The Development of Bilingual Teaching Materials on Mathematical Logic Based on Integrated Mathematics

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ABSTRACT

This research aims to develop bilingual teaching materials mathematical logic integrated with Islamic religious values, to more easily convey mathematical materials with everyday life. This development research uses 4D models (define, design, develop, disseminate). The subject of this study is student of university Nahdlatul Ulama West Nusa Tenggara. The instruments used are satisfaction questionnaires and validation questionnaires. Validity includes expert media validation, linguist validation, and validation of the substance of mathematical material. Research results based on expert validation include aspects of the feasibility of teaching materials getting a score of 91.5% with very decent criteria, and aspects of the validity of teaching materials reaching 210 with "highly valid" criteria, aspects of practicality of teaching materials reaching 90%. Based on these results, the bilingual teaching material integrated mathematical logic developed practically and validly for use.

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A. INTRODUCTION

West Nusa Tenggara (NTB) is one of the provinces in Indonesia that is also feeling the impact of the Covid-19 pandemic, one of the sectors that are also affected by the Covid-19 pandemic, namely the Education sector. Online learning system becomes an option made by the government so that teaching and learning activities continue to run in the Covid-19 outbreak period, even though there are many obstacles felt by all parties be it educators (teachers / lecturers), learners (students), and parents (Mishra et al., 2020). This is explained in research conducted by (Purwanto et al., 2020) that there are several obstacles experienced by students, teachers and parents in online teaching and learning activities, namely the mastery of technology is still lacking, the addition of internet quota costs, the existence of additional work for parents in accompanying children to learn, communication and socialization between students, teachers and parents becomes reduced and working hours are not limited for teachers because they have to communicate and coordinate with parents, other teachers, and principals (Handayani & Irawan, 2020). Learning mathematics in the pandemic period forced teachers to make a breakthrough to teach students, in general lecturers teach mathematics by writing directly in the form of formulas and formulas (Cassibba et al., 2021). But with the current conditions make all learning activities diverted into online learning.

In the online learning system at the higher education level lecturers are required to be more creative in compiling teaching materials so that students more easily understand the material

to be studied, especially in mathematics courses (Putri et al., 2020). In addition, students are also required to get used to reading and learning teaching materials and english-language papers. Learning activities using bilingual techniques can help teachers in integrating literacy and language in teaching (Morton, 2020).

Therefore, researchers aim to develop bilingual teaching materials in integrated mathematical logic materials in order to solve the problem. Teaching materials are defined as a learning device or equipment that is prepared in a structured manner (Silitonga & Purba, 2020) which can help students understand the material independently. Bilingual teaching material is a learning device that combines Indonesian with English (Nurfithriyya et al., 2020).

On the other hand, this research is important to do because it can add references to the world of education (Asrifan et al., 2017) related to learning instruments, namely in the form of developing bilingual teaching materials on integrated mathematics-based mathematical logic materials. As for the difference between this teaching material with other teaching materials in addition to using two languages, this teaching material is also in the example and practice of integrating mathematical logic material with religious values so that students can more easily understand mathematical logic materials. Research conducted by (Imswatama & Lukman, 2018) that learning with teaching materials is very effective in helping students train in understanding mathematical learning materials. In 2019, researchers have also conducted research related to the development of Student Worksheets on integrated mathematics-based set materials and research results showed positive results on students' affective abilities and singutive set materials (Riana & Ibrahim, 2019). Therefore, based on this experience in this study also researchers use a development research scheme (Research and Development).

B. METHODS

This research roadmap follows the 4D development model (define, design, develop, diseeminate) (Hidayanti & Utami, 2016). The process of determining product outlines, define, product design, product devlopment, and disseminate (Gorbi Irawan et al., 2018). At the validation stage will be conducted validity tests to media and language experts (designs) and mathematical material experts, then field trials to see the practicality and effectiveness of using bilingual teaching materials. The use of this model because the research team feels that using this model will make it easier for the research team to achieve the research target. The 4D model (Leksono & Fitriatien, 2021) in developing is depicted in the following Figure 1.
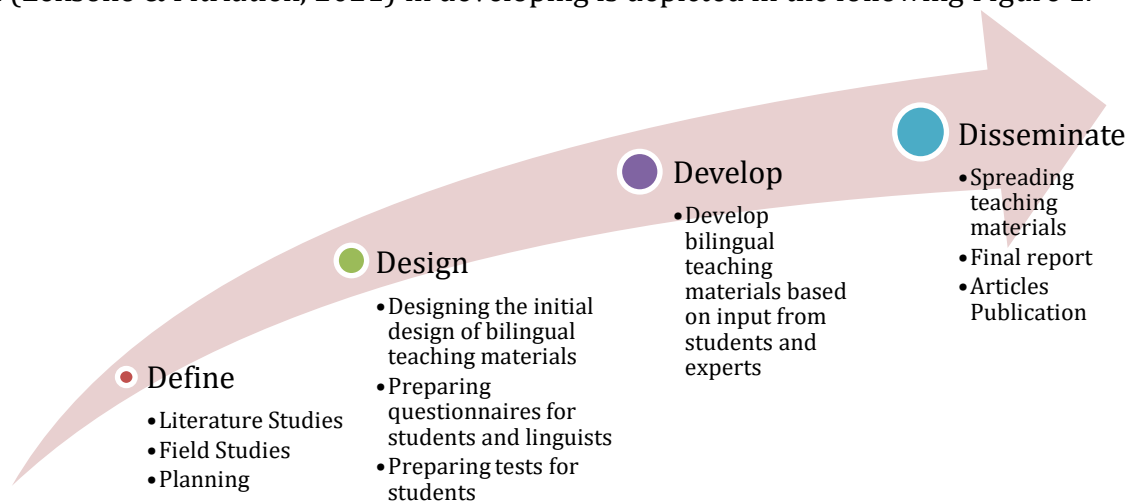

Figure 1. 4D Development Research Model

Research and Development consists of 4 stages, where stage 1 has been carried out almost 100%, stage 2 has reached 50%, stage 3 has reached 60%, while stage 4 has not been implemented.

1. Define, at this stage research conduct literature and field studies to determine the object of research, namely the students of the Information System Study Program 3rd Universitas Nahdlatul Ulama (UNU) NTB and planning to formulate content teaching materials and formulate religious values related to teaching material. The indicator of achievement at this stage is integrated mathematical logic.

2. Design, at this stage research begin to design the design that is the initial draft of teaching materials; arrange questionnaires for students and linguists to obtain valid and quality teaching materials; and disseminate the initial draft to the students as teaching materials in every lecture of mathematics online discrit. The indicator of achievement at this stage is in the form of integrated mathematical logic teaching materials and using two languages (bilingual).

3. Develop, if the mathematical logic material has been completed then the researcher will provide a test to find out the level of omnipotent understanding in the logic material, and a questionnaire to find out the response of students to the teaching materials that the researcher develops. In addition, to produce quality teaching materials researchers will also validate to linguists. Furthermore, the researcher will revise the initial draft after the student response and also revisions from linguists. The indicator of achievement at this stage is in the form of integrated mathematical logic teaching materials and using two languages (bilingual) that have been validated by linguists.
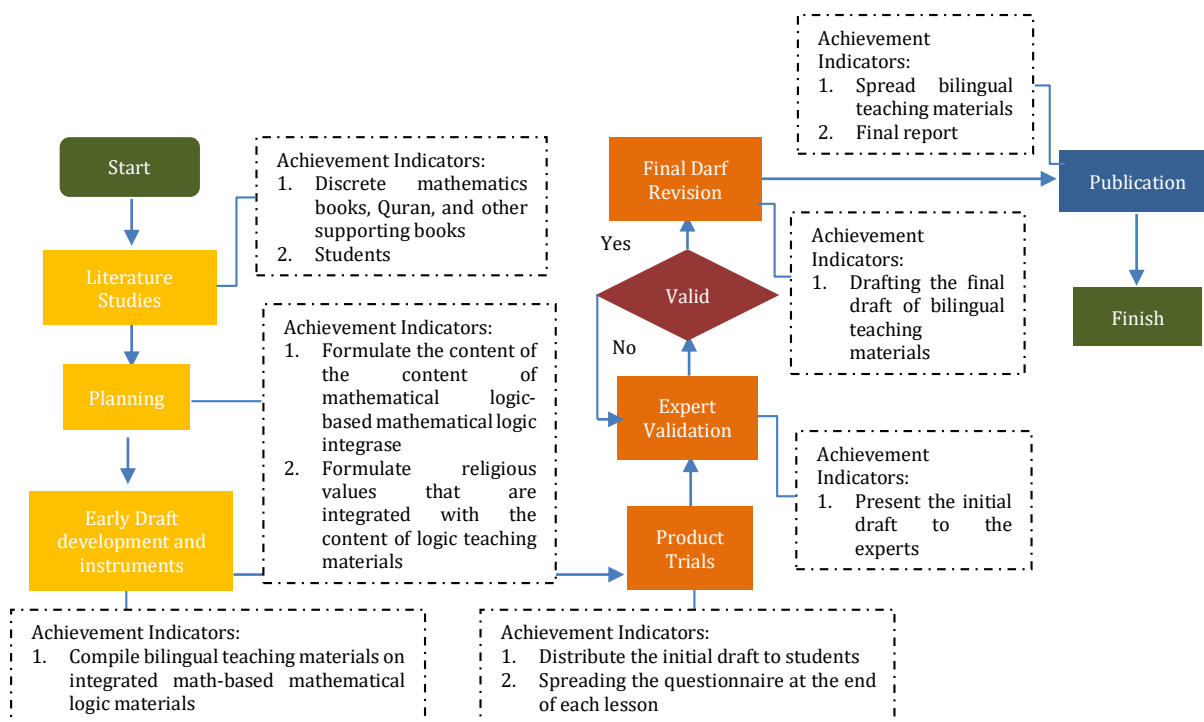

Figure 2. Road Map Of Teaching Materials Development Research

Calculation of expert validation results using the following formulas (Mathai et al., 2020).

$$\overline{X} = \frac{\sum_{i=1}^{n} S_i}{n} \qquad (1)$$

with $\bar{X}$ is the average value of validator assessment results, Si is the average score of the i validator assessment result and n is the number of validators.

Table 1. Teaching Material Validity Interval Criteria

Interval	Category
$\bar{X} > 176$	Highly Valid
$147 < \bar{X} \leq 176$	Valid
$117 < \bar{X} \leq 147$	Valid Enough
$88 < \bar{X} \leq 117$	Invalid
$\bar{X} \leq 88$	Very Invalid

The resulting integrated mathematical is said to be valid if the minimum level of validity achieved is a valid category (Syawahid & Retnawati, 2014). Furthermore, the researcher conducted initial trials (limited) to some students and at the end of this stage revisions were carried out if there was input from math teachers at the school.

4. Disseminate, the final stage of this research is the dissemination of Bilingual Teaching Materials On Mathematics-Based Mathematical Logic Materials Integrated into campuses and also libraries. The achievement indicator at this stage is in the form of Bilingual Teaching Materials in Integrated Mathematics-Based Mathematical Logic Materials that have been ISBN and then submitted to the campus in this case, namely the UNU NTB library.

Research instruments use: 1) questionnaires to validate the content of products from linguists; 2) Tests to measure the quality of Bilingual Teaching Materials on Integrated Mathematics-Based Mathematical Logic Materials. Data collection techniques use literature studies to collect all information related to curriculum, teaching materials, the Qur'an and other supporting religious books. In addition, data collection techniques use field studies in terms of being conducted online through lectures via LMS every week.

a. Test the eligibility of teaching materials. Determination of eligibility of the development of teaching materials is seen from the consistency of the results of teacher assessment of teaching materials and positive assessment of students to the learning process (Lei, 2020). The interval of criteria for practicality of teaching materials is presented in Table 2 below.

Table 2. Teaching Material Eligibility Interval Criteria

Criteria	Score
Very Worthy	5
Worthy	4
Enough Worthy	3
Not worth it	2
Very Unworthy	1

Then the results of the feasibility test are interpreted with the following formula (Jebb et al., 2021):

$$Eligibility\ Percentage = \frac{Number\ of\ scores\ (x)}{Highest\ score\ (Xi)}\ x\ 100\%$$

Table 3. Interpretation of Teaching Material Feasibility Assessment

Valuation (%)	Criteria
81 - 100	Very Worthy
61 – 80	Worthy
41 – 60	Enough Worthy
21 – 40	Not worth it
0 - 20	Very Unworthy

b. Expert Validation Data Analysis. This activity is carried out after obtaining validation results by experts, then analysis is carried out to get the provisions of the validity of teaching materials, if it has not been fulfilled then revisions are carried out. The revised teaching material is called Darft 2.

c. Limited Trials. This activity is a stage to find out the readability of sentences in teaching materials. The trial was limited to mathematics lecturers and 10 students who had high, moderate, and low ability.

d. Field Trials. This activity is a test phase on a wider object. Field trials are conducted to find out the quality of the resulting mathematical learning devices in terms of practicality. Field trials were conducted on 20 students. At this stage, learning is carried out using bilingual teaching materials of integrated mathematical logic in the form of Draft 3.

C. RESULTS AND DISCUSSION

The purpose of this study is to develop a bilingual teaching book of integrated mathematical logic so that the following are described as the results of the study at each stage of development along with their respective analyses.

1. Expert Validation Results

This stage relates to the results of previously designed product validation and the process and analysis of the results of developed product trials.

a. Instrument Eligibility Results

The initial stage is to conduct a feasibility test of the research instrument to two experts. As for the results of the feasibility test obtained that the instrument is worth using for the retrieval of research data. Next, perform expert validation of the product developed.

b. Expert Validation Results

This validation is done after the teaching book design is complete. Expert validation is done to get advice and input related to the content/content of the material and the suitability of language editors, namely from mathematicians, linguists and Islamic religious experts and aspects of the display of the presentation of teaching books. As for the results of validation with experts obtained information according to the Table 4 below.

Table 4. Validation Results Value

Assessment Aspects	Validator Score		Σ
	1	**2**	
Material/content feasibility	28	28	56
Presentation Suitability	48	51	97
Language Suitability	18	19	38
Integration Mathematical Development	10	8	18
Total	**104**	**106**	**210**
Information	**Highly Valid**		

Based on Table 4 above, the results of expert research are 210 which means "Highly Valid" (table 2 reference). However there are some inputs and suggestions from the revised validator.

2. Limited Trial Results

Learning devices that have been validated and produced Draft 2 are further tested. The first test was a limited trial. Limited trials were conducted to find out the readability of the device where 1 teacher assessed and provided input to the design and content of teaching materials and 10 students representing groups with high ability, moderate and less assess the readability of teaching materials. Practicality data is obtained from practicality questionnaire data according to teachers and students. The results of the practicality test are presented in Table 5 below.

Table 5. Small Scale Teaching Materials Practicality Score

No	Aspect	Score
1	Content Clarity	35
2	View Ministry	33
3	Ease of Use	35
4	Ease of Language to Understand	35
5	Clarity of Information	34
6	Compatible with KKNI	33
7	The Truth of the Material Content	33
8	Usefulness for Learning	35
	Total	272
	Percentage	85%

Based on the table above, it is seen that a total score of 272 or convert to 85% who have reached the criteria of "very easy to use" so that learning devices can already be said to be practical. The data generated in this limited trial is input and advice from teachers who assess teaching materials as well as input and suggestions from students who assess the readability of teaching materials. From the input and advice from teachers and students, it is then used as a basis for revisions to teaching materials. The revised results will result in Draft 3. Furthermore, based on the results of the effectiveness test obtained that the percentage of students who scored above the average of 24 students was 75%. Students are complete in understanding the material contained in teaching materials, this means effective teaching materials.

3. Field Trial Results

Based on the results of limited trials in the form of Draft 3, it is further tested on a wider scale, namely field trials. This field trial was conducted on 20 students. Field trials are conducted to obtain data on the practicality and effectiveness of teaching materials. Data from

field trial results is then used as a basis for revision of learning devices. The revised results resulted in Draft 4. As for the results of large-scale field tests according to Table 6 below.

Table 6. Large Scale Teaching Materials Practicality Score

No	Aspect	Score
1	Content Clarity	36
2	View Ministry	35
3	Ease of Use	38
4	Ease of Language to Understand	36
5	Clarity of Information	38
6	Compatible with KKNI	35
7	The Truth of the Material Content	35
8	Usefulness for Learning	36
	Total	288
	Percentage	90%

Based on Table 6 above, it is seen that a total score of 288 or convert to 90% that has reached the criteria is "very practice to use" so that the learning device can already be said to be practical. While the results of the effectiveness test obtained obtained that the percentage of students who scored above the average of 17 students is 85%. Students are complete in understanding the material contained in teaching materials, this means that teaching materials are effectively used in learning logic materials. Research in the development of teaching materials conducted by (Topuz & Birgin, 2020) & (William & Ndabakurane, 2017) that visualize the concepts and offers the opportunity for conceptual learning.

4. Product Revison

Based on the assessment given by experts / practitioners and data obtained at the trial stage, the teaching materials developed have been declared to meet the criteria of validity and practicality based on the assessment criteria that have been set. So that the initial draft that has been prepared can be expressed as the final product. However, some revisions are needed based on descriptive input provided by experts / practitioners.

a. Revised Draft 1

Based on the advice and input from the validator on draft 1 teaching materials, revisions were made to produce valid teaching materials. Here's a revision of the Draft 1 learning device. Based on the input of validators both orally and in writing on the validation sheet, there are several revisions that must be done, namely (1) improvement of incorrect writing, addition of content / content of alqur'an verses, in teaching material 1 clarified image and the word "kunpulan" changed to "collection", in teaching material 2 replace the word "mention" with the word "present", in the material 3 added image caption description and explain the color of the image, in teaching materials 5 add activities observing students.

b. Revised Draft 2

Based on the results of limited trials using Draft 2 teaching materials, revisions were made to produce Draft 3 learning devices that will be used in field trials. Here are the revised drafts 2. Based on input from students both orally and in writing, there are several revisions that must be done, including (1) improvement of erroneous writing, (1) the appearance of images that are less attractive and need to be colored, given explanations for terms that students do not understand such as the word enumeration, melata and so on.

c. Revised Draft 3

Based on the results of field trials, it was obtained that the mathematical learning device that had been produced already met practical criteria. However, based on the results of

observations in the field, revisions of existing products are carried out to produce the final product of integration mathematics teaching materials that really support mathematical learning in the field. Overall, the teaching materials used are quite usable and rated positively by students. Revisions are only made to a number of writings whose letter size needs to be enlarged.

D. CONCLUSION AND SUGGESTIONS

This research is a development research with a 4D model (define, design, devlop, disseminate). The products produced by mberupa integrated mathematical logic bilingual teaching materials aim to facilitate the learning process in pandemic times. The conclusion of this study is namely (1) Integrated mathematical logic bilingual teaching materials are worth using based on the results of trials that have been conducted; and (2) Bilingual teaching materials of integrated mathematical logic valid based on validation of islamic material, language, and religious experts. Therefore, the products resulting from this research can be applied in learning.

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