

Logic and Sets Textbook Containing Ethnomathematics of Sasak Culture: Validation and Design

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ABSTRACT

Ethnomathematics in learning mathematics is a trend that needs to be developed, especially in learning that raises local culture. Mathematics and culture have a very close relationship so the development and application of mathematical concepts in the learning process must be based on situations of daily life or local culture. This study aims to develop logic and sets textbooks containing ethnomathematics of Sasak culture. This book is also oriented toward improving higher-order thinking skills. This research is a Research and Development (R&D) by following the ADDIE development model, namely analysis, design, development, implementation, and evaluation. The first year of this research has been carried out until the development phase, namely by developing textbook products according to the design and validating the textbook products. The results showed that the textbook met the 'Very Good' category in the validity test after being assessed by experts so the textbook was suitable to be used as a learning resource.

Keywords: Ethnomathematics, Higher Order Thinking Skills, Logic and Sets Textbook, Sasak Culture.

ABSTRAK

Etnomatematika dalam pembelajaran matematika merupakan trend yang perlu dikembangkan, terutama dalam pembelajaran yang mengangkat budaya lokal. Matematika dan budaya memiliki hubungan yang sangat erat sehingga pengembangan dan penerapan konsep matematika dalam proses pembelajaran harus didasarkan pada situasi kehidupan sehari-hari atau budaya lokal. Penelitian ini bertujuan untuk mengembangkan buku ajar mata kuliah logika dan himpunan bermuatan etnomatematika yang berorientasi pada kemampuan berpikir tingkat tinggi. Penelitian ini merupakan Research and Development (R&D) atau penelitian pengembangan dengan mengikuti model pengembangan ADDIE, yaitu analisis, perancangan, pengembangan, implementasi, dan evaluasi. Tahun pertama penelitian ini telah dilakukan sampai pada fase pengembangan, yaitu dengan mengembangkan produk buku ajar sesuai rancangan dan memvalidasi produk buku ajar tersebut. Hasil penelitian menunjukkan bahwa buku ajar Logika dan Himpunan bermuatan Etnomatematika yang berorientasi pada kemampuan berpikir tingkat tinggi memenuhi kategori 'Sangat Baik' pada uji validitas setelah dinilai oleh para ahli, sehingga buku ajar tersebut layak digunakan sebagai sumber belajar.

Kata kunci: Etnomatematika, Kemampuan Berpikir Tingkat Tinggi, Buku Ajar Logika dan Himpunan, Budaya Sasak

Received : March 17, 2022
/Accepted : November 23, 2022

/Revised : September 19, 2022
/ Published : November 30, 2022

Introduction

Logic and sets are one of the compulsory subjects of the mathematics education study program, FKIP, University of Mataram. In this course, students learn logic which includes the ability to think analytically, logically and axiomatically as well as proof techniques and the basics of set theory and the relationship between logic and sets. Logic and sets are also materials that are taught from junior high school to college level. Therefore, learning logic and sets can train students' higher-order thinking skills.

Higher order thinking skills include various kinds of mathematical thinking skills possessed by students. Higher order thinking skills include the ability to understand and apply mathematical concepts; critical thinking; problem solving; logical thinking; mathematical communication;

mathematical connection; reasoning and proof, and creative thinking (Komala et al., 2020; Madu, 2017; Pratama & Retnawati, 2018; Saragih et al., 2017). Higher order thinking skills are needed in teaching and learning in universities and are general skills that must be possessed by every student, one of which is in the mathematics education study program. Higher order thinking skills play a role in applying, relating, or manipulating prior knowledge in sequence to solve new problems effectively (Akhsani & Purwanto, 2015; Pratama & Retnawati, 2018; Retnawati et al., 2018).

Higher order thinking skills in learning mathematics can be trained using textbook (Bulu & Nahak, 2020; Pratama & Retnawati, 2018). Mathematics textbook are developed to meet the needs of educators, usually in educational institutions. Textbook are one of the learning media that can help transfer information or knowledge well to students (Muslaini et al., 2018). Arifin and Kusrianto (Arifin & Kusrianto, 2009) mention the characteristics of textbook, including: arousing the interest of the readers, written and designed for student use, designed for their own environment, based on competence, compiled based on student needs and the final competencies to be achieved (Bulu & Nahak, 2020; Pratiwi et al., 2018), focuses on providing opportunities for students to practice, accommodating student learning difficulties, always providing summaries, communicative writing style, density based on student needs, packaged and used in the learning process, has a mechanism to collect feedback from students, and explain how to study textbook.

Ethnomathematics in learning mathematics is a trend that needs to be developed, especially in learning that raises local culture. Mathematics and culture have a very close relationship so that the development and application of mathematical concepts in the learning process must be based on situations of daily life or local culture (Ratriana et al., 2021). By applying ethnomathematics in mathematics learning, students are trained to be able to solve everyday problems related to mathematics (Risdiyanti & Prahmana, 2018b, 2018a). Ethnomathematics-based mathematics textbook can train students to develop their investigative skills (Araiku et al., 2020) and critical thinking (Martyanti & Suhartini, 2018) by assessing and choose mathematical concepts that are appropriate for the local culture. Mathematical investigation skills are needed in higher order thinking (Ardianingsih et al., 2020; Subarinah, 2013, 2016; Subarinah et al., 2020).

Based on a textbook needs analysis questionnaire given to 243 mathematics education students who have taken and are currently taking logic and set courses, it is found that 40% of students say that there are no textbooks available in logic and set courses so they only learn from the internet, ppt material from lecturers, YouTube, and outside reference books. While the remaining 60% said that there were already textbooks for logic and set courses, but the problems in these books were the lack of practice on higher-order thinking questions and the absence of the local cultural context that was applied. The average learning outcomes for logic and set courses from 243 students in the 2019/2020 school year are also still low, at 61. This shows that students' higher-order thinking skills in logic and sets courses are still low. Therefore, the development of logic and set textbooks that are oriented towards improving students' higher-order thinking skills is very much needed.

The development of ethnomathematics-based mathematics textbook is a recent research topic with the aim of developing innovative and creative mathematics learning (Choirudin et al., 2020; Mardiah et al., 2018; Rohmaini et al., 2020; Utami et al., 2018). Research on the development of ethnomathematical-based textbook is currently still dominated by the school

level, both elementary, junior high, and senior high school. Subarinah (Subarinah et al., 2020) in her research stated that it is important for university teachers to develop teaching materials that are oriented to higher order thinking skills. Therefore, in this study, researchers will develop a textbook for logic and set courses that contain ethnomathematics with orientation to higher-order thinking skills.

Research Methods

This research is a Research and Development (R&D) by following the ADDIE development model (Branch, 2009). There are five stages of ADDIE used in this study, namely analysis, design, development, implementation, and evaluation. The stages of ADDIE development can be seen in Figure 1 below.

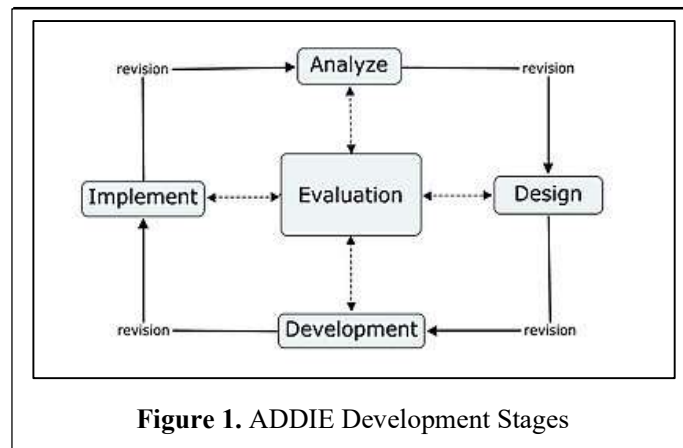


Figure 1. ADDIE Development Stages

The analysis stage is carried out to determine the objectives of product development in the form of textbook for Logic and Sets courses containing ethnomathematics to improve higher-order thinking skills. The analysis carried out includes: material in textbook, indicators of higher order thinking, and cultural analysis of the Sasak tribe. The design stage is carried out by making a textbook design (prototype) which will be developed to compile the completeness of the research instrument. Furthermore, the development stage includes development activities based on the design carried out. Furthermore, the validation and revision process is carried out at this stage so that the textbook product becomes valid according to the expected goals.

In the first year, this research has been carried out to the development stage. Researchers have developed a textbook product according to the design and validated the textbook product. The validity data collection technique in this development stage is based on content validation by involving expert validation as many as five validators. The validators in this development research consisted of one mathematics education lecturer, two mathematics teachers at the junior high school level, and two mathematics teachers at the high school level. The validation process is carried out by providing research instruments in the form of a product validation questionnaire sheet which is equipped with an assessment rubric. The results of the assessment of all these validators serve as a reference for complete information regarding the feasibility of a developed textbook product.

The data obtained were then analyzed quantitatively. The questionnaire sheet to see the validity of this textbook product consists of 24 items and uses a scale of 5 with categories, namely a

score of 5 = very good, a score of 4 = good, a score of 3 = sufficient, a score of 2 = poor, a score of 1 = very poor. The eligibility criteria for textbook products are determined by converting the total score on the questionnaire using the formula shown in Table 1 below.

Table 1. Formula for Determining Interval Category

Formula	Category
$X > \bar{X}_i + 1,8 \times sb_i$	Very Good
$\bar{X}_i + 0,6 \times sb_i < X \leq \bar{X}_i + 1,8 \times sb_i$	Good
$\bar{X}_i - 0,6 \times sb_i < X \leq \bar{X}_i + 0,6 \times sb_i$	Sufficient
$\bar{X}_i - 1,8 \times sb_i < X \leq \bar{X}_i - 0,6 \times sb_i$	Poor
$X \leq \bar{X}_i - 1,8 \times sb_i$	Very Poor

(Widoyoko, 2016)

Information:

$$\bar{X}_i \text{ (Ideal average)} = \frac{1}{2} \times (\text{ideal maximum score} + \text{ideal minimum score})$$

$$sb_i \text{ (Ideal standard deviation)} = \frac{1}{6} \times (\text{ideal maximum score} - \text{ideal minimum score})$$

$$X = \text{Empirical score}$$

Based on Table 1, the categorization of the validity of the textbook products used in this study can be seen in Table 2 below.

Table 2. Validation Questionnaire Score Category

Interval	Category
$X > 100,8$	Very Good
$81,6 < X \leq 100,8$	Good
$62,4 < X \leq 81,6$	Sufficient
$43,2 < X \leq 62,4$	Poor
$X \leq 43,2$	Very Poor

Furthermore, the textbook product developed in this study is said to be feasible if the product validation results reach a good category. In other words, the product deserves to be used as teaching material in the classroom.

Result and Discussions

Logic and sets textbook were developed containing ethnomathematics, culture of the Sasak tribe, Lombok, West Nusa Tenggara, which include: traditional food, games, and musical instruments. In addition, this textbook is also oriented towards high order thinking skills (HOTS). The material presented in Logic and Sets is intended for the university level. This textbook consists of five chapters, namely (1) Logic, (2) Set Theory I, (3) Set Theory II, (4) Logic and Sets Theory, and (5) Higher Order Thinking in Mathematics Olympiad. The material

and examples of questions in each chapter are presented using examples with the theme of Sasak culture, as well as practice questions that are made. Some of the practice questions in the textbook contain ethnomathematics so that the problems presented are close to local cultural life. Specifically, Chapter V in the textbook only contains practice questions that require higher-order thinking skills. The following Table 3 are the Basic Competencies and Indicators of Competence Achievement contained in the developed of textbook.

Table 3. Basic Competencies and Indicators of Competence Achievement

Basic Competencies	Indicators of Competence Achievement
Chapter I Logic Students can understand logic which includes single propositions, compound propositions, tautologies, contradictions, contingencies, equivalences, quantifiable statements, validity of proofs, and be able to apply them in problem solving.	<p>Students can determine propositions and not propositions.</p> <p>Students can determine the truth value of a single proposition.</p> <p>Students can determine the truth value of a compound proposition by using a truth table.</p> <p>Students can determine the negation of a single proposition.</p> <p>Students can determine the negation of a compound proposition.</p> <p>Students can determine a proposition that is a tautology by using a truth table.</p> <p>Students can determine a proposition that is a contradiction by using a truth table.</p> <p>Students can prove equivalent propositions using a truth table.</p> <p>Students can determine the truth value of quantified statements.</p> <p>Students can determine the negation of a quantified statement.</p> <p>Students can determine the validity of an argument by using a truth table.</p> <p>Students can determine the validity of an argument by using the rules of inference.</p> <p>Students can apply logical concepts in solving math-related problems.</p>
Chapter II Sets Theory I Students can understand definitions and theorems related to sets, relations between sets, operations on sets, power sets, and sets of numbers. Students can apply definitions and theorems in solving problems related to sets, relations between sets, operations on sets, power sets, and sets of numbers. Students can analyze problems related to sets, relations between sets, operations on sets, power sets, and sets of numbers.	<p>Students can name examples and non-examples of sets.</p> <p>Students can explain the definition of subsets.</p> <p>Students can determine the subsets of a set.</p> <p>Students can explain the definition of the similarity of two sets.</p> <p>Students can explain the definition of two intersecting and mutually exclusive sets.</p> <p>Students can determine the intersection of two sets.</p> <p>Students can represent a set into a Venn diagram.</p> <p>Students can explain the definition of union and intersection of two sets.</p> <p>Students can determine the union and intersection of two sets.</p> <p>Students can make a Venn diagram of a union and intersection of two sets.</p> <p>Students can determine the difference between two sets.</p>

Basic Competencies	Indicators of Competence Achievement
<p>Chapter III Sets Theory II</p> <p>Students can understand set theory II which includes relations, functions, cardinality, partially ordered sets, and be able to apply them in problem solving.</p>	<ul style="list-style-type: none"> . Students can determine the power set of a set. . Students can define relations of a sets. . Students can define functions of a sets. . Students can define cardinality of a sets. . Students can define a partially ordered set of a sets. . Students can prove several theorems related to the relations. . Students can prove several theorems related to functions. . Students can prove several theorems related to cardinality. . Students can prove several theorems related to partially ordered sets. . Students can determine the relations of a sets. . Students can determine the function of a sets. . Students can determine cardinality of a sets. . Students can determine the partially ordered set of a sets. . Students can apply the concept of relations in solving math-related problems. . Students can apply the concept of functions in solving math-related problems. . Students can apply the concept of cardinality in solving math-related problems. . Students can apply the concept of partially ordered sets in solving math-related problems.
<p>Chapter IV Logic and Sets Theory</p> <ul style="list-style-type: none"> . Students can apply set theory to determine the validity of an argument. . Students can apply logic to prove the concept of set theory. 	<ul style="list-style-type: none"> . Students can determine the Venn diagram of a proposition. . Students can determine the validity of an argument by using a Venn diagram. . Students can prove the concept of set theory by using direct evidence. . Students can prove the concept of set theory by using indirect evidence.

In Figure 1, in the left column, it can be seen that the modus ponens concept presented in the textbook uses an example of a local context, namely *bebalung* which is a traditional food typical of the Sasak tribe. Then, in Figure 1, in the right column, which is an example of the concept of set theory in Chapter 2. It can be seen that, examples of members in the sets use local special food, snacks, or drinks. In the picture above, one of the traditional cakes typical of the Sasak tribe is *Cerorot*.

Figure 2 below is an example of a textbook design in the form of some examples of material contained in the textbook.

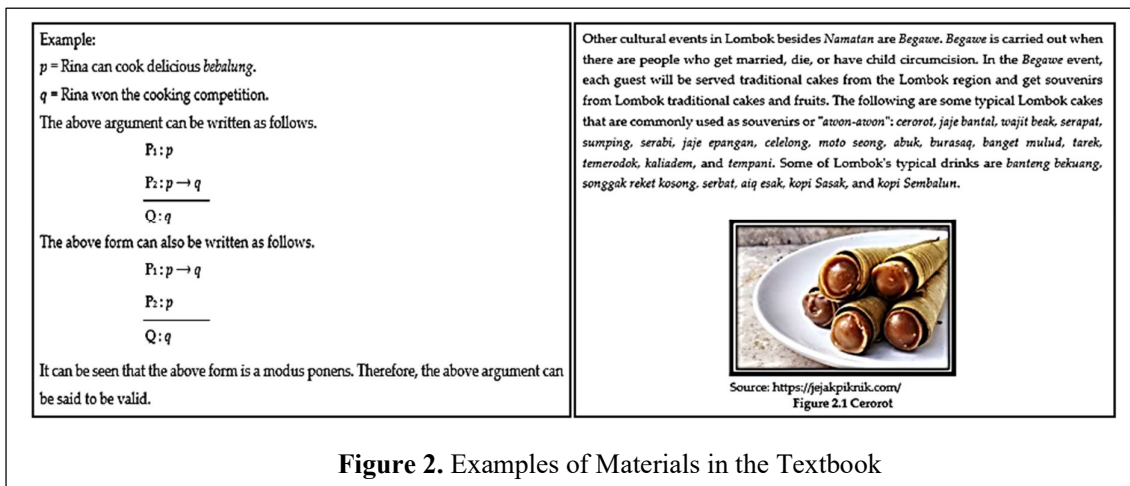


Figure 2. Examples of Materials in the Textbook

Figure 3 below is an example of a textbook design in the form of some examples of practice questions contained in the textbook.

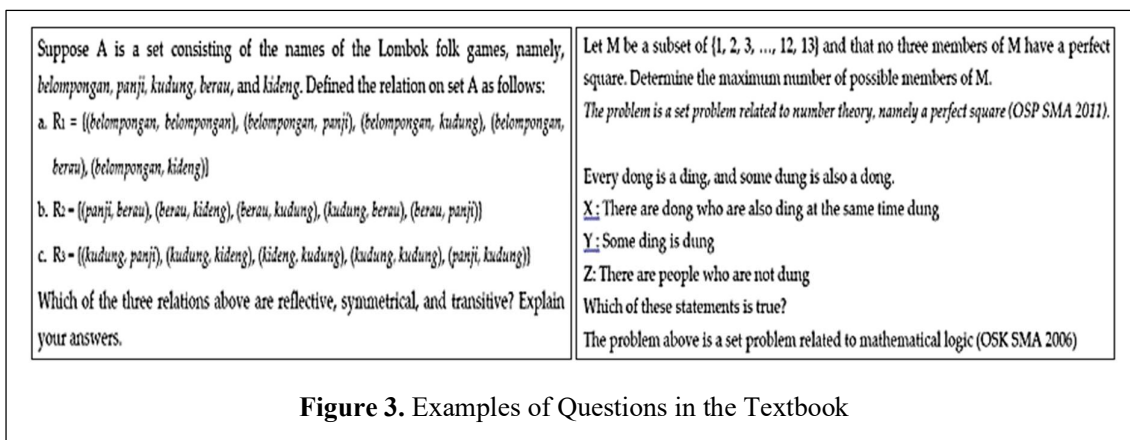


Figure 3. Examples of Questions in the Textbook

Figure 3 above shows some examples of questions in the textbook. The questions presented are at various levels of difficulty, ranging from ordinary levels to questions that require high-level thinking skills to solve them. Especially in Chapter V, many examples of Olympic questions are presented to improve students' higher-order thinking skills.

The textbook that has been developed are assessed by five experts or validators. The data for the validation test was obtained through a validation sheet in the form of a questionnaire. The data was collected to determine the classification of the validity and results of small-scale trials. Validation by experts is needed as an evaluator of the language, content, and presentation of book that have been developed. The data obtained in the form of quantitative and qualitative data through a questionnaire given to the validator. The results of the validator assessment can be seen in Table 4.

Table 4. Expert Validation Results

Component	Validator 1	Validator 2	Validator 3	Validator 4	Validator 5
Language	33	34	35	33	35

Content	55	58	60	59	58
Presentation	24	25	25	24	24
Total Score	112	117	120	116	117

Based on Table 4 above, it can be seen that the assessment results of all validators are at a total score of more than 100.8. Then the average score of the validation test is 116.4. This data indicates that the developed textbook is in the Very Good category in terms of validity. Thus, this textbook is worthy of being used as a textbook. The assessments, comments, and suggestions of experts are used as a reference to improve the quality of textbook. The textbook developed is feasible to use with some minor revisions. Several experts left comments and suggestions to improve the quality of the textbook. The following are comments given by validators related to the development of the Logic and Sets textbook.

Table 5. Validator's Suggestions and Feedback

Validator	Suggestions and Feedback
Validator 1	Add ethnomathematical HOTS questions. Change the title of Chapter IV so as not to seem repeating Chapters I, II, and III. Non-Indonesian languages should be written in italics. There are still some sub-chapters that have not been numbered, it's better to be numbered consistently.
Validator 2	The function material is equipped with special functions, such as absolute value functions, rational functions, largest integer functions that are less than or equal to. Non-Indonesian languages (Sasak, English) should be written in italics.
Validator 3	-
Validator 4	Basically, the contents of textbook really help improve students' ability to think at higher levels, it is hoped that (textbook) can optimally motivate students to have more fun learning mathematics because it is associated with the surrounding environment, so learning mathematics is more interesting.
Validator 5	Non-Indonesian languages (Sasak, English) should be written in italics.

Several previous studies have also used expert validation methods to measure the validity of the content of the developed product. Research conducted by Ratriana et al. (Ratriana et al., 2021) and Utami et al. (Utami et al., 2018) is to develop an E-Module Based on Ethnomathematics to improve learning achievement dan problem-solving skills that have been proven valid. Rohmaini et al. (Rohmaini et al., 2020) also developed an ethnomathematics-based learning module with the help of Wingeom based on Borg and Gall's steps, where the learning module falls into valid and attractive criteria to facilitate mathematics learning. E-Module characterized by HOTS based on ethnomathematics of Simalungun tribal developed by Sandri and Mailani (Sandri & Mailani, 2021) is also feasible and effective for students to use during the learning process.

Learning mathematics using a cultural approach is an alternative learning resource to create interactive, interesting, and fun learning (Choirudin et al., 2020; Islam & Mariana, 2021; Mardiah et al., 2018; Rohmaini et al., 2020; Utami et al., 2018). Farda et al. (Farda et al., 2017) in their research add that, learning with local culture or ethnomathematics can increase attitudes towards love of local culture, learning can be more fun while increasing students' enthusiasm for learning. In line with this, Mania and Alam (Mania & Alam, 2021) in their research on teacher perceptions in learning mathematics with an ethnomathematical approach concluded that students can learn mathematics more easily. Furthermore, previous research conducted by Aini and Suparman (Aini & Suparman, 2018) revealed that TIMSS type questions with an ethnomathematical theme have a positive impact on students as prospective teachers. Students can practice their mathematical reasoning skills, so they feel motivated in learning mathematics. The development of ethnomathematical comics based on geometry material can also generate students' learning motivation (Fajriah et al., 2021). This is in line with the opinion of Zaenuri et al. (Zaenuri et al., 2019) that ethnomathematics-based geometry learning can increase student motivation.

Not only in terms of attitude, from the aspect of knowledge as well, several previous studies that developed similar products and ethnomathematical-based learning can also play a role in improving aspects of knowledge and skills. Ethnomathematics-based RME learning increases students' higher-order mathematical thinking skills (Ardianingsih et al., 2020). Students' critical thinking skills can also be improved through ethnomathematical-based mathematics learning, because the problems presented are in accordance with contextual culture (Martyanti & Suhartini, 2018).

Acknowledgement

The author would thank you to Mathematics Education Department, University of Mataram, both in funding or conducting research.

Conclusion

The Logic and Sets textbook containing Ethnomathematics with an orientation to high order thinking skills that was developed meets the 'Very Good' category on the validity test after being assessed by experts. Several aspects such as aspects of language, content, and presentation were declared valid. So, it can be said that this textbook is appropriate to be used as an alternative source of learning for Logic and Sets courses for students. Through this textbook, with a local culture nuance, it is hoped that it can improve students' higher-order thinking skills in learning mathematics. Further research can be conducted to determine the practicality and effectiveness of textbook from various other aspects.

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