



# The Development of Interactive Instructional Media Oriented to Creative Problem Solving Model on Function Graphic Subject

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## ABSTRACT

The main purpose of this research was to result Interactive Instructional Media Oriented to Creative Problem Solving Model. The method of this research used research and development method by 4-D of development model those were consisted by Define Stage, Design Stage, Develop Stage and Disseminate Stage. However, this research was limited to Develop. The research subjects on individual limited test were as much 2 students, on field trials were as much 20 students. Instrument those were used to get the data in this research were questionnaire and documentation. Technical that was used to analyse the data was percentage descriptive counting. The result of this research showed that development of Interactive Instructional Media Oriented to Creative Problem Solving Model had gone well that was proved by means of learning result was 81.10 when the simulation of using interactive instructional media

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## 1. Introduction

The function graphic is one of core teaching material that is tested in calculus learning at school of IT unit level and applies to all existing departments. The teaching in mathematics learning is started from concretely then is continued to abstract that corresponding with the one of mathematics characteristics which has abstract object. So many students have difficulty in learning mathematics. It is caused of the mathematics characteristics. One of material that the abstract characteristics which is still difficult in understood and analysed by students is the function graphic. This material is one of the mathematics learning materials that is taught in calculus subject, which of course this material has been linked to previous material. But in this case students are still having difficulty analysing and finding solutions to solve problems those are related to the problems of applying graph functions. This abstract nature of mathematics that need the media to help learn it concretely because if in this case only relying on verbal explanations while teaching then it will not be able to help students understand it. (Howlitschek & Joeckel, 2017).

Preliminary observations was conducted through interviews with mathematics lecturers and STMIK STIKOM Bali students showed that only a few students wanted to take lessons well when lecturers used computer-based learning media to help carry out mathematics teaching. While some other students were busy with their own activities. This is due to the fact that lecturers themselves rarely provide opportunities for students to find functional graph concepts independently, students are only told to watch and memorize a formula that has been presented through learning media, so that the activity and process skills are not well-honed. Student-oriented learning models are considered insufficient to be applied in order the learning process of function graphics becomes meaningful. Because in addition to implementing a student-oriented learning model. It is necessary to develop a learning media that is more innovative, contextual, and not be boring, and most importantly, students can be directly involved in using this media. So that students can use the knowledge that they have to guide students in building new knowledge, and of course this will be able to attract students to actively find solutions in solving problems

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from the case which relate to the material of function graphic. One of the developments of interactive learning media that can be developed is in the form of developing interactive instructional media oriented to the Creative Problem Solving model. Where interactive instructional media oriented to Creative Problem Solving model that be meant is instructional media that is oriented in accordance with the syntax of Creative Problem Solving model. The design of learning media will be made as interactive as possible so students can be directly involved in its use and will use a computer application in the form of GeoGebra.

This research refers to some of the research results that is related to the development of instructional media to enrich the discussion and study of researchers. The research results on the use of GeoGebra in geomatic learning (Wihardjo et al., 2016) have similarities with what researchers have done in terms of utilizing GeoGebra applications, while the difference is output/product that was resulted. Wihardjo et al. used the utilizing of GeoGebra to find out the differences between learning outcomes of students who were taught using GeoGebra and without using GeoGebra, while researchers used the utilizing of GeoGebra to create interactive instructional media. The research results on the use of the Creative Problem Solving model in mathematics learning (Pratiwi et al., 2014) have similarities to what researchers have done in terms of utilizing the Creative Problem Solving model while the difference is the outcome/product which was resulted. Pratiwi et al. used the Creative Problem Solving model as a mathematical learning model that was applied in class to support student interest and learning outcomes, while researchers used the Creative Problem Solving model as an orientation for developing interactive instructional media. The research results on the utilizing of GeoGebra in mathematics learning (Nur, 2016) have similarities with what researchers do in terms of utilizing GeoGebra applications, while the difference is the output or product that was result. Nur used the utilizing of GeoGebra to carry out mathematics learning, while researchers used GeoGebra to create interactive learning media.

Referring to the problems and research results those were related to Geogebra and the Creative Problem Solving model that have been done before, so that the researchers are interested in conducting research on The Development of Interactive Instructional Media Oriented to Creative Problem Solving Model.

## 2. Method

The method that was used in this study was the research and development method. The development design that be used was the 4-D development model, which has 4 stages (Trianti, 2007), namely:

### a. Define Stage

The purpose of this stage was to set and define the learning conditions were begun with analysing objectives of the material boundaries that was developed by the device. This stage includes 3 main steps, namely: 1) Literature Study of Package Books, Instructional Materials Guide Book, and Software User Guide, 2) Software Installation, 3) Curriculum analysis, learning objectives, material and conceptual framework

### b. Design Stage

The purpose in this stage was the development and manufacture of interactive learning media. This stage consisted of several steps, namely: 1) Compilation of benchmark reference content was the first step that connects between set up and design stages. Content was prepared based on the results of specific learning objectives formulation (basic competencies), and 2) Selection of formats. it was for example in the selection of this format was able to be done by reviewing the formats of existing devices and those were developed in more advanced countries.

### c. Develop Stage

The purpose of this stage was to produce interactive instructional media that had been validated based on expert input. This stage included: 1) Media validation by experts was followed by revisions, 2) Simulation was the activity of *operationalizing* the teaching plan, and, 3) Limited trials with students. The results of stages 2 and 3 were used as the basis for revisions. The next step was further testing (field trials) with students who were in accordance with the actual class.

### d. Disseminate Stage

This stage is the stage when it use of devices that have been developed on a wider scale for example in other classes, in other schools, by other teachers. Another goal is to test the effectiveness from the use of devices in teaching and learning activities. However, this research was limited to the Develop Stage.

Research on the development of interactive instructional media oriented to Creative Problem Solving model was carried out at STMIK STIKOM Bali which is located at Jl. Raya Puputan No. 86 Renon, Denpasar-Bali. The data sources of this development research were obtained from students, lecturers and experts. The data types of this research were quantitative data and qualitative data. Quantitative data

were consisted of the results from student responses and media validity while qualitative data were in the form of literature studies and curriculum analysis results.

The method of data retrieval from student responses was taken using evaluation tool in form of test. Data from media validity results were taken using a questionnaire which was tested by experts with small revisions. The collection of qualitative data from this research was taken using documentation. Data from the questionnaires that were collected had been analysed using descriptive percentages counting in the form of scores. Formula that was used to calculate the percentages was as follows (Sudrajat, 2008).

$$\text{Percentage} = \frac{\sum (\text{Answer} \times \text{Each Choice Weight})}{n \times \text{Highest weight}} \times 100\%$$

Note:

$\sum$  = Sum

n = sum of all questionnaire items

Next to calculate the percentage of entire subject. It was able to use the following formula:

$$\text{Percentage} = \frac{F}{N}$$

Note:

F = Sum of percentage from all subject

N = number of subjects

In providing meaning and decision making at the level of accuracy or effectiveness then percentage results were converted to the following levels of achievement scale:

Table 1 Achievement Level Scale

Achievement Level (%)	90-100	80-89	65-79	55-64	0-54
Criteria	Excellence	Good	Enough	Less	Poor
Affirmation	No Revision Needed	Small Revision	Revision	Revision	Revision

### 3. Results and Discussion

Based on the stages of the 4-D development model that was used to develop interactive instructional media oriented to Creative Problem Solving model, then there are several things that will be explained, as follows.

#### A. Define Stage

There were five main steps that must be carried out in the defining stage, namely:

##### 1. Front End Analysis

This stage was done to find out the problems that occur in the learning process of calculus subject at STMIK STIKOM Bali. Based on the results of direct observations that were conducted by researchers during the learning process in classroom and the results of interviews with lecturers of calculus courses, there were several problems were found, namely: a) Students still have difficulty analyzing and finding solutions to solve problems that are related to problems of applying the function graphic in calculus subject, b) Learning activities are still centered on lecturers, c) Tutorials and computer-based instructional media that have been used by lecturers in mathematics at STMIK STIKOM Bali have not been able to attract the learning interest of some students, d) The interest and concentration of students who lack focus when lecturers use computer-based instructional media to help do mathematics teaching, e) There is no direct involvement of students in the use of instructional media so students are less skilled in finding basic concepts of abstract mathematics, f) There is no use of interactive instructional media that is used in the process of learning Mathematics optimally yet, g) Limitations of instructional media when involving students in their use, h) There is no student-oriented interactive instructional media so as to be able to realize an active, creative, effective and enjoyable learning process, and i) *Analysis of Students*.

STMIK STIKOM Bali students are referred to as students in this matter. The number of students which be analysed was 20 students (10 high ability people and 10 low ability people). Based on the results of observations in classroom learning, between students who have high and low abilities gave almost the same reaction or response to the learning process that occurs. Where only few student who wanted to take lessons well when lecturers used computer-based instructional media to help done teaching mathematics while some other students were busy with their own activities. This was due to the fact that

lecturers themselves rarely provided opportunities for students to find functional graph concepts independently. Students were only told to watch and memorize a formula that had been presented through learning media, so that the activity and skills in the learning process were not well-honed.

### 2. Task Analysis

At this stage were done of analysis of the material that will be developed in interactive instructional media is oriented towards the Creative Problem Solving model. The conformity of the teaching material presented must be relevant to the core competence and basic competencies that had been determined by the education unit, based on a predetermined curriculum analysis. The materials that were presented on interactive instructional media oriented to Creative Problem Solving model, including:

#### PRELIMINARY

It is explain the concept of Graph Functions in general and the importance of studying Function Charts in this view.

#### BASIC COMPETENCIES

It presents the goals that must be achieved in studying the Function Graph in this view.

#### RELATION

it presents: 1) general set, 2) relation concept, 3) arrow diagram, 4) Cartesian diagram and 5) sequential pair set in this view.

#### FUNCTION

It presents about: 1) the concept of Functions and 2) Forms of Functions and Graphs (Linear Functions, Quadratic Functions and Rational Functions) in this view.

### 3. Concept Analysis

At this stage were done of identification and analysis from the concepts that will be presented in interactive instructional media oriented to Creative Problem Solving model. The concepts of interactive instructional media were oriented to syntax of the Creative Problem Solving model. The Creative Problem Solving model has four syntaxes, namely: understanding the problem, arranging a problem solving plan, implementing a problem solving plan and re-examining the problem solving.

## B. Design Stage

This stage was carried out with the aim of designing interactive Instructional media oriented to Creative Problem Solving model so that a prototype of Mathematics learning media was obtained which was still in the form of an initial draft. In addition, at this stage the limited trial instrument was designed to test the draft. The stages that must be passed at this planning stage include:

### 1. Arrangement of a Benchmark Reference Test

At this stage was done of test preparation that was used to measure the ability of students to do the problem solving. The test that was arranged in this research was the final test to measure students' problem solving abilities after utilizing interactive instructional media oriented to Creative Problem Solving model in the learning process. The assessment score that was used to measure the results of the student's problem solving ability test was using the five scale of Benchmark Reference Assessment because this approach required a minimum percentage of mastery from student problem solving abilities. The Five Scale of Benchmark Reference Assessment score can be seen in table 2 below.

Table 2 The Five Scale of Benchmark Reference Assessment score to student's problem solving ability test

Percentage of Mastery	Score	Letter Value	Predicate
90 – 100	4	A	Excellence
80 – 89	3	B	Good
65 – 79	2	C	Enough
40 – 64	1	D	Less
00 – 39	0	E	Poor

Note: It was declared to pass, if at least they have the ability of 65%

### 2. Media Selection

At this stage, the determination and selection of media was used to present the interactive instructional media oriented to Creative Problem Solving model. Based on the front end analysis, student analysis, task analysis, concept analysis and analysis of available support facilities, the media that was able to present interactive instructional media was oriented to Creative Problem Solving model in order to can directly involved students in their using and simulation was *GeoGebra*.

### 3. The format Selection

The interactive instructional media oriented to Creative Problem Solving model developed was created using one of the computer application programs that can be used as a instructional media for mathematics that was *GeoGebra*. *GeoGebra* has variety of facilities that can be used to create interactive instructional media that can involve students directly when applying it. It was can helped students in developing their own thinking and creativity in expressing a problem that was considered most appropriate to answer a case.

### C. Develop Stage

At this stage the validation of interactive instructional media oriented to Creative Problem Solving model in the hope of getting input or revision from experts, so that the media that was developed can be a better media. The things those were done at this stage include:

#### 1. The Validation of Interactive Instructional Media Oriented to Creative Problem Solving Model

The validation results those were conducted by three experts on interactive Instructional media oriented to Creative Problem Solving model can be seen in table 3 below.

Table 3. The Results of Expert Validation on Interactive Instructional Media Oriented to Creative Problem Solving Model

No	Aspects that was Evaluated	Expert		Jml	Percentage (%)	Revision
		I	II			
1.	Educational Criteria			13	86	Small Revision
2.	Cosmetic of Program			12	80	Small Revision
3.	Technique Quality			13	86	Small Revision
	<b>Means</b>				<b>84</b>	

It was as for some inputs or revisions that were provided by experts on interactive instructional media oriented to Creative Problem Solving model that had been validated and the revision results that had been made can be seen in full on Table 4 below.

Table 4. The Revision Results of Interactive Instructional Media Oriented to Creative Problem Solving Model

No.	Revision Aspect	Expert	Before Revision	After Revision	Appropriateness
1.	Educational Criteria	II	please add forms of exploration so that there are more than 3 types	It has contained 9 types of exploration forms	Proper to use
		III	Please add images that reflect the shape of mathematical problems	It has an image that reflects the shape of a mathematical problem.	Proper to use
2.	Cosmetic of Program	I	Please use bold letters on each post title	In each post title uses bold letters	Proper to use
		III	Please use sound effects that help in the process of thinking students.	It has contained sound effects that help in the process of thinking students	Proper to use
3.	Technique Quality	I	please use the Safety Program so that the program cannot be changed by the user (cannot be edited)	The Safety Program has been used so that the program cannot be changed by the user (cannot be edited)	Proper to use
		II	Please add instructions for using the program to make it easier for users	It added instructions for using the program to make it easier for users	Proper to use
			Please use animation to	The animation has	Proper to use

No.	Revision Aspect	Expert	Before Revision	After Revision	Appropriateness
		II	load material in everyday life.	been used to load material in everyday life.	

### 2. Simulation from the Use of Interactive Instructional Media Oriented to Creative Problem Solving Model

At this stage was done of simulation activity used interactive instructional media oriented to Creative Problem Solving model on the learning process in class that only involved 2 students. First of all in this simulation process, students were involved in learning that utilized interactive instructional media oriented to Creative Problem Solving model then they was given a case where the assessment results of problem solving from this case can be used as the score of test results. The simulation test results on the used of interactive instructional media oriented to Creative Problem Solving model at STIKOM Bali can be seen in full on table 5 below.

Table 5. Simulation Results on the Used of Interactive Instructional Media Oriented to Creative Problem Solving Model at STIKOM Bali

No.	Students	Score
1.	Alamsyah	82
2.	Suarini Lomi	80
	<b>Means</b>	<b>81</b>

### 3. Limited Trials

At this stage a limited trial on the use of interactive instructional media oriented to Creative Problem Solving model was carried out on 20 students that took Calculus subject. The results of the limited trial can be seen in table 6 below.

Table 6. Limited Test Results of Using Interactive Instructional Media Oriented to Creative Problem Solving Model at STIKOM Bali

No.	Students	Score
1.	I Gede Eka Widiastra	83
2.	Sang Putu Satria Megaartha	87
3.	I Gede Wira Aditya Pratama Putra	85
4.	Ade Alan Setiawan	80
5.	Agus Dickna Yudisthira	78
6.	Ni Luh Ayu Shintia Dewi	76
7.	Ni Kadek Omi Mayuni	85
8.	I Putu Indrayana	83
9.	Ni Putu Krisnadewi	78
10.	Ni Kadek Pajar Kusumawati	77
11.	Sugeng Dwiastanto	77
12.	I Nyoman Arie Indrawan	79
13.	Wayan Mitha Utami	87
14.	Ni Luh Putu Ayustini	76
15.	Ulfatus Saadah	83
16.	Oksa Candra MArtadinata	85
17.	Muhammad Nisar Alip Saputro	83
18.	A. A. Made Semberiana	78
19.	Refo Junior Farigia	85
20.	Anne MarthaAgustie Marpaung	77
	<b>Means</b>	<b>81,10</b>

Two students were involved in the simulation activities on the used of interactive instructional media oriented to Creative Problem Solving model. The averages of learning outcomes were 81.00. If the average value was matched with the percentage level on achievement of the five scale so the simulation activities that used interactive learning media oriented to Creative Problem Solving model were

appertained to run well. In a limited trial that involved 20 students were used to measure student responses on the use of interactive instructional media oriented to Creative Problem Solving model at STIKOM Bali by the average of learning outcomes were 80.65. If the average value was matched with the percentage level of achievement on the five scale so the used of interactive instructional media oriented to Creative Problem Solving model at STIKOM Bali had included going well.

#### **4. Conclusions and Suggestions**

The design of the development on the used of interactive instructional media oriented to Creative Problem Solving model that used the 4-D development model design by utilizing the Geogebra application program had gone well because it can resulted interactive instructional media oriented to Creative Problem Solving model that is feasible be used. This was evidenced by the average of learning outcomes of 81.00 when simulation on the used of interactive instructional media oriented to Creative Problem Solving model. Student responses to the used of interactive instructional media oriented to Creative Problem Solving model were good. This was evidenced by the average of student learning outcomes in limited trials of 81.10. To obtain interactive instructional media oriented to Creative Problem Solving model that more qualified so it should be do the use of devices that had been developed on a broader scale such as in other classes, in another school, by another teacher, so that the results of the assessment obtained will be more accurate and detailed. It should use the Borg and Gall development model on the development of this instructional media in the future, so that we can obtain better and more tested learning media, because with the Borg and Gall model there are more trials conducted, such as initial trials, field trials, and trials usage..

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