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Development Of E-Learning For Students' Creative Thinking On Algorithms And Programming In Senior High School

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Abstract:
The ability to creative thinking is one of the focuses in informatics learning on algorithmic and programming materials. Through the process of creative thinking, students learn how to see a solution to a problem from various perspectives and learn how to find innovative answers and solve problems in various ways. One of the competencies that high school students must have in informatics subjects is the ability to understand concepts and use algorithms and programming in the computer field to solve various programming problems, without a well-designed algorithm, the programming process will be wrong, damaged, or slow and not efficient. The purpose of this research is to develop e-learning for students to creative thinking in algorithms and programming in high school. The research and development method used in this research is Research and Development (R&D), in this study the implementation is only up to the sixth step 6. This research was conducted at SMAN 1 Pagelaran Pringsewu Lampung in class X 2019/2020 academic year. The results of the analysis carried out in this study indicate that the condition of the SMAN 1 Pagelaran School and the potential availability of facilities and infrastructure that support the development of e-learning for students to creative thinking in algorithms and programming. The results of the validation of the media expert for the development of e-learning have an average score of 3.82 and the results of the validation of the material experts on an average of 3.75 can be concluded by the expert validators that e-learning is good to implement in senior high school.

***Key Word**: e-learning ; creative thinking ; algorithms and programming.*

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I. Introduction

The ability to think creatively is one of the focuses in informatics learning on algorithmic and programming materials. This is in line with one of the objectives of informatics learning listed in the 2013 curriculum, namely to prepare Indonesian students to have the ability to live as individuals and creative citizens. Every student must have four abilities in the 21st century to be able to compete in the globalization era, namely communication, collaboration, critical thinking, and creative thinking[1]. Creative thinking is a type of thinking that leads to the acquisition of new insights, new perspectives, new approaches, or new ways of understanding something[2]. Through the process of creative thinking, students learn how to see a problem solving from various perspectives and learn how to find innovative answers and solve problems in various ways. The ability to think creatively is an ability that includes four criteria, including fluency, flexibility, authenticity and detail[3].

The competencies that high school students must have in informatics are the ability to understand concepts and use algorithms and programming in the computer field to solve various programming problems, without a well-designed algorithm, the programming process will be wrong, damaged, or slow and inefficient. ability in programming requires thinking skills, such as analysis, design, analogical thinking, evaluation, and reflection[4], it takes creative thinking skills to create algorithms that provide alternative possibilities for solving programming problems quickly and accurately.

To measure the initial creative thinking ability, the researcher gave 4 questions to 30 students in class X 2018/2019 academic year on algorithm and programming material with creative thinking indicators, The pretest results show the ability to think fluently only 46% of students only solve problems with one solution, students have not been able to solve problems in many ways or in different ways, the ability to think flexibly 48% of students have solved the problems given in two ways, but there are error in one of the methods given, the original thinking ability of 42% of students gave other answers that already exist, while in elaboration thinking skills only 41% of students answered by developing ideas.

Based on the test results, it was concluded that the majority of students' abilities were below 50% in solving problems that required creative thinking skills. This means that expressing ideas or thinking about ways to solve various problems, and coming up with new ideas or knowledge is unusual for students. Factors that influence include limited time, media, learning resources and psychological barriers in students as well as the use of facilities and infrastructure that have not been maximally used in the informatics learning process in

algorithm and programming materials. The influencing factors are limited time, media, learning resources, and psychological barriers in students as well as the utilization of facilities and infrastructure that have not been maximally used in the informatics learning process in algorithm and programming materials. The learning strategy has not been able to encourage students to think creatively so that it makes students bored in class. Learning that should be student-centered is in fact still teacher-centered. Students do not have the confidence to express their opinions and thoughts due to shame and fear if their opinions or answers are wrong.

For this problem, it is necessary to develop an alternative development of learning media according to the needs and characteristics of students, namely the development of e-learning-based media to minimize student and teacher difficulties in learning on algorithm and programming materials. By using e-learning media, students are more active in developing their abilities and can improve their creative thinking skills. Previous research stated that elearning can improve students' creative thinking skills[567]. In the digital era, the rapid development of information and communication technology is the main reason for the development of e-learning based learning media. Learning behavior in the current digital generation requires learning media that is suitable for characteristics and can condition students to learn independently.

The selection of online-based learning media considers the ability to store, process, present unlimited information, does not require large production costs when compared to the cost of procuring printed textbooks, web-based teaching materials can easily be updated at any time according to learning needs. Based on the problems and supported by previous research, the aim of the researcher is to develop e-learning for students to think creatively in algorithmic and programming materials in high schools.

II. Methods

The research and development method used in this research is Research and Development (R&D) or often called development (Sugiono, 2012: 297) is a "research method used to produce certain products, and to test the effectiveness of these products". Research and development steps according to Sugiyono include the following steps: (1) potential and problems, (2) data collection, (3) product design, (4) design validation, (5) design improvement, (6) product testing, (7) product revision, (8) use trial, (9) product revision, and (10) mass production. This research was conducted at SMAN 1 Pagelaran Pringsewu Lampung.

The ten steps of Sugiyono's modification of RnD Product Development, in this study the implementation is only up to the sixth step (6). This was done because of limitations, both in terms of time and cost. In this study, the steps carried out by researchers find out how the potential and existing problems by observing, studying literature, reviewing theories and looking for research relevant to the title taken by the researcher and product planning and development includes product design planning, product design making, product validation by experts, product design improvement validation results and e-learning final products.

In this study, the instruments used consisted of test and non-test instruments, the test instrument is used to measure students' ability to use e-learning to improve creative thinking skills, the non-test instrument was used to determine the potential by distributing questionnaires for initial research requirements and expert validation questionnaires.

Data analysis results obtained from teachers and students are used to determine the level of need in the development of e-learning, the data is processed using descriptive statistics. The instrument used has 4 answers, the assessment score can be searched using the following formula:

$$X = \frac{\sum_{i}^{n} = 1^{x_i}}{n}$$

with:

$$x_{i=}\frac{total\ scorer}{Max\ Score} x\ 4$$

(Source, Sugiono 2015)[8]

Information : X = Average
X_i = The operational test score of each student
n= The number of students who filled out the questionnaire

Table no1: The results of the assessment scores of each material expert validator, media expert are then searched for the average and converted to determine the validity and feasibility of e-learning-based informatics learning applications. The following is the eligibility criteria for the average analysis shown in Table1 Kriteria Validasi

T**able1** Kriteria Validasi

Quality Score	Eligibility Criteria	Information
$3,26 < x \leq 4,00$	Valid	No Revision
$2,51 < x \leq 3,26$	Sufficiently Valid	Partial Revision
$1,76 < x \leq 2,51$	Less Valid	Partial revision & review of material / media
$1,00 < x \leq 1,76$	Not Valid	Total Revisions

III. Result

The result of this research is the development of e-learning learning for students in improving creative thinking in algorithmic and programming materials. The procedures that have been described are the results of the design validation obtained in several validators, including the media expert validator and the algorithm and programming material expert validator in accordance with the competencies of expert validation and predetermined criteria Limited trials to see the ease of use and attractiveness of the product were tested on 5 students of class X MIPA 3 SMAN 1 Pagelaran and 5 informatics teachers MGMP Pringsewu. e-learning development webpage view to improve students' creative thinking

Table no2: The results of this study state that for the Media expert validation was carried out to assess whether the e-learning learning application development design to improve students' creative thinking was categorized as proper learning. The aspect assessed by the media expert validataor is the feasibility aspect of graphics which consists of 14 indicators. From table 1, the validation of media experts gets an average score of 3.82 with valid criteria, it can be concluded that the development of e-learning is able to improve students' creative thinking in algorithm and programming material.

Table 2 Media Expert Validation Results

Aspect	Analysis	Validator	
		1	2
Graphics	∑ score	52	50
	x_i	3,86	3,79
	X	3,82	
	Criteria	valid	

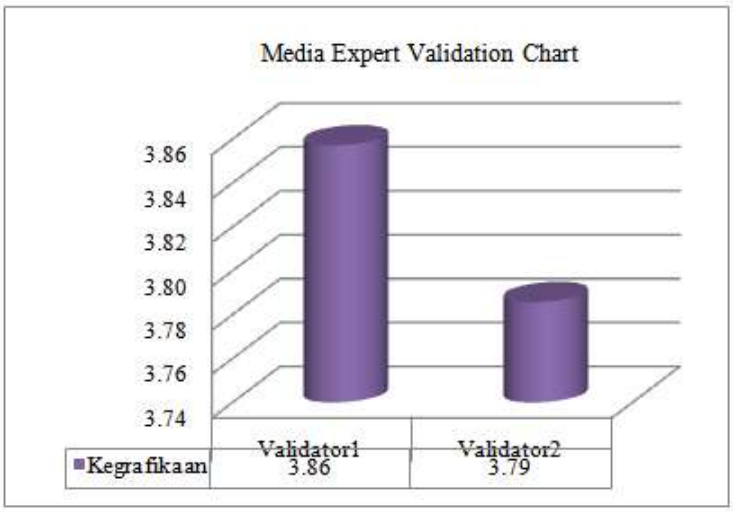
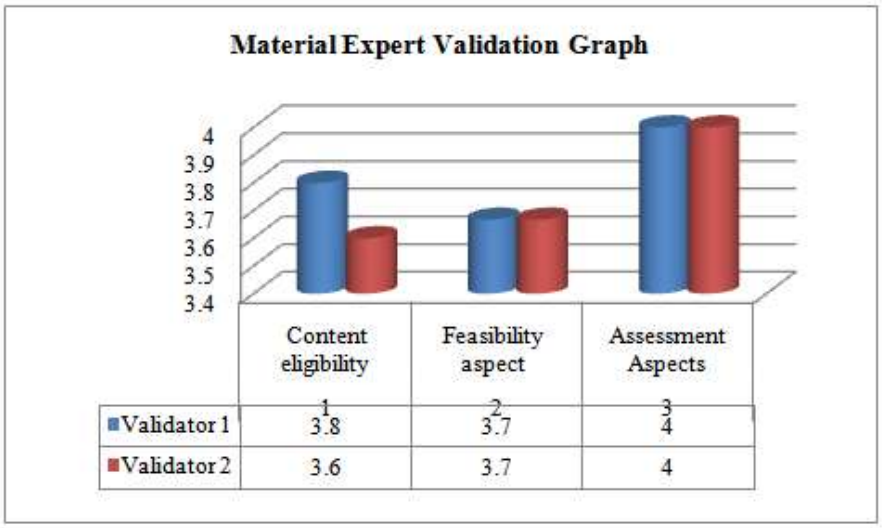


Table no3: Material expert validation is used as a reference to improve whether the material contained in e-learning is in accordance with core competencies, basic competencies and learning objectives. The material expert's assessment consists of three aspect, namely the content feasibility aspect consisting of 5 indicators, the presentation feasibility aspect there are 3 indicators and the contextual assessment aspect there are 2 indicators. The table of the results of the material expert validation explains that the content feasibility aspect gets a score of 3.80 with a decent criterion, the feasibility aspect of presenting a score of 3.70 with a decent criterion and for

the aspect of assessment with a score of 4 the criteria is feasible. The result validation of Material experts gets an average score of 3.75 creteria valid.

Tabel no3 Material Expert Validation Results

No	Aspect	Validator		Total Score	Criteria
		1	2		
1	Content eligibility	3,8	3,6	3,80	valid
2	Feasibility aspect	3,7	3,7	3,70	valid
3	Assessment Aspects	4	4	4	valid
Score average		**3,75**			valid



IV. Discussion

The results of the analysis carried out in this study indicate that the condition of the SMAN 1 Pagelaran School and the potential availability of facilities and infrastructure that support the development of e-learning to improve students' creative thinking. SMAN 1 Pagelaran has facilities and infrastructure such as computer labs, servers, internet connections that can facilitate this development activity. Supported by the ability of teachers and students on the day of observations that researchers have done, students and teachers have the potential to be used to develop e-learning based learning applications, E-learning has a positive and significant effect on the quality of student learning[9]. The development of e-learning is a learning method that combines face-to-face learning with online learning that allows students to learn anytime and anywhere. The development of e-learning is able to present a learning model that motivates, fun and improves students' creative thinking in learning.

The results of the development that the researchers have done are divided into 2 stages:1) The preliminary stage is to determine the potential and problems by making observations, namely direct observation and interviewing informatics teachers and students who have studied algorithm and programming material in class XI regarding constraints during learning, conducting literature studies, reviewing theories and looking for research both from national journals and international, 2) The planning and development stage of the researcher selects and develops appropriate learning media for use at the school level. The media developed is e-learning which involves students in interactive learning by validating material experts and media experts to test the appropriateness of the product being developed, at the testing stage it is only carried out on a limited test of 5 students from class x mipa 3 and 5 informatics teachers to assess whether the product being developed provides convenience and attractiveness to students in participating in learning.

E-learning systems in virtual learning environments can develop creative thinking for students[10], creative thinking or creativity is a problem-solving activity carried out through an unconscious experiential process in which it includes fluency in generating a number of ideas, flexibility, using time to produce various types of solutions , new ideas or resulting solutions[11]. It can be concluded that the development of e-learning by researchers is very helpful for students in improving creative thinking in algorithmic and programming materials.

In the results of the feasibility test by media experts carried out on the feasibility aspect of graphics consisting of 14 indicators, it gets an average score of 3.82 with a description of the development product is suitable for use. Feasibility in testing media experts is very necessary because media is a component in the environment of students that can stimulate students to learn[12].

The results of the product feasibility test by material experts consist of three aspects, namely the content feasibility aspect consisting of 5 indicators, the presentation feasibility aspect there are 3 indicators and the contextual assessment aspect there are 2 indicators with a total average score of 3.75 with a description of the development product is feasible for use. The feasibility factor of e-learning is considered feasible by material experts because the product developed is in accordance with core competencies and basic competencies, e-learning is deemed feasible if it meets the three elements: 1) validation by experts; 2) validation of practitioner users (professional teachers); 3) audience validation by students[13].

V. Conclusion

Based on the results of research and development, it can be concluded that the potential and conditions of the school are very supportive for the development of e-learning based learning applications to improve students' creative thinking at SMAN 1 Pagelaran, Pringsewu Regency. The results of the validation of the media expert got an average score of 3.82 for the results of the validation of the material experts, which had an average score of 3.75 result valid . It was concluded that the development of e-learning for students' creative thinking on algorithmic material was feasible for use in high school.

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