the ability of spatial thinking of students with a mean difference of 12,6 classes. Interactive multimedia based E-Learning learning media is more effective for improving learning outcomes and learners' spatial thinking abilities are seen from higher average grade values than average classes that use PowerPoint media.

The ability of students to think spatially also increased after using learning media products, especially in the regional aspect, which increased by 56,2%. The following is the percentage of students' spatial thinking ability scores in the experimental class (X IIS 3).

Table 4. Percentage of Students' Spatial Thinking Ability Scores

Category	Percentage of Spatial Thinking Ability		Increase
	Pretest	*Posttest*	
Comparation	37,5 %	78,1 %	40,5 %
Aura	45,8%	84,3 %	38,5 %
Region	31,3 %	87,5 %	56,2 %
Transition	42,2 %	75,8 %	33,6 %
Analogy	43,7 %	83,3 %	39,6 %
Hierarki	46,4 %	85,4 %	39 %
Pattern	47,2 %	81,3 %	34,1 %
Association	40,7 %	82,3 %	41,6 %

Source: R&D Primary Data Analysis, 2018

The following diagram displays the percentage score of spatial thinking ability.

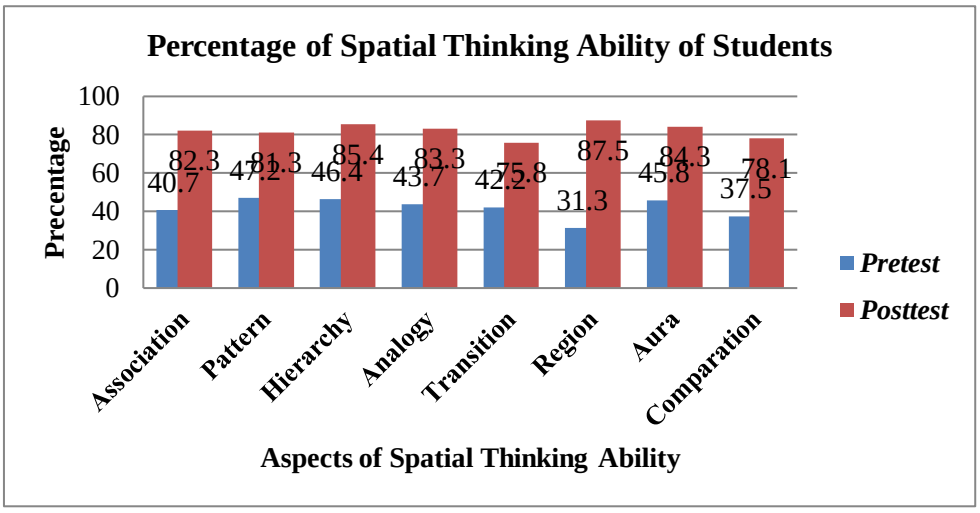

Figure 2. Percentage of Spatial Thinking Ability Score Diagram

The effectiveness of interactive multimedia-based E-Learning learning media to improve learning outcomes and learners' spatial thinking abilities is measured using a t-test or two-difference test (two-sample assuming equal variances) which is done after a prerequisite test, namely the normality test and homogeneity test which states that both classes are normally distributed and homogeneous.

The results of student scores that have been obtained are then tested for normality and homogeneity. The normality test uses the Lilliefors method with a significant level of 5% ($\alpha = 0.05$) assisted by Microsoft Excel. The results of the normality test in each class are as follows :

Table 5. Normality Test Results

No.	Data	Class	Price L		
			L Hitung	L Tabel	Conclusion
1	*Pretest*	Control	0,1497	0,1566	Normal
2		Experiment	0,1464	0,1566	Normal
1	*Posttest*	Control	0,1448	0,1566	Normal
2		Experiment	0,1509	0,1566	Normal

Source: R&D Primary Data, 2018

If $L_{hitung} < L_{tabel}$ then it can be concluded that the data is normally distributed, if Lhitung> Ltabel it can be concluded that the data is not normally distributed. After performing a normality test then perform a homogeneity test to find out whether the sample used is homogeneous or not. The variance homogeneity test uses data on the learning outcomes of the control class and experimental class.

Table 6. Homogeneity Test Results

No.	Data	X^2_{obs}	X^2_{tabel}	Conclusion
1	*Pretest*	1,0925	3,841	Homogeneous
2	*Posttest*	0,6742	3,841	Homogeneous

Source: R&D Primary Data, 2018

If $X^2_{obs} < X^2_{tabel}$, it can be concluded that the data is homogeneous, if $X^2_{obs} > {}^2_{tabel}$, it can be concluded that the data is not homogeneous. The two prerequisite tests that have been carried out can then be continued by testing the effectiveness of the learning media.

The data used are comparative data on the results of learning the posttest of the control class and the experimental class. The effectiveness test uses the Two-Sample Assuming Equal test with a significant level of 5% ($\alpha = 0.05$). The effectiveness test calculation is obtained $T_{hitung} = 2.8724$ and $T_{table} = 1.6698$. Based on these calculations, the test decision is H_0 rejected because of $T_{hitung} > T_{table}$, so it can be concluded that the interactive multimedia-based E-Learning media is more effective in improving student learning outcomes and spatial thinking skills compared to PowerPoint learning media.

The experimental class using interactive media-based E-Learning media on hydrosphere material has a higher average value and when compared to classes that use PowerPoint media. In addition, the increase in the value of learning outcomes and the ability of spatial thinking pretest to the posttest value of the experimental class is also much greater than the class that uses PowerPoint media.

D. Conclusions

Based on the results of data analysis and discussion in this development research, it can be concluded as follows :

1) The needs of students are dominated by the characteristics of visual learning styles, so that it requires interesting and interactive learning media with visualization of media colors and fonts used which are dominant in blue and using Comic Sans MS fonts.
2) The development of media in this study is interactive multimedia-based E-Learning learning media using the Adobe Flash program. The material is designed and packaged attractively and also interactively (self service) and equipped with supporting materials in the form of text, images, maps and videos.

3) Interactive multimedia-based E-Learning media is declared appropriate for use in learning. This is based on the results of assessments from material experts and media experts who get very good categories, while the assessment of product trials in general provided by educators and students get good categories.
4) Interactive multimedia-based learning media E-Learning is more effective for improving learning outcomes and students' spatial thinking skills compared to PowerPoint media. This is seen from the average grade of the class that uses interactive multimedia-based E-Learning media higher than the average class that uses PowerPoint media. The ability of students to think spatially has increased after using this learning media, especially in the region aspect.

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