

THE DEVELOPMENT OF COMPUTER BASED INTERACTIVE LEARNING MEDIA ON LIMIT FUNCTION**Febrina Rachmawati**

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email: atikwintarti@unesa.ac.id**Abstract**

This study is aimed to develop computer based interactive learning media on limit function for students grader XI using Visual Basic for Application (VBA) and Adobe Flash Professional CS6. This learning media is expected to improve students' understanding and as a media for students' self learning. The research is using ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The subject of this research are all students in XI IPA 1 SMAN 22 Surabaya, which are categorize low, medium, and high ability in math based on the student's initial ability test. The data is collected from validation, observations, tests, and questionnaires. Data analysis is carried out by qualitative for text and quantitative for number. The validation obtained from three media experts' assessment can be categorized as "Good" and from three material experts categorized as "Very Good". This media can be used with a little revision. The mode of learning implementation is 4 and the average of student activities is 3. It means the learning media is practical. The percentage of student respon results is 80.13%, which means students' response toward the learning media is positive and the Student Satisfaction Percentage is 87.88% which indicates that the learning media is effective. It can be concluded, this learning media can be considered as a good learning media because it is valid, practical, and effective.

Keywords: Development learning media, interactive, limit function.

INTRODUCTION

The rapid development of Information and Communication Technology (ICT) has affected all sectors in society, as in the education sector. The influence of technology appears when the 2013 Curriculum (K-13) was implemented. ICT is not only approved as a local content but also integrated into each subject.

The influence of this development is in line with the statement of Hamzah (2015) in a national conference which said that the development of computers was also increasingly rapid along with the development of learning. Computers are not only used as calculators or typewriters but also used as a media to help and facilitate students in learning, understanding, and exploring the material.

Learning using media, especially computer-assisted learning media, will become more fun and interactive. Students can also more active in class during learning activities. While teachers can make innovations so that learning would be efficient and effective. According to Arsyad (2013) learning media is a tool that can help teachers and students in the teaching and learning process. Learning media can clarify the presentation of information

related to the material that presented, increase interest and stimulate for learning, and even affect the psychology of students so that learning outcomes will reached.

According to Setyaningtyas, Dwiwana, and Muksar (2018) mathematics is a science that rich in concepts and their interrelated. This connection occurs because mathematics is a science that studies logic, patterns of order, and logical sequences. Mathematics is also known as the parent of science because mathematics is the basis of the development of every knowledge. This is related to the logical and systematic rationale that is built from mathematical reasoning. Based on this, understanding basic concepts is very important to make it easier to understand the following concepts. Then, Limit function is one concept in mathematics.

Jordan in Winarso and Toheri (2017) argue that the usual mistakes done by students when solving math problems. That can be happened because students are lack of knowledge about symbols in mathematics, calculation errors, and wrong completion procedures. Winarso and Toheri (2017) found that around 40.38% of students did not fully understand the concept of limit function and some students experienced misconceptions when solving limit

function questions so that function limits were one concept in mathematics that was still considered difficult.

Difficulties experienced by students need help so that the goals of learning can be well received. In addition, good handling will make students understand difficult material and get good learning outcomes. The use of computer-assisted learning media can be an alternative to overcome these difficulties.

Hamzah (2015) said that computer using has been proved effectively in learning to help students understand and learn mathematics. This is because of several advantages possessed by the computer, for example the ability to visualize an object, the ability to make simulations, and the speed in the calculation process. Therefore, computers become one of the learning media that is widely used especially for mathematics learning.

According to Sujoko (2013) there are three functions of using electronic media in classroom learning, namely as a supplement, complement, and substitution. Learning media can be used or not in learning depending on the user, time, and circumstances. Based on this, the authors develop media that can be used as an addition to students to help students understand limit function material.

Visual Basic for Application (VBA) is a programming application in Microsoft Visual Basic. VBA is the fastest and easiest way to create and customize Microsoft Windows applications according to user requirements. VBA offers application programming and cross platform features to support ActiveX technology for Microsoft Windows operating systems. Based on Ngo-ye (2015) VBA has the advantage of making it easier for users to learn something and have a positive impact directly on user experience. When compared with other programming languages such as Java and PHP, users must download and install related software to access it.

The researcher carried out LMP activities (Learning Management Program) in one of the schools. The researcher found that students tend to often forget material or formulas that have been taught before. Students also complain because the formula must be memorized very much without knowing the use of these formulas. The researcher also observed that it was very rare for mathematics teachers at the school to use computers as learning media.

Therefore, it is necessary to develop computer-assisted learning media by utilizing Visual Basic for Application and Adobe Flash Professional CS6 as learning supplements for students with interactive learning media display. Based on these descriptions, researchers are interested in conducting research with the title, "Development of Computer Based Learning Media On Limit Function".

Based on the description, the research question is how the process and results of developing good interactive

learning media assisted by computers in limit function material. While the purpose of this study is to describe the process and results of developing good interactive learning media assisted by computers in limit function material.

The results of this study are expected to be able to provide benefits to students as a means to improve student understanding related to limit function material and can be used by teachers as an innovation for learning or providing training for students.

Learning Media

Media is a word that comes from Latin, *medius*, which is means middle, intermediary, or introduction. In Arabic, the media is called *wasail*, which also means middle. This middle word is interpreted as an intermediary or delivery message from the sender to the recipient of the message (Arsyad, 2013). In teaching and learning process, media is interpreted as graphical or photographic tools to deliver material. This is in line with Riyana (2012) who states that learning media is a container of messages, while the material to be taught is a message of learning, and the goal to be achieved is the learning process.

In addition, Hamzah (2015) also argued that learning media can be interpreted as media which used in learning processes and objectives. Wibawanto (2017) gave almost the same opinion regarding learning media, learning media is a creative media that is used to provide learning material to students so that teaching and learning activities being more effective and efficient. Then, Student can enjoy the class too. From some of these opinions it can be concluded that learning media is media that contains instructional material from sources systematically that are used to motivate and help students learn.

Computer Assisted Learning Media

Computer assisted learning media are learning media using data processing tools in accordance with the procedures that have been formulated. In education, computers have several functions, including as managers in learning or Computer-Managed Instruction (CMI) and as an additional means of learning whose utilization includes the presentation of information related to material or training or both, also called Computer-Assisted Instruction (CAI). In CAI, there are four formats for presenting messages and information consisting of programmed tutorials, intelligence tutorials, drill and practice, and simulations depending on the presentation desired by the designer and developer of learning.

According to Arsyad (2016) there are several supporting factors for the success of CAI, such as the atmosphere of learning must be fun, interactivity, students get training opportunities that can motivate and provide feedback, and can be guidance for students with the

informal environment. So that the developed learning media are expected to become learning media which is good and beneficial for students. In this study the media that will be developed include in the form of tutorials, drills, and practices which contain 3 main menus, namely material animations, examples, and exercises with additional challenges.

Interactive Learning Media Assisted by Computers

Interactive in learning have a close relationship with computer-based learning media. Interactions in computer-based learning generally follow three elements, such as: (1) Instructional sequences that can be adjusted, (2) Answers/responses or student work, and (3) Feedback that can be adjusted (Arsyad, 2016). Therefore, it is necessary to consider the use of problem-centered designs, case studies, or simulations. So, students can be directly involved mentally with the presentation. Then brief instructional presentation and provide opportunities to interact at least every three or four screen displays or every one two minutes. However, it is necessary avoiding to give interactions that seem compelling, for example giving questions that only want to get student answers.

Therefore, computer-assisted interactive learning media are learning media using computers that are characterized by exchanging conversations from input and output such as when a user enters a question or command and the system immediately responds.

Visual Basic for Application (VBA)

VBA is an acronym for Visual Basic for Application. VBA is a programming language by Microsoft to develop programs and expand the capabilities of Office applications so that no longer need the substance of a programming language used to build applications completely from scratch. In addition, VBA is relatively simple. Hence, using VBA is not considered difficult and easier to learn.

Duane (2005) said that VBA in Office can be accessed easily through the sub menu option on the file menu then by activating the check button for developers to customize the ribbon. So, VBA no longer needs to be downloaded or installed like other programming language applications. However, it should be noted, VBA users must know how to write the syntax on VBA.

Adobe Flash Professional CS6

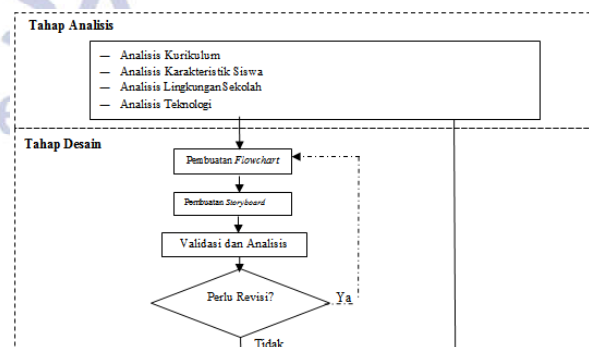
Flash is a software to create animations that are also interactive. Flash is one of the software released by Macromedia which has now been adopted by Adobe, Inc. This is in line with Wibawanto's statement (2017) flash is a standart professional application authoring tool for creating

interactive and dynamic animations and applications. There is an authoring program to develop multimedia products designed to organize and manipulate multimedia elements individually and provide user interaction. Flash can be used for page sites, CD-ROMs and interactive applications, as well as videos.

Adobe Flash Professional CS6 has different advantages compared to other programs, which makes it easier for users and gives space to create animation in accordance with the movement (motion) and the desired scenario. The resulting file is also small in size and flexible (Wibawanto, 2017). In addition, compared to the previous version, Adobe Flash Professional CS6 provides support for HTML 5 and Android and iOS with the latest Adobe Flash Player.

METHOD

This research is a development research using the ADDIE development model. The orientation of this research is the development of software products with three main menus including material, training, and evaluation. According to Robert (2009), the ADDIE development model consists of 5 phases, Analysis (Analyze), Design (Design), Development (Develop), Implementation (Implementation), and Evaluation (Evaluation). The ones developed in this study are as follows.



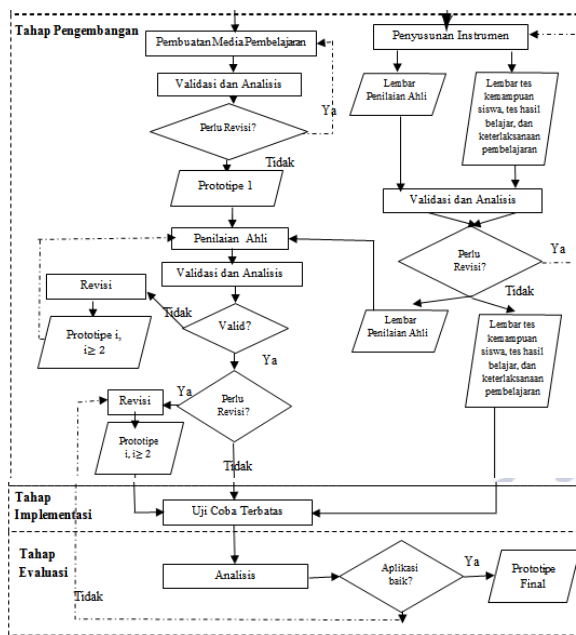


Figure 1 Flowchart of Research for Development of Computer-Assisted Interactive Learning Media

This research was conducted in an even semester, in February 2019 at Surabaya State High School 22. The limited test was carried out in class XI IPA 1 which was taking the limit of algebraic function material. The subject of this study were all students in class XI IPA 1 Surabaya Senior High School 22 academic year 2018-2019. Students in the class are grouped first by researchers based on initial ability tests (high, medium, and low).

The research instruments used were the Learning Media Validation Sheet, Learning Implementation Examination Sheet, Student Activity Observation Sheet, Initial Ability Test Sheet, Learning Outcome Test Sheet, and Student Response Questionnaire Sheet. To analyze the data used 3 techniques, namely Validity Analysis related to the validity of media and material, Practical Analysis related to the analysis of media assessment in general, observations of learning implementation, and student activities, and Effectiveness Analysis related to analysis of student learning outcomes and student responses.

RESULT & DISCUSSION

Computer-assisted interactive learning media created and developed by researchers validated by material experts and media experts. The material expert consisted of one UNESA Mathematics department lecturer and two high school mathematics teachers. Whereas for media experts consist of one UNESA Mathematics department lecturer, one ITS alumni majoring in Informatics Engineering, and one UNESA alumni majoring in Technology Education who understands about VBA.

There are several revisions made by researchers after the media has been validated by Media or Material Experts. Following are the media changes that were developed.



Figure 2 The initial appearance of the media before and after validation

The background of the learning media is changed to blue graded from the previous color. This change is made so that the appearance of the media is more modern and not monotonous. For Font style from the word learning media in the media it is changed to Komika Axis with a large size compared to other words and white with blue edges to stand out.

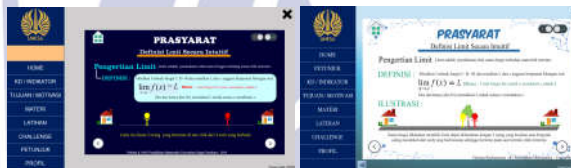


Figure 3 Display material on the material page in the media before and after validation

Background changes on the material page are done so that the writing can be seen clearly. In addition, these changes can make the material delivered will be more prominent because it has a contrasting color with the background of the media that is colored in graded blue.

Based on the analysis of the validation results in accordance with the validity criteria of computer-assisted interactive learning media, the media developed by the researchers included valid criteria that were both material and 4 and in terms of media with a value of 3 obtained using mode. Here are the results.

Table 1 Results of Media Validation Analysis by Media Experts

Aspect	Criteria	Validator			Mod
		1	2	3	
Simplicity	1. The sentence used is easy to understand	4	4	3	4
	2. Animation presented in interactive learning media assisted by computers is easy to understand.	3	3	4	3
	3. Animations presented in interactive learning media are computer-assisted according to student characteristics.	4	2	4	4

Aspect	Criteria	Validator			Mod
		1	2	3	
Cohesiveness	1. The order between pages matches	3	4	3	3
	2. Instructions made for user use in computer-assisted interactive learning media is appropriate	4	4	3	4
Balance	1. The writing size of each page is appropriate	3	3	4	3
	2. The size of the image on each page is appropriate	2	3	3	3
	3. Animation used on each page is appropriate	3	3	4	3
	4. The writing layout of each page is balanced	3	3	3	3
	5. The layout of the image for each page is balanced	2	3	4	2
Shape	1. Animation used is interesting	2	2	4	2
	2. The image used is interesting	2	2	4	2
	3. The letters (font type) used are easy to read	3	3	4	3
Color	1. The color of each page matches	2	2	4	2
	2. Color gradation accordingly	3	2	3	3
	3. The color used does not obscure the message you want to convey.	3	3	3	3
Sound	1. Music backgrounds that are used are appropriate and pleasant to hear	3	2	3	3
	2. Sounds are added is appropriate	4	2	4	4

Table 2 Results of Media Validation Analysis by Material Experts

Aspect	Criteria	Validator			Mod
		1	2	3	
Format	1. Clarity of work instructions.	4	4	4	4
	2. Conformity between material and learning indicators.	4	4	4	4
	3. Suitability of writing, images, and animation on material in computer-assisted learning media.	3	4	4	4
	4. Clarity of writing in the material on interactive learning media assisted by computers	3	4	4	4
	5. The suitability of writing, drawing, and animation in problem training and evaluation in computer-assisted learning media.	4	4	4	4
	6. Clarity of writing in the problem exercise and evaluation in interactive learning media assisted by computers.	4	4	4	4
Content	1. Conformity between material limits of algebraic functions with material in interactive learning media assisted by computers.	3	4	4	4
	2. Clarity of the concept of limit algebraic functions on computer assisted learning media.	3	3	4	3

Aspect	Criteria	Validator			Mod
		1	2	3	
	3. The suitability of animation in interactive learning media is aided by computers with mathematical concepts contained in the limit material of algebraic functions,	2	3	4	2
	4. Media clarity in delivering material on interactive learning media assisted by computers	3	3	4	3
Language	1. The language used.	4	3	4	4
	2. Effectiveness of the sentence used.	3	3	4	3
	3. Ease of understanding the language used.	3	3	4	3
	4. Use of words according to Enhanced Spelling.	3	3	4	3

Then from the general assessment carried out by the six validators, the results show that this interactive learning media can be used with a slight revision which is one aspect of practicality.

After validation, a limited trial was conducted at SMA 22 Surabaya by taking the subject of students in class XI IPA 1 grouped into 3 categories, namely, students with low, moderate, and high abilities based on the prerequisite material preliminary test scores determine the limit value of algebraic functions.

In this trial, researchers acted as teachers. While the mathematics teacher of class XI IPA 1 acts as an observer of the implementation of learning and student activities during learning using the developed media. Based on the observation analysis of the implementation of learning using the mode obtained a value of 4 which means that learning takes place very well using the media and from the analysis of observations of student activities get a mean value of 3 which means good student activity during learning. Based on this, the learning media developed have met the criteria of practicality.

After students try the material and exercises presented in the developed media, students are asked to work on the questions in the evaluation menu. After that, students are given a written test and asked to fill out the student response questionnaire. Both of these were made by researchers to determine the effectiveness of media in terms of completeness of learning outcomes and student responses after using the media.

Scores from the test results obtained by students of XI IPA 1 are presented in the following table.

Table 3 Results of Student Learning Outcomes Test Score Analysis

NAME	GROUP	SCORE	INFORMATION
CA2	Low	67	Not Pass

CO	Low	67	Not Pass
DA2	Low	86	Pass
DT	Low	67	Not Pass
DP	Low	86	Pass
GP	Low	86	Pass
IK	Low	67	Not Pass
MA	Low	86	Pass
NF	Low	86	Pass
RY	Low	86	Pass
SN	Low	86	Pass
SN2	Low	100	Pass
SF	Low	86	Pass
TI	Low	86	Pass
VA	Low	86	Pass
YU	Low	86	Pass
AF	Moderate	86	Pass
DA1	Moderate	86	Pass
FF	Moderate	86	Pass
IS	Moderate	86	Pass
MY	Moderate	86	Pass
MR	Moderate	86	Pass
NL	Moderate	86	Pass
PR	Moderate	86	Pass
BJ	High	100	Pass
CA1	High	86	Pass
EF	High	86	Pass
IL	High	86	Pass
IC	High	86	Pass
MH	High	100	Pass
NY	High	86	Pass
SM	High	86	Pass
WC	High	86	Pass

Based on these data, students are said to be completed or graduated if the student score is more than or equal to 75. From **Table 3** the Student Mastery Percentage (SMP) is reached 87.88%, which means more than 70% effectiveness criteria. In addition, the results of the analysis of student responses showed 80.13%, which means that students' responses while using this media are positive. Therefore the media developed has met the effectiveness criteria.

Computer-assisted interactive learning media have met the criteria of validity, practicality, and effectiveness. Therefore, this media can be said to be an interactive learning media aided by a computer in good limit function material.

In this study, researchers became teachers of mathematics in class XI IPA 1. While the mathematics teacher in the class became an observer during the learning process. This is because, researchers who make this media so that researchers know very well about this media and its use. If math teachers who teach using this media, more time is needed to provide training to teachers regarding the use of this learning media. But because researchers who teach with this media, researchers cannot see the ease or practicality of this media from the teacher or teacher side,

so that in this study only saw the practicality of the media from the students' side.

CLOSURE

Conclusion

- The process of developing computer-assisted interactive learning media in this study used the ADDIE development model. The following are the processes of developing interactive learning media.
 - In the Analyze stage, researchers look for information related to the problems faced during the teaching and learning process, namely students who tend to be passive during the teaching and learning process because the learning method used is a direct learning method and often the teacher only provides summaries to students without giving explanation and use of computers as media learning in mathematics learning is not optimal. Therefore researchers developed interactive learning media assisted by computers by utilizing the Adobe Professional Flash CS6 application and Visual Basic Phot Application to overcome these problems. The researcher also analyzed the curriculum, school environment, and student characteristics.
 - In the Design stage, flowcharts and storyboards are created as the initial design and the form and appearance of the media are adjusted to the initial design and characteristics of the students.
 - In the Development stage, computer-assisted interactive learning media is validated by media and material validators. Then a revision of learning media is made based on suggestions from the validator.
 - In the Implementation stage, valid learning media were tested on XI IPA 1 students at Surabaya State High School 22.
 - In the Evaluation stage, an assessment is based on the initial ability test, observation of the implementation of learning, observation of student activities, test of learning outcomes, and student response questionnaires.
- Computer-assisted interactive learning media are declared good because they meet valid, practical, and effective criteria in accordance with the overall results and analysis of research data with the following details.
 - Computer-assisted interactive learning media are declared valid according to the validity criteria using a mode equal to 3 which means this media is good in terms of validity.
 - Computer-assisted interactive learning media are stated to be practical in accordance with the practicality criteria of learning media, because the

value of learning media in general states that this learning media can be used with little revision, the value of implementing learning with mode is 4 which means learning using this computer-assisted interactive learning media going very well, and the value of student activities with an average of 3 from a maximum value of 4 which means student activity while using this media in good learning.

- c. Computer-assisted interactive learning media are declared effective according to the effectiveness criteria of learning media, because the results of Student Mastery Percentage are 87.88% and Student Response Percentage is 80.13% which means that students' responses to learning media are positive.

Suggestions

Here are some suggestions by researchers.

1. This development research product should be used as a learning supplement for limit material for algebraic functions in class XI high school.
2. In the use of computer-assisted interactive learning media in the classroom, teachers are required to operate Microsoft Office properly because before being able to access this media, several configurations need to be done to enable VBA access..
3. It is better if the teacher who teaches on this trial using this computer-assisted interactive learning media is not a researcher, so the practicality of this media can be reviewed better.

SPECIAL THANK YOU

Thank you to the supervisors, examiners, validators, and deputy principals of the SMAN 22 Surabaya curriculum section who gave advice and helped researchers during this research.

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