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Development of Problem-Based Number Theory Learning Tools

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ABSTRACT

Development of Problem-Based Number Theory Learning Tools" in the 2022 FMIPA Unimed Mathematics Education Lecture. This research is the development of learning tools that aim to describe the development process that produces valid, practical, and effective number theory learning tools. Problem-Based Number Theory Learning developed by following the Four D's: Define, Design, Develop, and Disseminate. The trial of device development was carried out in the S1 Mathematics Education Study program in the Number Theory lecture. In the development of number theory lecture tools produce: Textbooks, and 14 Lesson Plans (LP) that are valid, practical and effective. The implementation process is carried out by preparing components of teaching materials for the Number Theory course in the form of: textbooks, LP which are carried out in the Number Theory course in 2022. In the implementation of disseminate applying limited Number Theory teaching materials produced: LP as many as 14 valid, practical and effective meetings to the Lecturer Team in the Department of Mathematics FMIPA Unimed.

A. INTRODUCTION

The number theory course is designed for prospective teacher students so that students after taking this course: master the concept of number theory, which is shown by the ability to work individually and in teams in applying the concept of integer systems and their properties, integer division, congruence, prime factorization, linear diophantine equations, non-linear diophantine equations, applications of concongruence. Waclaw Sieprinski (2015: 16).

With the demands of this professional competence, every lecturer in the mathematics education study program is obliged to compile complete and systematic learning tools so that learning takes place interactively, inspiring, fun, challenging, and motivating students to actively participate and providing sufficient space (Waclaw Sierprinski, 2015).

Some of the learning tools needed include textbooks, lesson plans (LP), and evaluation tools. The preparation of learning tools is the beginning of learning. To produce good quality learning devices, learning tools must be arranged neatly and in accordance with the rules of correct and good learning development (Nugroho, 2009: 18).

Problem-solving ability is the strategic ability or competence shown by students in understanding, choosing problem-solving approaches and strategies, and using models to solve problems (Guru Pembelajar & Tenaga Kependidikan, 2016: 37).

The strategy for solving a mathematical problem is recommended, it is necessary to follow four steps (Trianto, 2011: 26), namely:

1. Understanding the problem, what is known, what is not known, whether the information is sufficient, and the conditions that must be met, restate the real problem in a more operational form.
2. Planning for troubleshooting, a step that can be done considering a problem that has been solved that has similarities to the problem to be solved, looking for rule patterns, and drawing up a resolution procedure.
3. Solve the problem as planned, and carry out the procedures that were created in the previous step to get resolved it.
4. Re-examine the procedures and completion results, analyze and evaluate the applied procedures and the results obtained according to the outlined procedures.

Problem-based learning is a learning approach that involves students in problem-solving investigations, which integrates skills and concepts from various aspects. Sinaga Bornok (2007: 36). Problem-based learning is a learning approach that uses real-world problems as a context for students to learn about critical thinking, creativity, skills in solving problems, and obtaining essential knowledge and concepts from these teaching materials. Dahar (1989: 58). The stages of the problem-based learning model (Ibrahim & Nur, 2000: 27), are:

1. Introduce students to problem situations.
2. Organizing students to learn, and assisting students in defining problems.
3. Guiding the investigation of the problems presented both individually and in groups.
4. Assist students in developing problem-solving.
5. Help students analyze the work to be done.

The stages, and steps of the problem-based learning model can be seen in the following table:

Table 1. Problems-Based Learning Syntax.

Phase	Student Activities	Lecturer Activities
1.	Orientation to the problem	Explaining learning objectives, and logistics, motivating students to be involved in activities
2.	Organizing learning	Defining and organizing tasks related to the problem
3.	Guiding individual and group investigations	Encouraging students to collect information, carry out observations to solve problems
4.	Develop and present work	Assist students in planning and preparing appropriate works
5.	Analyze and evaluate the problem-solving process	Helping students to reflect, evaluate, and investigate the carried out.

Amir (2009: 48)

B. RESEARCH METHODS

Mathematics Education students at the Faculty of Mathematics and Science, Universitas Negeri Medan are the subject of this research. And the object of this research is a problem-based learning tool for number theory developed in this study.

This research is said to be successful if the instruments and teaching materials are developed to encounter the criteria of validity, practicality, and effectiveness. Validity is met if the developed teaching material meets the validity of the content and construct. Practicality is fulfilled, if the teaching materials developed are easy for lecturers and students (Siagian, 2017). Effectiveness is met if the results of student lectures after getting learning with teaching materials are based on a complete problem-learning approach. The teaching materials based on the problem-based learning approach developed are said to be effective if $\geq 80\%$ of all test sub jects meet the completeness of individual learning absorbing 65% of the material submitted and there is a positive.

The instruments used in this development research are: (1) validation sheets; (2) expert and practitioner assessment sheets on the practicality and effectiveness of the device; (3) observation sheets; (4) student and lecturer response questionnaires; and (5) learning outcomes tests.

C. RESULT AND DISCUSSION

The realization of the validity, practicality, and effectiveness of textbook learning tools and problem-based number theory lecture event units carried out in the mathematics education study program FMIPA Universitas Negeri Medan, can be seen as follows.

1. Average Score of Validation Results LP 1 – LP 15 Number Theory Lectures.

The state of the LP 1 – LP 15 implementation process Number Theory Lectures which include Learning Activity Objectives, Material Descriptions, Summaries, Assignments, Formative Tests, Formative Answer Keys, and Worksheets, which are designed to be improved or revised according to the advice of expert validators and the input of the research team, in the trial. The results of the LP 1 – LP 15 expert validator assessment of the Problem-Based Number Theory Lecture developed, are briefly summarized in Table 2.

Based on the data in Table 2, it can be explained that the validation results of the five expert validators against LP 1 – LP 15 Learning Activity Objectives 4.03 are valid, the Material Description 4.02 is valid, the Summary 4.05 is valid, Task 4.03 is valid, the Formative test is 4.07 is valid, the Formative Answer Key is 4.10 is valid, and the Worksheet is 4.07 is valid, and the Average total score is 4.05. Thus, from the results of the assessment of the five expert validators, it was concluded that the mathematical problem-solving ability test instrument developed was already classified as valid.

Table 2. Summary of LP 1 – LP 15 Component Validation Results

No	Assessed Aspects	Average Score	Information
1.	Learning Activity Objectives	4,03	Valid
2.	Material Description	4,02	Valid
3.	Summary	4,05	Valid
4.	Assignment	4,03	Valid
5.	Formative Test	4,07	Valid
6.	Formative Answer Key	4,10	Valid
7.	Work Sheet	4,07	valid
	Total Average	**4,05**	

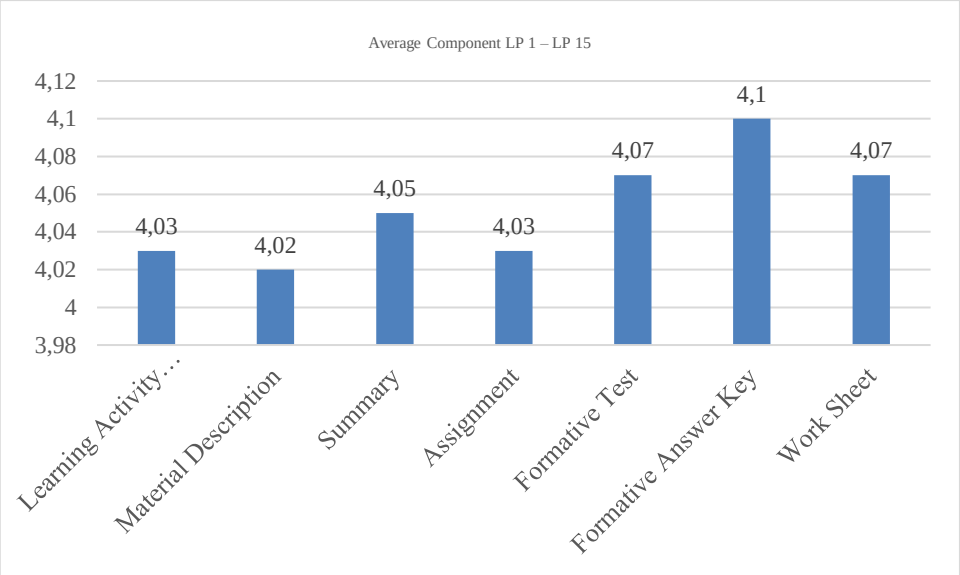

Fig. 1. Histogram of Average Component of Validity Score LP 1 – LP 15

2. Average Results of Practicality of LP 1 – LP 15 Implementation.

The results of the implementation of lectures on aspects of lecturer activities and student activities in the trial are briefly presented in table 3.

Table 3. Average Results of Observations of the Implementation of LP 1 – LP 15 Trial Lectures

Average Lecturer and Students Activity Score	LP 1 – LP 15
Lecturer Activities	3,79
Student Activities	3,84

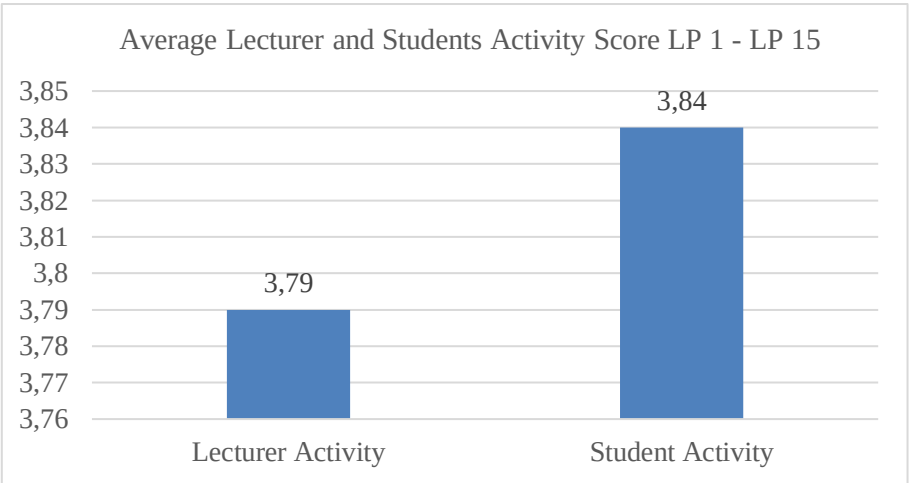

Fig. 2. Average Lecture Implementation Score LP 1 – LP 15

Thus, from the results of the LP 1 – LP 15 lecture trial, it shows that the implementation of lectures based on the activities of lecturers and students is classified as a practical criterion. This also indicates that the implementation of lectures in the LP 1 – LP 15 trial using problem-based lecture tools has met practical criteria.

3. Student Learning Completion of LP 1 – LP 15 Implementation

The results of LP 1 – LP 15 completeness in student number theory problem solving ability, are briefly presented in the following table

Table 4. Summary of Student Learning Completion of LP 1 – LP 15 Implementation

	Trial Percentage 1	Trial Percentage 2
Completeness	34,87	81,92
Incompleteness	63,13	8,82

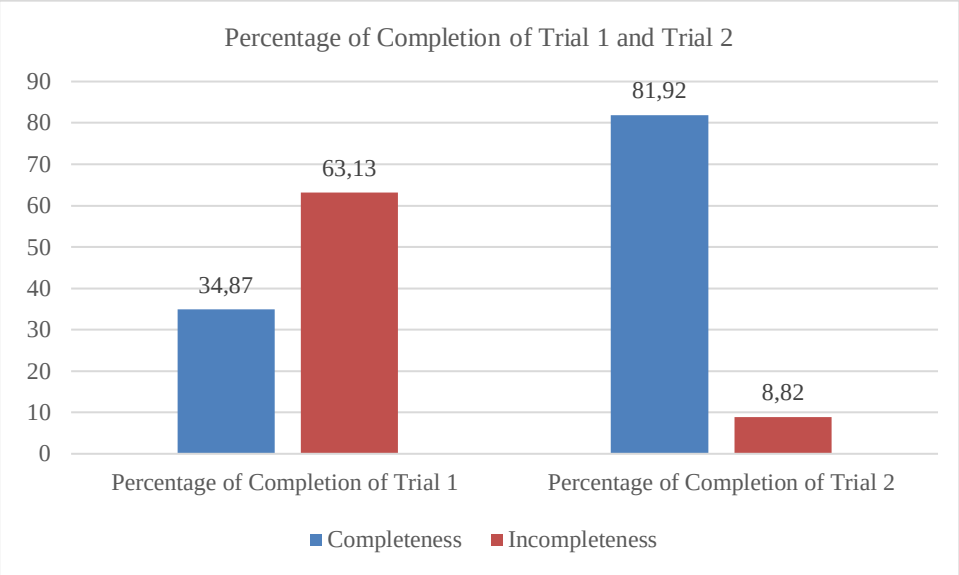

Fig. 3. Percentage of Completeness of Learning Students Trial 1 and Trial 2 LP 1 – LP 15 Number Theory Course

Overall, based on the results of trial 2, it shows that the implementation of LP 1 – LP 15 Number Theory by applying or using problem-based lecture model-based lecture tools have met the criteria for effectiveness.

D. CONCLUSION AND SUGGESTIONS

Based on the results of research on the development of problem-based learning-oriented number theory lecture tools can improve the ability of number theory problems, so that: Number theory lecture tools in the form of textbooks, and problem-based learning-oriented lecture event units that are produced have met valid, practical, and effective criteria.

The embodiment of the validity, practicality and effectiveness of the devices used, through the results of data analysis, it can be concluded that:

1. LP 1 – LP 15 validity has met the criteria set with valid criteria with a scale of 4 ≤scale ≤5.
2. The practicality of LP 1 – LP 15 has met the criteria set validly with a scale of 4 ≤scale ≤5.
3. LP 1 – LP 15 effectiveness has met the effectiveness criteria with individual and classical completion criteria. The achievement of lecture results is at least 80% classical completion; (2) student activities meet the established time tolerance criteria; (3) more than 65% of students responded positively to the lecture tools developed; and (4) the ability of lecturers to manage good category lectures.

The resulting lecture equipment still needs to be tested to other universities with various conditions in order to obtain a truly quality lecture device so that lecture devices can be used in a wider scope. The development of problem-based learning-oriented lecture tools needs to be developed for other materials that are in accordance with problem solving. The resulting lecture equipment still needs to be tested at other universities with various conditions in order to obtain a truly quality lecture device so that the lecture device can be used

on a wider scale. The development of problem-based learning-oriented lecture tools needs to be developed for other materials that are in accordance with the problem-based learning model.

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