

DEVELOPMENT OF MATHEMATICS TEACHING MATERIALS TO IMPROVE STUDENTS' HIGHER ORDER THINKING SKILLS AND CHARACTER BUILDING

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ABSTRACT

The ability to think at a high level and character reinforcement were the main aspects that were prioritized in education, especially in the 2013 curriculum. In the implementation of learning, an effort was needed to help students improve these abilities, one of which was teaching materials. This study aimed to develop mathematics teaching materials as an effort to improve students' Higher Order Thinking Skills and Character Building. ADDIE development models namely, Analyze, Design, Development, Implementation, and Evaluation were used in this development research. The research subjects used in the application stage were 37 students of class VIIB MTs Negeri 1 Banyuwangi. The results showed that the product validation rate by material experts obtained a percentage of 85% with a very valid and feasible category to use, while media experts obtained a percentage of 93.3% with a very valid and feasible category for use. After being validated, the teaching materials were tested for use to students by obtaining a percentage of 73.81% with a good category so that the product was said to be practical. Hasil test the effectiveness of the product was shown from the results of the Paired Sample T-test by producing a significance level (sig.2-tailed) of $0.000 < 0.050$, which states that there was a significant difference between the pre-test and post-test values that has been given. In addition, the student N-gain score of 0.56% which was categorized as effectively increasing student HOTS during learning using developed teaching materials. The results of the student's attitude activity show that there was a better student character that appears during the learning. Based on the categories that have been determined, the mathematics teaching materials developed are declared valid, practical, and effective for use.

Keywords: Teaching Materials; High Order Thinking Skills (HOTS); Character Building

1. Introduction

In the current era of the industrial revolution, the country needs a society that has competitiveness to face the challenges of the times (Kurnia, 2018). Efforts to improve the quality of the nation's society, one of which is carried out through educational aspects. Education is a means to develop its potential and change the *mindset* to quality. Education in schools plays an important role in preparing the younger generation, namely students in the future, so that the orientation is not only on the ability of students to master the subject

matter, but also their ability to solve a problem that occurs in everyday life.

(Suryaman, 2020) argues that the curriculum is positioned as an educational spirit, which requires innovative, dynamic, and periodic evaluation in accordance with science and technology, the times, competencies that required society and graduate users. This is evidenced by the very significant changes in the curriculum in Indonesia from the last few years, where revisions continue to be carried out by the government. In 2013, the government implemented the 2013 Curriculum in the Indonesian education system and underwent revisions in 2017 due to adjusting to the learning context. The important points emphasized in this revision are (1) increasing competence, (2) strengthening character, (3) growing high literacy (Harosid, 2018).

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In the 2013 curriculum, through mathematics subjects, students are expected to achieve competence to be able to involve their reasoning abilities, be critical, communicate skills, cooperate, confident, creative, and innovative in solving of daily life problems. This term is referred to as *Higher Order Thinking Skills* (HOTS). The government mentions this as a target for the character of students according to 21st century skills (Ariyana, 2018). HOTS is proposed to be applied to overcome Indonesia's lagging rank in the *Programme for International Student Assessment* (PISA) and *Trends in International Mathematics and Science Study* (TIMSS) in 2018 low when compared to other countries (Hukubun, 2022).

Government policy in the Indonesian curriculum also applies the strengthening of character education (*Character Building*) as a framework for the concept of 21st century thinking in Indonesia or the so-called *Indonesian for 21 Century Skill Standard* (Majid, 2012). Character education has a very important role in preparing Indonesia's golden generation for competition in this 21st century life. Through the implementation of the 2013 Curriculum, it is hoped that it will produce a generation of Indonesians who are smart, productive, creative, and innovative, accompanied by ethics and noble morals as a whole, integrated, and balanced (Maulida, 2015).

The problem that occurs in the world of education today is the character values of the younger generation that are eroded. The results of interviews with mathematics teachers and observations conducted at MTs Negeri 1 Banyuwangi, especially class VIIB related to problem identification, students are still applying bad habits in learning. They have not independently worked on the tasks of the teacher, are accustomed to cheating to friends, are not disciplined and on time when collecting tasks, even aggravated by the absence of students' sincerity to learn mathematics so that there is a lack of responsibility and minimal motivation to learn mathematics.

One of the triggering factors for the problems that occur is the lack of innovation in character-based learning models that can be used as a reference for the application of higher-order thinking and strengthening abilities. values of attitude and character. This character-based learning model is implemented through teaching materials to measure higher-order thinking skills

and character values in students (Amran, 2019). The teaching materials used during learning are only sourced from LKS provided by the school, as a result of which students do not get much broader knowledge related to mathematics materials and lack of innovation and creation in learning (Sumaryanta, 2020).

The problem that arises is the absence of the development of teaching materials as additional references and alternative learning resources for students. In fact, according to the 2013 curriculum rules, teachers and schools apply competency-based teaching materials and character education as a conceptual basis in the learning process. This research is expected to help overcome the problems that have been previously presented through the development of teaching materials. Not only teaching materials, but the material content is based on higher-order thinking skills (HOTS) and strengthening character education (*character building*) for students, thus providing an interesting learning experience and in line with the educational goals to be achieved in the 2013 Curriculum.

2. Research Methods

The type of research applied is *Research and Development* (R&D) by applying the ADDIE model developed by Dick and Carry (Rayanto, 2020). In accordance with its abbreviation, this model has five stages, namely *Analysis* (analysis) to find clear clues in the form of systematic steps of the entire learning process. *Design*, *Development*, *Implementation*, and *Evaluation*.

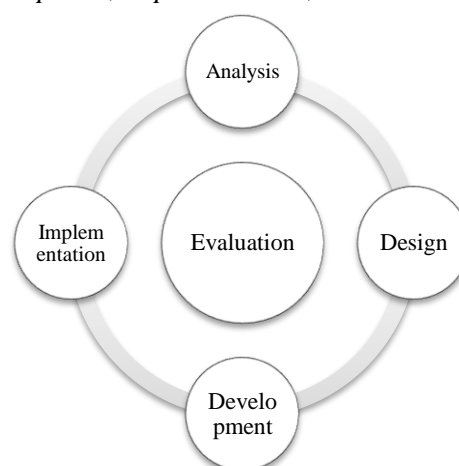


Figure 1. ADDIE Development Model Stage (Setyosari, 2017)

Teaching materials that have been developed and validated by experts, are then applied to students of MTs Negeri 1 Banyuwangi

class VIIB in the 2022/2023 school year as research subjects in product feasibility trials. In the development stage, the data collected in the form of observation results, questionnaire sheets are used to find out the problems, needs, and responses of teachers related to learning p roses so far. In addition, input from teachers and students related to the product developed is in the form of validation results of material experts and media experts to assess the feasibility of the product before field trials. At the implementation stage, data was collected through the response teachers and students of the product after being tested (Sugiyono, 2010). Data collection instruments use interview sheets, validation questionnaire sheets, teacher and student response questionnaire sheets, learning outcomes tests in the form of *pre-test* and *post-test*, and student attitude observation sheet. The data that has been collected, then analyzed qualitatively on the results of interviews and observations, questionnaire data and *pre-test* and *post-test* results are analyzed using quantitative.

3. Results and Discussion

In this study, researchers developed HOTS-based teaching materials and *character building*. The research design applied is to follow the ADDIE model which consists of 5 stages.

1) Analysis Stage

Performance analysis is to analyze the learning conditions that occur in the classroom objectively. In this stage, the problems that occur begin to be seen and the causes of the onset of such problems are clearly explored. Student analysis, namely tracing the characteristics of class VIIB MTs Negeri 1 Banyuwangi students based on the knowledge, skills, and developments of each student. So, from this data, it can be known the extent of students' abilities during learning and what important things need to be applied in developing teaching materials. In addition, to find out how the teacher's method teaches and student response to teaching and learning activities in the classroom. Analysis of learning materials, namely identifying the material that students are studying. The goal is to know the main parts of the material to be taught and arranged systematically (Kharisma, 2018). The material being studied by students is Data Presentation in even semesters. In addition, the basic competencies in the data presentation material are analyzed and developed to be used as a basis for achieving learning objectives.

Objective analysis, which is to analyze what abilities or competencies students need to have in accordance with the 2013 Curriculum. Based on this analysis, students are expected to have higher-order thinking skills (HOTS) and strengthening character education (character building) (Kusmana, 2021). Needs analysis, which is to analyze what teaching materials are needed to achieve learning objectives in accordance with the 2013 Curriculum. Based on this analysis, researchers developed teaching materials in the form of HOTS-based mathematics modules and Character Building for students to help achieve learning goals.

2) Design Stage

The design stage is carried out to determine specific competencies, methods, teaching materials, and strategies used in the learning process. The steps taken by researchers to design products are:

- a. Identify existing products, namely sourced from LKS which is the handle of class VIIB students when learning mathematics.
- b. Designing the design of the learning module which is divided into three parts, including:
 - 1) The initial part, consisting of: the module cover consists of the title, author name, institution name, institution logo, and module user object, preface, table of contents, concept map, introduction, contains: basic competencies, analysis of achievement indicators, and student instructions for using the module when studying
 - 2) The content section, consisting of learning objectives, student learning activities according to the 5M learning syntax (observing, questioning, collecting information, reasoning, and communicating) (Antara, 2020) , material descriptions adapted to HOTS indicators and *Character Building*, illustrations in the form of images that help make it easier for students to understand the material, sample questions, student work columns, and evaluation questions.
 - 3) The closing section, consisting of a glossary, a bibliography, an answer key, and a back cover.
- c. Develop module assessment instruments including validation questionnaires for material experts, media experts, and mathematics teachers, student response

questionnaires, *post-test* learning outcomes tests, attitude observation sheets.

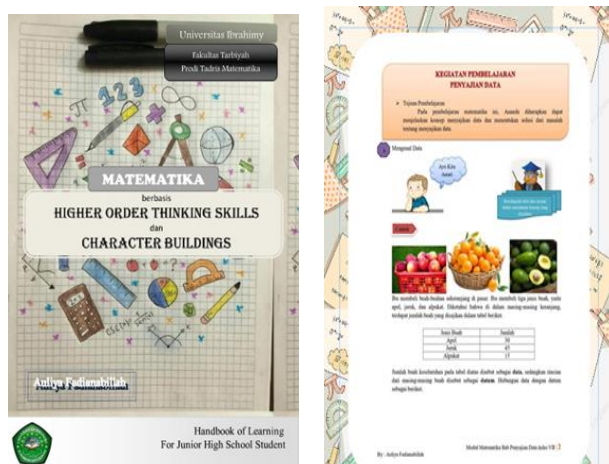


Figure 2. Developed Products Based o HOTS and Character Building.

3) Development Phase

After the initial design of the finished product, the product is developed through a validation process to determine the level of validity of the product. In this process, product validation is carried out by two material expert lecturers and two media expert lecturers.

Table 1. Percentage of Assessment of Each Aspect Related to the Material

Assessment Aspects	Percentage	Category
Conformity to the material	75%	Valid
Eligibility of Contents	87,5%	Very Valid
Relevance of modules to RPP	87,5%	Very Valid
HOTS Implementation	82,5%	Very Valid
Character building implementation	87,5%	Very Valid
TOTAL	85%	Very Valid

Based on the percentage results obtained, the product developed based on the assessment of the material expert got a score of 85%, then classified into the categories contained in **Table 1.** which states that the product **is so very valid** that it is worthy of use.

Table 2. Percentage of Assessment of Each Aspect related to Media

Assessment Aspects	Percentage	Category
Display	93,75%	Very Valid
Lay out arrangement and layout	92,5%	Very Valid
Systematics of drafting	91,67%	Very Valid
Ease of Use	95,83%	Very Valid
TOTAL	93,3%	Very Valid

From the percentage results obtained, the product was developed based on the assessment of media experts, where validator I and validator II gave an average percentage score of 93.3% then classified into categories found in **Table 2.** which states that the product **is so very valid** that it is fit for use. Subsequently, the product was revised as per the input of experts.

4) Implementation Phase

After the product is finished revising, the product is tested in the learning process to find out its practicality and effectiveness.

a. Teacher responses to the product

The product developed by the researcher was given to Mr. Hariyono, S.Pd. as a mathematics teacher in class VII B. Responses contain assessment indicators based on aspects of assessment of material experts and media experts. The product developed based on the assessment of mathematics teachers got a score of 90%, and which states that the product **is so very valid** that it is worthy of use.

b. Product Practicality Test

Researchers provide questionnaires to students to find out students' responses to the products that have been used. The overall average percentage result of the student assessment was 75,6% (**Good**). So, this product is practice and ready to be learning materials to improve HOTS and character building.

c. Product Effectiveness Test

Teaching materials were tested on class VII B MTs Negeri 1 Banyuwangi students totaling 37 people. Before the trial, students were given *pre-test* questions to find out the extent of students' high level of thinking

about the data presentation material. After the data presentation material was finished teaching, the researcher gave a post-test question to students which aimed to find out whether there was a difference in the student's high level of thinking after using the teaching material.

Paired Samples Test								
Paired Differences								
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	Df	Sig. (2-tailed)
Pair 1 pre_test - post_test	-27.973	7.769	1.277	Lower	Upper	-21.901	36	.000
				-30.563	-25.383			

Figure 3. SPSS output results on student post-test pre-test results

The results of the *Paired Sample T-Test* test processed using the SPSS version 25 application showed a significance level (sig. 2-tailed) of 0.000 where the value was smaller than the sig < 0.05; meaning that H_0 was rejected and H_1 was accepted. Thus, the test results state that there is a significant difference between the pre-test and post-test values that have been given.

Table. 3 Normalized Gain Results of Student Learning Tests

AVERAGE	Pre-Test Value	Post-Test Scores	N-gain	Category
	49.86	77.84	0.558919	Keep

Meanwhile, the results of the *normalized gain* calculation in the pre-test and post-test show that the product developed has an effectiveness level of 0.558919 which is in the category of medium effectiveness level.

The results of the observation of student attitudes at each meeting are indicated by the achievement of the percentages shown in the following graph.

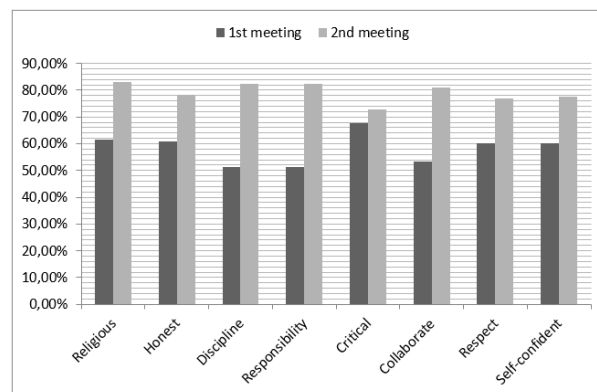


Figure 4. Level of Difference in Student Attitude Assessment Percentage

Judging from the chart above, there is a significant increase in each meeting. The character that the effort is instilled in the students through the developed teaching materials begins to be revealed. Aspects of character education (character building) in students that are formed include:

- Religious, where students always pray at the beginning and end of learning, saying greetings when they want to enter and leave the classroom.
- Honest, where students say honestly in following the learning process, namely by answering questions according to their abilities, responding to the teacher based on what he knows, and not cheating while doing assignments.
- Discipline, where students comply with applicable regulations, namely wearing school attributes completely, bringing stationery and textbooks, arriving on time, and collecting assignments on time at the specified time.
- Responsibility, where the student is responsible for completing the tasks assigned by the teacher, understands that it is his obligation to be a student to always learn.
- Critical, where students actively ask questions or give their arguments during the learning process. The student carefully and carefully pays attention to what is conveyed by the teacher so that he can understand the knowledge taught logically and critically.
- Collaborate, where students show efforts to work together between friends in group activities. There is an attitude of mutual help and support for each other to jointly complete the tasks given.

- g) Respect, where students value the teacher who is explaining and the friend who is having an opinion. Students watched and listened carefully to the person who was talking without showing any indifference to him
- h) Self-confidence, where students appear bold to convey their ideas or opinions in front of teachers or other friends.

5) **Evaluation Stage**

Based on the assessment of experts, namely material experts, media experts, and mathematics teachers, the teaching materials developed in the form of mathematics modules in the data presentation chapter are declared valid and feasible to be applied to the learning process. But there are still some things that need to be revised to perfect it. In practicality tests and effectiveness tests, the product proved to be practical and effective to use based on student responses and the results of their learning tests.

4. Conclusions

Based on the results of this research and development, it is concluded that:

- 1) Development of mathematics teaching materials in the form of modules in an effort to improve *students' Higher Order Thinking Skills and Character Building*, declared suitable for use in the learning process. The product has gone through the validation stage. Validation results according to material experts reached a percentage of 85% which was categorized as valid. The validation results according to media experts reached a percentage of 93.3% which was categorized as very valid.
- 2) Development of mathematics teaching materials in the form of modules in an effort to improve *students' Higher Order Thinking Skills and Character Building*, is declared practical to use in the learning process. The practicality of the product based on the assessment of class VII B students in MTs Negeri 1 Banyuwangi totaled 37 students. From the assessment score given, the overall percentage shows a

value of 73.81%. Based on these results, the product is in the "good" category so it is practical to use in learning.

- 3) The development of mathematics teaching materials in the form of modules in an effort to improve students' *Higher Order Thinking Skills and Character Building*, is declared effective in being used in the learning process. This is based on the results of *the pre-test* and *post-test* of students, which from the results of *the normalized gain* calculation showed that the average result reached 0.558919 which is in the category of moderate effectiveness, meaning that the product is declared effective in increasing student HOTS.
- 4) Development of mathematics teaching materials in the form of modules in an effort to improve *students' Higher Order Thinking Skills and Character Building*, can help instill character education in the learning process. This is shown in the results of using character building-based teaching materials to make students' attitudes better.

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