The Development of Teaching Materials for Subjects of Numerical Method Assisted by MATLAB Software in Mathematics Education Department Students

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Abstract. The purpose of this study was to develop teaching materials for numerical methods supported by valid, practical, and effective MATLAB software for students of Mathematics Education Department at UIN Alauddin Makassar. The type of research used was Research and Development with reference to the ADDIE development model, namely Analysis, Design, Development, Implementation, and Evaluation. The product developed in the form of teaching materials was a module which not only contains material in the Numerical Method course but also was equipped with MATLAB syntax that can help students actively in the teaching and learning process. The instruments used in this study were expert validation sheets, observation sheets for the implementation of teaching materials, student questionnaire responses, observation sheets for student activities, and learning achievement tests. Based on the results of trials conducted, it was found that (1) The validation results for teaching materials and all instruments are in the very valid category. (2) Practical, the average of all aspects are in the category implemented entirely and all aspects of student responses are very positive (3) Effective, student learning outcomes have met the completeness criteria and the average student activity using teaching materials assisted with MATLAB software is in the category very good. So it was concluded that the development of teaching materials assisted by MATLAB software in the numerical methods course of students Mathematics Education Department at UIN Alauddin Makassar had met the criteria of validity, practicality, and effectiveness.

Keywords: teaching materials, MATLAB software, numerical method courses

1. Introduction

Science and technology are two things that are very influential to increase human resources in a nation. One of the efforts made to improve human resources is to improve education quality[1]. National education based on Pancasila and the 1945 Constitution of Indonesia also explains that education functions to develop capabilities and shape the character and civilization of a dignified nation in the educating context and aims to develop the students potential to become people of faith and piety to God Almighty, noble, knowledgeable, capable, creative, independent and responsible[2].

Mathematics as one of the lessons that play an important role in education. Mathematics is a universal science that underlies modern technology development, mathematics also has an important role in
various scientific disciplines and actively advances human thought [3]. Therefore, mathematics subjects need to be given to all students from an early age because with mathematics students can develop logical, rational, critical, and creative reasoning and provide skills to students to be able to solve various problems in daily life.

The ability to solve mathematical problems is a basic ability possessed by students and characterized by use of real problems in learning mathematics as something students must learn as prospective educators to train and increase their creativity in solving problems encountered in learning process. One way that can be done by an educator in solving mathematical problems in order to create an optimal learning process by developing teaching materials that are used[4].

Teaching materials are all forms of materials used by instructors in the learning process to achieve a learning goal, teaching materials referred to may be written or unwritten teaching materials such as Hand Outs, books, modules, student worksheets (LKS), radios, CD cassettes, etc[3]. Teaching material has a very important role in learning process, namely as a representation of teacher's explanation in front of the class [5]. To realize the module function it is necessary to pay attention to everything that supports the learning process such as, considering concepts, types, and steps in selecting learning material[6].

The use of learning modules combined with the use of certain software makes learning process more efficient and makes it easier for students to solve problems [7]. Numerical methods are special subjects for mathematical problems that cannot be solved exactly. In addition, observations say that numerical methods are one of difficult subject to understand because they require techniques to formulate mathematical problems, they can be solved by calculation operations. Solving these problems requires a very long description and description with a long time manually working on the questions, while the material to be studied is a lot of which all the solutions require accuracy and skills in answering each question given. During this time to be able to solve above problems, only using Microsoft Office Excel software to facilitate students, but the software is limited to the material system of linear equations and non-linear equations, so solving problems will be difficult without other software help. In addition, the problem arises because the numerical method of teaching material software assisted by software is still lacking and even difficult to find.

One solution or alternative that can be used to improve numerical method learning outcomes is to use technology. The presence of computer technology has made it easier for various parties, including education as a means of supporting education[8]. The use of technology in learning mathematics is very broad, both as a medium of learning and independent learning media. Learning mathematics in tertiary institutions such as linear algebra, calculus, geometry, numerical methods, and linear programs using software such as Maple, MATLAB, Fortran, Minitab, SPSS, Lindo and others[3]. One of the computer software that can be used in learning numerical methods is MATLAB software.

MATLAB software is a high-level programming language where students implement a range of numerical methods and optimization techniques through group-based projects (teamwork) to gain hands-on experience with modern scientific computing to solve numerical problems[9]. This program can be used to increase speed, and accuracy in various calculations in numerical method materials so the time needed to do more efficiently and more accurate results compared with calculations done manually[8]. Rikayanti's research concluded that development of MATLAB-based teaching materials based on analysis result and student responses had reached a stage that was close to needs. MATLAB software is practically used for students[10]. Zulhendri's research concludes that using MATLAB program is very effective against linear algebra lecture activities and can be used to increase speed,
and accuracy in various calculations in linear algebra material so the time needed to do it is more efficient and the results obtained are more accurate than those calculated done manually[3].

Considering the importance of using computer-assisted teaching materials in learning process, this article describes the development result of MATLAB software-assisted teaching materials to measure student learning outcomes and see the teaching materials quality developed.

2. Methodology
This research was a research and development (R & D) by adapting ADDIE development model that is suspected of 5 stages, namely Analysis, Design, Development, Implementation, and Evaluation [11]. The product that will be developed in this research is teaching material in the form of numerical modul methods courses of the Mathematics Education Department students of UIN Alauddin Makassar.

Place and Subjects of this study were Mathematics Education students in Mathematics class 1-2. This research was conducted at the Faculty of tarbiyah and teacher training at UIN Alauddin Makassar.

The data collection instruments used in this study were: (1) Validation sheets were used to measure the validity of teaching materials and other research instruments, (2) The implementation of teaching materials and student questionnaire responses were used to measure the practicality of teaching materials, (3) Tests of learning outcomes and student activity observation sheets are used to measure the effectiveness of teaching materials [5]. The data that has been collected is then analyzed quantitatively to explain the validity, practicality, and effectiveness of teaching materials assisted with MATLAB software. The trial data in class is used to explain the effectiveness and practicality of Mathematics software-assisted teaching materials in numerical methods courses.

3. Result and Discussion
The process of developing teaching material by MATLAB software in numerical methods courses at the Mathematics Education Department at UIN Alauddin Makassar. The development of teaching materials supported by MATLAB software in numerical methods courses is done using the ADDIE model. The following discussion is brief.

a. Analysis. Before developing the teaching material, an analysis of Mathematics Education Department students need was carried out, where the analysis phase was first stage carried out in this study. The activities carried out at this stage are analyzing the problems contained in the teaching and learning process such as learning process that is not only centered on lecturers but, is expected to be able to actively involve students in the learning process so lecturers are only as facilitators in delivering learning material. In line with the behavioristic view that learning stage more emphasis on changes in student behavior as a result of stimuli and responses that have an impact on the achievement of student learning outcomes [12]. In addition, numerical method teaching materials are needed in accordance with the characteristics of current students. After knowing the need for the development of teaching materials, the next stage of analysis is conducting instructional analysis and student analysis, instructional analysis is carried out by analyzing subject matter in numerical methods courses consisting of systems of linear equations, non-linear equations, interpolations, numerical derivatives, and numerical integrals. Do these materials have a relationship between one material with another and which material will be discussed first. Student analysis obtained based on the observation of researchers that in learning numerical methods students are less active in learning and even tend to be passive.
b. Design, The instructional materials design begin by selecting the title of teaching material to be developed, then designing cover and registering the material in numerical methods courses supplemented with the MATLAB syntax which will be included in the teaching material. The teaching materials compiled consist of title, preface, table of contents, concept map, introduction, introduction to MATLAB, material description, general MATLAB syntax, sample questions, evaluation, and bibliography. In addition to designing teaching materials, researchers also design RPS (Semester Learning Plans) and learning outcomes tests. The preparation of RPS contains the steps that will be taken during learning process, while the preparation of learning outcomes tests as an evaluation tool used by lecturers to measure the learning process success learning with careful planning. Every time you have to do learning it's obligatory to do the preparation because without planning and preparation it will only damage your mind and morals[13].

c. Development, modules are arranged with specifications in the print media form, displayed with modules design that have been determined at the design stage and compiled by applying the MATLAB syntax which has the facility and ability to do mathematical computation easily and quickly without requiring a complicated computer programming language. The preparation of modules in print media form consists of 6 chapters. Chapter 1 explains guidance on the use of MATLAB and basic operations that are often used in mathematics, while Chapter 2-6 contains material on numerical methods courses, namely (systems of linear equations, non-linear equations, interpolations, numerical derivatives, numerical integrals) which are equipped with Mathematics syntax according with the material presented. The five materials presented in the teaching material are equipped with evaluation questions at the end of the chapter they can hone their abilities based on the understanding they have. In addition to developing teaching materials in modules form, a study test was also made, RPS and other research instruments were in student form response questionnaires, student activity sheets, and instructional materials implementation sheets. Teaching materials and other instruments that have been developed and approved by the supervisor are then validated by the two validators before being used in the teaching and learning process. The validation process is carried out 2 times by paying attention to the suggestions and comments of both validators. The validation result for all instruments is 4.7 which is in the very valid category because the entire instrument is at an interval of $4.3 \leq M \leq 5$.

| Tabel 1. Summary of Validation Results | Source                  | Average score | Criteria        |
|---------------------------------------|-------------------------|---------------|-----------------|
| Module                                | 4.7                     | Very Valid    |
| RPP                                   | 4.7                     | Very Valid    |
| Student Activities                    | 4.5                     | Very Valid    |
| Student Response Questionnaire         | 4.7                     | Very Valid    |
| Teaching Material Implementation      | 4.7                     | Very Valid    |
| Learning Outcomes Test                | 4.7                     | Very Valid    |
| Rata-Rata Total Kevalidan Instrumen   | 4.7                     | Very Valid    |

Today, education is needed that can shape creative, innovative and competitive generations. In line with the Digital Era theory 4.0 by Freud Perfical and Henry Ellington said that learning innovations carried out in the development of digital information technology are utilizing the rapidly developing information technology facilities in industrial revolution 4.0 era to improve the education quality as to obtain effective, efficient results and learning attraction to create quality young people[14].

d. Implementation, Teaching materials and other instruments that have been valid then tested on Mathematics Education Department students class of 1 to 2 mathematics class 36 students to meet the practicality and effectiveness criteria of teaching materials. Trial activities carried out during
2 meetings including the provision of THB on June 12 2019. The practicality of teaching materials was seen from the student questionnaire responses and implementation observations result of teaching materials observed by two observers. While the effectiveness of teaching materials can be seen from learning outcomes test and observation sheets of student activities observed by 3 observers.

| Tabel 2. Practicality Test Results |
|-----------------------------------|
| The assessment sheet               | Average Rating | Category          |
| Implementation of teaching materials | 1.96           | Fully implemented |

Table 2, shows the observations average result of the teaching materials implementation assisted with MATLAB software on numerical methods courses include syntax components, social interactions, and the principle of reaction is 1.96 at the interval (1.5≤M≤2) which means in the category of being implemented entirely. In addition to the implementation sheet of teaching materials, the student response questionnaire was also a supporter of the practicality of teaching materials given to 36 students after participating in the whole series of numerical method learning using MATLAB software-assisted modules. The analysis result showed the student responses percentage of 95.7%, this indicates the use of teaching materials by MATLAB software in practical category. In contrast to Rikayanti's research, the analysis result and responses of students have reached stages that are close to the needs while research result that I have done fulfilled the practical criteria. The advantages of teaching materials that I developed are the teaching materials content that are made, such as the examples given are done manually then compared with the MATLAB result. In addition, before entering the material, the author explains in general MATLAB basic and simple arithmetic operations that can make the reader have an initial description of the MATLAB before being associated with the numerical method itself.

| Tabel 3. Test the Effectiveness of Teaching Materials |
|-----------------------------------------------|
| No                | The assessment sheet                  | Assessment                        | Category |
| 1.                | Learning Outcomes Test                | 88.89 % of students are in the complete category | Effective |
| 2.                | Student activities                    | Average student activity from 7 assessment aspect of 84.11% | Effective |

Table 3 shows the teaching material developed meets the effectiveness criteria with student learning completeness percentage of 88.89% and student incompleteness percentage of 11.11% which is done by correcting the answers based on the scoring rubric of learning test result. The analysis result of student activities conducted through observation by 2 observers during the learning process are in the very good category because the average student activity is in the range of 80≤P≤100.

e. Evaluation, this stage is final stage in the development process. At a stage the revision is based on criticism from the users of teaching materials as a refinement of the teaching materials that have been developed. In line with the theory which says that evaluation is important to know the effectiveness of the development carried out and give value to what is developed[15].

4. Conclusion
The process of developing teaching materials by using the ADDIE model which consists of 5 stages, namely Analysis, Design, Development, Implementation, Evaluation. Based on the numerical method trial results module assisted by MATLAB software, obtained valid, practical and effective teaching materials. Validated teaching materials and research instruments are in the very valid category with an average of 4.7. Valid teaching materials are applied in learning process to see the practicality and effectiveness of teaching materials. Teaching material developed was declared practical by looking at questionnaire analysis responses of students at a percentage of 95.7% and implementation sheet of teaching materials for all three aspects were in the category of being implemented entirely. The effectiveness of teaching materials seen from the analysis of learning outcomes tests shows that the percentage of students mastery learning is 88.89% and the percentage of incompleteness is 11.11% in addition, the percentage of student activity is 84.11%.

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