# Development Of Textbook Based On E-Learning ‘Matlab Simulation’ In Numerical Analysis

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# Development Of Textbook Based On E-Learning 'Matlab Simulation' In Numerical Analysis

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**Abstract**. This study aims to develop a Numerical Analysis textbook based on e-learning media 'Matlab simulation'. Textbooks developed include the completion of calculations using Matlab and supporting applications for e-learning simulations contained in Playstore. The development stages used ADDIE (Analysis, Design, Development, Implementation and Evaluation). Validation of textbooks involved two media experts and material experts. While the limited test involved three students and field trials involving 20 Mathematics Education Study Program students in Class VI A Academic Year 2017 / 2018. The results of the study showed that (1) the assessment of media experts was 79.50% (good category), material experts amounted to 78.20% (good category), and student assessment when the trial was 78.80% (good category ); (2) understanding the concept of students increased from 65.20 (pretest) to 78.90 (posttest); (3) student responses after using textbooks based on MATLAB simulation e-learning media showed good categories, with a mean score of 70.15 %. Based on these results, textbooks developed are appropriate for learning.

## 1. Introduction

Mathematics is the science that underlies the development of modern technology and has an important role in various disciplines and the development of human thought power. Learning mathematics is learning, structure and looking for the relationships between concepts and structures. Understanding and mastery of concepts is a prerequisite for being able to master the next concept. Students are said to understand the concept if they can construct the meaning of learning messages, between oral, written and graphic, delivered through teaching, books, or computer screens. One result of the latest research is that the most important feature in effective teaching is to give students "opportunities to learn". The teacher can set goals, times, types of assignments, questions, answers that can be accepted, and types of discussions that will affect students' opportunities for learning. This must involve skill efficiency and conceptual understanding [1].

The problem that occurs in the field is that learning is still centered on the lecturer, as happened in the learning of numerical analysis courses in the mathematics education program of the Universitas PGRI Madiun. Learning numerical analysis requires precision in performing calculations both using manual

and computer programs. This ability needs to be owned by students because the problems in numerical analysis are very complex. The use of computers today is very necessary to facilitate solving complex problems, such as calculations in numerical analysis. Computer Based Learning enables students to progress at their own pace and provides them with appropriate ways of learning by individualizing the learning process [2], [3], [4].

In recent days, lecturer only teaches through power point and students only listen, do the exercises and write down the writing board. On the other hand, the unavailability of many books that combine material with its application to computer applications makes learning only centered on the lecturer. Actually, students have the ability to operate the Matlab program that has been taught in computer application courses, but so far this ability has not been utilized in other subject learning. In addition, there are still many students who make mistakes in calculating both analytical and computational algorithm errors, thus impacting on low student learning outcomes. Errors made by students are due to errors in analytic concepts related to the material being studied, errors in writing algorithm formulas in computing and errors in calculations in analytic and computational views in the book or material presented. It is necessary to have a support that supports a kind of analytical and computational simulation to overcome errors that occur. Based on these problems and the importance of using computers in learning, researchers will develop textbooks based on Matlab e-learning simulation in numerical analysis courses. According [5], Matlab is a programming language with high capability in the field of computing. Programming languages are not only required to have the ability in terms of computing, but also good visualization skills. Matlab has the ability to integrate computing, visualization and programming.

The textbook to be developed is equipped with a video simulation on how to do calculations using Matlab, so students can learn by themselves doing calculations with a computer. Simulations create a scenario-based environment, where students interact to apply previous knowledge and practical skills to real-world problems, also allow teachers to reach their own goals, as well (Andreu-Andrés & García-Casas (2011), García-Carbonell & Watts (2012), Angelini (2015) cited in [6]). Learning with video simulation will give students the freedom to learn by themselves wherever and whenever. In a Mathematics learner-centered teaching model, learners are who learn mathematics by doing mathematics; they are the part of the acquisition of their own mathematical knowledge [7].

## 2. Method

The development approach in this study used ADDIE (Analysis, Design, Development, Implementation and Evaluation. ADDIE is instructional systems design (ISD) framework that instructional designers use to develop media [8]. Media development steps are shown in the following schematic picture.

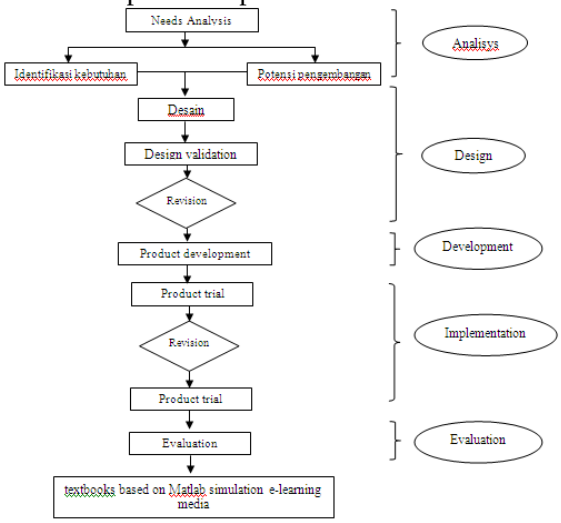


**Figure1**. Flowchart of Research Design

The subject of this study involved students in the sixth semester of Mathematics Education Study Program, Universitas PGRI Madiun, who were involved in the piloting of MATLAB simulation e-learning textbooks on Numerical Analysis subjects. The validator in this study involved material and media expert lecturers.
The validity of the product must be tested for its effectiveness in order to achieve the learning objectives. Acoording to [9], in order to be able to produce certain products, research is used in the form of needs analysis. In addition, researchers conduct research to create new products, create products and test the effectiveness of these products. The research data was collected using media and material expert validation sheets, concept comprehension tests and response questionnaires.

## 3. Results and Discussions

### 3.1. Result

The first stage is the analysis phase, which is needs analysis and potential development analysis. Based on observations made, it was found that in learning of Numerical Analysis, the lecturer only delivered material from powerpoint and had not used a computer application to help students in calculating. The books available were only limited to delivering material and had not inserted material with computer applications.
The textbooks developed will be given video simulations embedded in the Playstore application. The details of the structure of the video content are: Preliminary Simulation, Error Simulation, Root Simulation of Nonlinear Equations, Linear Equation System Simulation, Regression and Interpolation Analysis Simulation, Numerical Integration Simulation.
The second stage is design. The researcher prepared the materials for the textbooks, designed the flow of video simulation as a companion of textbooks, compiled validation sheets for media and material experts, a textbook assessment sheet by students, a concept comprehension test and a response questionnaire to see the students' responses after using textbooks developed. Following is the flow of textbook design based on simulation.

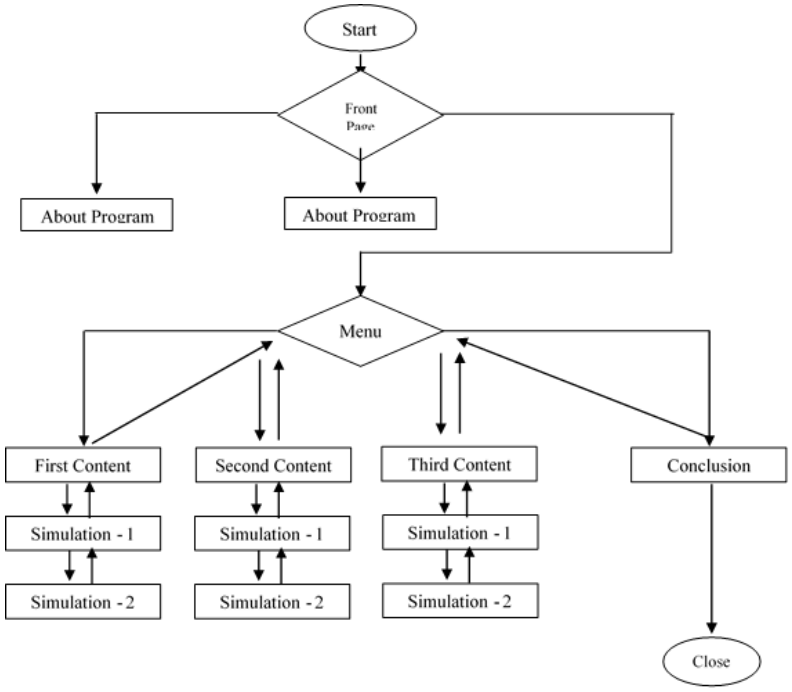


**Figure 2.** Video Simulation Flowchart

The third stage is development. Activities carried out to make textbooks based on MATLAB simulation e-learning media and designs that have been made. The following was a display of textbooks developed.

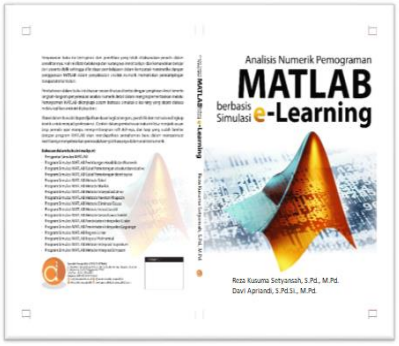


**Figure 3**. Cover of Textbook Products

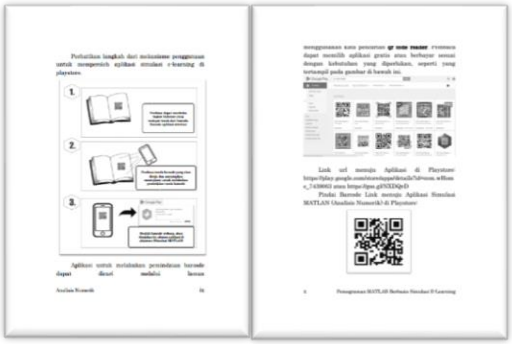

**Figure 4.** Display of Preliminaries of Textbooks

Preliminaries ofbook introduction contain preface, table of contents and e-learning simulation mechanism. The preliminaries in this book reinforce the presentation of the stages of the e-learning simulation mechanism by adding a display installation of the Playstore application for mentoring this book.

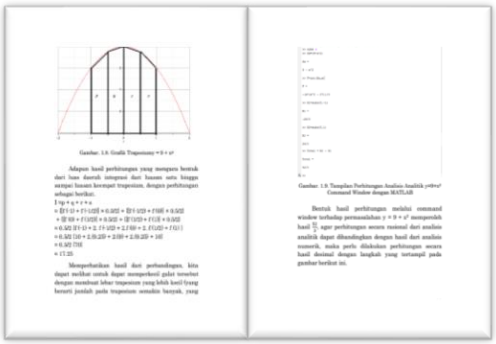

**Figure 5.** Display of Textbook Contents

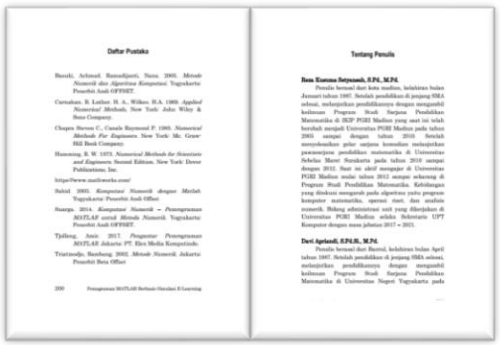

**Figure 6.** Display of Postliminaries

In the contents of the textbook presents an understanding of learning using two analytical and numerical approaches, which in numerical approaches using the MATLAB program given a simulation in the playstore application. In Postliminaries content, it presents a bibliography, about the author and additional practice questions with an analytical and numerical calculation approach.
After the simulation media-based textbooks were completed, textbooks were validated or assessed by media and material experts. The validator of the textbook material was conducted by an expert, Irna Tri Y, S.Pd., M.T.,. Following are the results of validation by material experts.

**Table 1.** Validation by material experts

| Aspects | Percentage | Description | Average Percentage |
|---|---|---|---|
| Language | 80,12 % | Valid | 78,20 |
| Suitability | 75.80 % | Valid | |
| Clarity | 78,44 % | Valid | |
| Feasibility | 78,44 % | Valid | |

The media expert who assessed the feasibility of the textbook was Andria M. Kom. Following are the results of validation by media experts.

**Table 2.** Percentage of Validation by e-learning Media Experts

| Aspects | Percentage | Description | Percentage |
|---|---|---|---|
| Relevance | 79.70 % | Valid | |
| Systematic | 75.90 % | Valid | |
| Systematic suitability | 78,40 % | Valid | 79,50 |
| Compatibility of programming languages | 76,50 % | Valid | |
| Readability and communicativeness | 87,00 % | Valid | |

Based on the assessment of material experts, 78.20% were included in the good category. The assessment from media experts was 79.50% including in the good category. From the results of the assessment, media and material experts concluded that textbooks based on simulation media deserved to be tested in learning. The validator also provides suggestions for the improvement of simulation media-based textbooks which can be seen in the following table.

**Table 3.** Suggestions and Improvement of Textbooks Based on E-Learning Media Simulation of Matlab

| **Validator** | Suggestion | Action |
|---|---|---|
| Andria, M. Kom | Clarity on the flow and ratio of the video simulation needs to be clarified | Enlarge ratio adjusts of the presentation panel in youtube as MATLAB video reference |
| Irna Tri Y, S.Pd., M.T | The order of the material should be displayed more clearly so that it is easy to understand | The order of the material is made in the prefix display in the google sites and given on each menu tab so that it is easy to read and access |

The fourth and fifth stages are implementation and evaluation. At this stage the researcher conducted a trial simulation based textbook for 20 students of Mathematics Education Study Program in grade VI A, in the Academic Year of 2017/2018. Students give an assessment after using a textbook based on simulation media in learning. From the results of the trial obtained a percentage of 78.80% included in the good category. Students are also given concept comprehension tests to see the effectiveness of developed textbooks. From the results of the pre test obtained an average value of 65,20 and the post test results obtained an average value of 78,90. in analysing the practicality of textbooks, a questionnaire was answered by 20 students. The response of textbooks using based on simulation media gained an average of 70,15%. This showed that students gave a positive response to the developed MATLAB e-learning textbooks.

3.2. Discussions

Validity testing of textbooks was carried out by material and media experts. Based on the assessment of material experts, 78.,20% were included in the good category and the assessment from media experts was 79,50% were also including in the good category. The results of expert validation of the product developed are declared valid if the validation results show more than 70% results [10]. From the results of the assessment, media and material experts concluded that textbooks based on simulation media were valid and deserved to be tested in learning.

Effectiveness Test was done by giving students a concept understanding test. Textbooks are said to be effective if students fulfill learning completeness. Completeness of learning was obtained from the percentage of concept comprehension tests. Students are declared complete, if the completeness of the individual has reached the Minimum Completeness Criteria (KKM) which is ≥ 75. From the results of the pretest, the average score was 65.20 and the posttest results obtained an average value of 78.90.

Practicality Test was done by giving a response questionnaire to students after using textbooks in learning. Student responses to the use of textbooks based on simulation media obtained an average

percentage of 70.15%. This showed that students gave a positive response to textbooks based on Matlab simulation e-learning media developed.

## 4. Conclusion

The conclusions of this study stated that: (1) Validity test of textbooks based on Matlab simulation e-learning media in Numerical Analysis courses obtained a percentage of 79.50% (Media Expert) and 78.20% (Material Expert), (2)The effectiveness test of textbooks based on Matlab e-learning media simulation in the course of Numerical Analysis increased from 65.20 (pretest) to 78.90 (posttest) declared to be completed in a classical manner, (3) The practicality test of textbooks based on Matlab e-learning simulation media in the Numerical Analysis subject obtained an average score of 70.15%. it showed that students give a positive response to the product being developed. Based on these results it was concluded that textbooks based on Matlab simulation e-learning media were feasible to be applied in learning

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