Development of Roadmap Design of Applied Mathematics Standard Competency Relevant for Department of Electronic Engineering

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***Abstract*—** This study aims to produce a Roadmap that shows the relationship between the needs of what mathematics materials are needed in the electrical engineering department and roadmap-based applied mathematics textbooks that meet valid, practical and effective criteria to improve student mathematics learning outcomes. This study uses the Ploom development model by dividing the development stage into three phases. Test the validity of the Rodmap mathematics flow chart and Roadmap-based learning books developed through the self-evaluation stage and the expert assessment stage (1 mathematics expert, 1 electrical engineering expert, 1 language expert and 1 educational technology expert). Practicality tests are carried out to students in the electrical engineering department of UNP as users of Roadmap-based textbooks and effectiveness tests are carried out to students after using Roadmap-based textbooks. The results showed that the Roadmap validity test obtained an assessment of 3.76 with a very valid category, then the Roadmap-based textbook validity test by obtaining a score of 3,179 textbook practicality tests by small group stage students obtained an assessment of 88. 44% and the effectiveness test of the Small Group stage student learning outcomes test obtained 100% with the very effective category. Thus it can be concluded that the development of the roadmap design developed obtains results with valid, practical and effective categories to improve learning outcomes.

***Keywords*—** Roadmap Design, Textbooks, Plomp development model.

INTRODUCTION

The main mission of each university is to develop competent and professional graduates according to the competence of their respective majors (Rofaida & Gautama, 2019). Padang State University (UNP) is one of the universities that organizes undergraduate programs for technical vocational education, educational study programs at the undergraduate level and vocational education at the D4 and D3 levels (Efronia & Mukhaiyar, 2020)

The implementation of higher education by the Faculty of Engineering (FT) in the field of technology and professional vocational has a superior mission, and is relevant to the needs of the job market and can innovate sustainably according to the challenges of the times. Each department at FT UNP has standardized graduate competency standards, including the Department of Electrical Engineering. The need for basic competence for those who will graduate from the electrical engineering major is important to be given in order to reduce the intellectual unemployment rate (Efronia & Mukhaiyar, 2020).

Electrical engineering competency standards are an effort to obtain the specified capabilities, and their existence is very important (Setiadi, 2016). Electrical engineering competency standards consist of the competencies contained in the FT UNP manual based on the basic ability requirements of students. These competencies are needed to continue the following competencies, with basic courses namely Applied Mathematics, Engineering Physics, DC Electrical Circuits, Electrical Materials Science, AC Electrical Circuits, Computer Programming Applications, Measuring and Measurement Tools (Efronia & Mukhaiyar, 2020).

Mathematical competence is a standard or basic competency that has an important role in the electrical engineering department because students are required to have the right frame of mind to model engineering problems, analyze and solve problems (Hennig et al., 2015). The mathematical competence of an engineer will affect the professionalism of the engineer in the world of work (Firouzian et al., 2014). Mathematics is a key skill for engineering students and the skills acquired during the first year are indispensable for advanced courses (Soares et al., 2019). Research also shows that engineering students' math scores are highly correlated with students' future academic success (Hennig et al., 2015).

Technical mathematics competence in some cases has problems that clearly exceed school mathematics (Hennig et al., 2015). A simple example is the basic electrical engineering course on the quantitative description of electromagnetic fields. This topic requires

students to be able to handle several integrals in relation to various coordinate systems (Braun et al., 2014). The inability of students to model and understand material problems affects their ability to describe its integrals (Nugroho et al., 2019).

Along with these problems, mathematics courses present a big challenge for engineering students (Gollish, 2019). First, based on research conducted by Mukhaiyar (2020) on 2015 UNP Electrical Engineering Education Study Program students in the odd semester lectures of Electrical Engineering Education students it was found that these students had not mastered the competencies that should have been fulfilled. The problem that is often encountered by PSPTE students is the inability to meet standard competencies so that it results in interference with other advanced courses. This often happens in related or advanced courses, such as Engineering Mathematics and Applied Physics (Efronia & Mukhaiyar, 2020).

Second, teaching materials that do not meet the needs of applied mathematics Engineering. The need for mathematics in the field of engineering must have clear standards and focus in accordance with the needs of the Engineer (Ronaldo, 2020). Mathematics as a standard competency should be a simple calculation tool that can be used in decision making by an engineer in the world of work (Ghaliyah & Bakri, 2015). The availability of teaching materials that are relevant to the learning objectives will make it easier for lecturers and students to carry out learning. (Priatna et al., 2017). However, in some cases it was found that the learning of engineering mathematics was directed to the discovery of the origin of the formula which was not really a priority for engineering students.

Third, the aspect that we often see from math problems is the deteriorating mathematical skills of incoming students. The increasing difference in ability results in the inability of students to understand advanced mathematical abilities in other subjects (Mat & Buniyamin, 2017). The heterogeneity of the educational background of incoming students affects their basic understanding of engineering mathematics (Hennig et al., 2015). The difference is not only in the skill level of students but also in the topics taught (Sergejeva & Aboltins, 2020).

Fourth, mathematical competence that does not meet the professional needs of engineers in the world of work. Standard mathematics courses do not provide the necessary mathematical prerequisites to overcome engineering majors requirements (Harris et al., 2015). The notion of 'mathematical maturity' is used as an open concept to conceptualize the demands of the world of work (Firouzian, 2014). Mathematical maturity is closely related to high-level modeling competencies, namely the ability to manipulate symbolic and graphic expressions as well as the ability to use relevant computational tools (Faulkner et al., 2019). Based on interviews and discussions conducted by Faulkner et al (2019) with several European University engineering lecturers, it was concluded that students' ability to conceptualize mathematical problems in machines has not been able to meet the expectations of the world of work. The scope of the above problems is rooted in the absence of a standard mathematical competency roadmap that suits the needs of an Engineer. Although it looks simple, transforming the standard competence of mathematics to students is not an easy job.

Based on the explanation above, it is necessary to have standard competence in Engineering Mathematics that meets the expectations and needs of the Electrical Engineering Department, Faculty of Engineering, UNP so that graduates are able to compete and meet the needs of the Business World and the Industrial World. The rearrangement of the standard competency roadmap for electrical engineering mathematics is expected to be able to provide learning reference development to meet the needs of students and the world of work. The existence of the Mathematics standard competency roadmap will make a positive contribution in improving the knowledge and basic competencies of PSPTE students. Availability of a roadmap for the standard competence of Electrical Engineering Students will direct learning to be more focused, efficient and effective in accordance with the professional needs of Engineers,

METHOD

Types of research

This type of research is research and development (Research and Development). According to Sugiyono (2012: 407) development research is a series of processes or steps in developing a new product or perfecting an existing product so that it can be accounted for and test the effectiveness of the product. The development model chosen is the plopm model. Based on the iteration of the Plomp development cycle, Plomp (Plomp and Nieveen, 2013:30) divides the development phase into three phases, namely preliminary research, development or prototyping phase, and assessment phase. This research was carried out to develop and produce a Roadmap Design of Competency Standards for Engineering Mathematics for the Electrical Engineering Department of UNP.

Research time and place

Research on the development of road maps and applied mathematics textbooks for the electrical engineering department was carried out at the Faculty of Engineering, Padang State University on 1 February 2022 - 1 June 2022.

Target/subject of research

In developmentthe design of a relevant applied mathematics standard competency roadmap for electrical engineering majors involves4 experts consisting of 1 electrical engineering lecturer, 1 mathematics lecturer, 1 Indonesian language lecturer, and 1 educational technology lecturer to determine the validity of the road map and mathematics learning book. Furthermore, at the trial stage of developing a design competency roadmap for engineering mathematics standards involving several studentsmajoring in electrical engineering UNP, which is divided into 3 stages of testing, namely one-to-one evaluation, small group test (Small Group evaluation), small group test (Small Group evaluation).

Procedure

This development research procedure consists of 3 stages, namely the preliminary research phase, the development or prototyping phase and the assessment phase. Know the problems or obstacles that occur, define and define the conditions of learning. This stage consists of several activities, namely needs analysis, curriculum analysis, concept analysis and analysis of student characteristics.

Next stepdevelopment or prototyping (development or prototyping phase).At this stage, a series of prototypes are developed. The prototype is evaluated with reference to formative evaluation. Formative evaluation is the process of collecting data about a product during development, which aims to improve the condition of the product before producing the final product.

Last, stageassessment (assessment phases), carried out during field tests (field tests) in class or large groups. The revised results obtained in the small group test were followed by a field test in one class. At this stage, activities are focused on evaluating the quality of the products produced in the previous stage. Assessment is carried out to determine whether the product has met expectations, is practical and effective to improve students' basic mathematical abilities. After the trial, expert lecturers and students will be given a questionnaire. The aim is to find out the responses of expert lecturers and students about the roadmap design used during the learning process. This field test is carried out with the aim of seeing the level of practicality of a product designed.

Data and Instruments

The types of data in the research conducted consisted of two, namely qualitative and quantitative data. Qualitative data was obtained from data from observations, interviews with expert lecturers and interviews with students, while quantitative data was obtained from validity tests, practicality tests and mathematics learning outcomes tests.

Meanwhile, the instruments used in this study consisted of instruments at the preliminary research stage which included interview guides with expert lecturers, interview guidelines with students, student characteristic questionnaires, and needs analysis sheets, curriculum analysis, Concept Analysis. Validity instruments which include self-evaluation sheets and roadmap design validation sheets. Practical instruments include interview guidelines, student response questionnaires, lecturer response questionnaires. And the instrument of effectiveness used a final test which was conducted in the form of essay questions.

Data analysis technique

The type of data taken in this study is primary data, namely data from the validation results by the validator on the roadmap design and evaluation tool. The data taken from the implementation of the trial was limited to the test subjects in the form of observations during the learning process, questionnaires for expert lecturer responses and student responses and test sheets for learning mathematics results. The data obtained through the data collection instrument was then analyzed by descriptive statistical analysis for quantitative data and qualitative (non-statistical) analysis for qualitative data.

Validity Data Analysis

The steps used to determine the level of validity are as follows:

Validation sheets that have been assessed are presented in tabular form by scoring each answer as shown in table 1 below.

Table 1: *Assessment Score Against Validity*

Alternative Answer	Score
Strongly Disagree	1
Don't agree	2
Agree	3
Strongly agree	4

Source: Riduwan (2012:13)

Summing up the total score given by the validator on each aspect of the validation sheet

Giving validation value with the following formula

$V = \frac{X}{Y} \times 100\ \%$ (Modified from(Supranto, 2008: 96)

Information:

- V: The final value of each validator
- X: Sum of all scores
- Y: Maximum score

The interpretation of the validity of the roadmap design is determined by the following criteria:

Table 2: *Validity CriteriaRoadmap design*

Criteria (%)	**Interpretation**
$25 \leq V \leq 40$	Invalid
$40 < V \leq 55$	Less Valid
$55 < V \leq 70$	Quite Valid
$70 < V \leq 85$	Valid
$85 < V \leq 100$	Very Valid

Modified fromRiduwan (2010: 89)

Table 3: *Questionnaire Rating Scale*

Alternative Answer	**Score**
Strongly Disagree	1
Don't agree	2
Agree	3
Strongly agree	4

Source: Riduwan (2012:13)

The practicality questionnaire of the roadmap design is described using the data frequency analysis technique with the formula:

$P = \frac{R}{SM} x100\%$ (Purwanto modification, 2004: 102)

Information

- P= Practicality Value
- R= Score Obtained
- SM = Maximum Score

The practicality category uses the classification in table 4.

Table 4: *Practicality Category Roadmap design*

No.	**Achievement Rate (%)**	**Category**
1	$25 \leq P \leq 40$	Not Practical
2	$40 < P \leq 55$	Less Practical
3	$55 < P \leq 70$	Practical enough
4	$70 < P \leq 85$	Practical
5	$85 < P \leq 100$	Very Practical
Modified from Riduwan(2010:89)		

The roadmap design is said to be valid if the value of the percentage of validity () given by the validator > 70. If the value of the percentage of validity () 70, then the roadmap design must be revised before being tested in the next stage.

Practical Data Analysis

a. Analysis of Expert Lecturer Response Questionnaire and Student Response

The data on the practicality test of the roadmap design can be seen from the questionnaires that have been filled out by students. Questionnaire responses from expert lecturers and students were arranged in the form of a Likert Scale. This Likert scale is arranged with the following alternative categories of answers.

In Table 13, it can be concluded that the design of the roadmap is said to be practical if the target is to achieve the practical value >70.

b. Data Analysis of Interview Results

Descriptive technique is used to describe the interview data. There are three stages in analyzing qualitative data, namely reducing data, presenting data and drawing conclusions. Data reduction is the process of selecting, focusing and transforming the raw data obtained through interviews.

Effectiveness Data Analysis

Data on the effectiveness of the roadmap design can be obtained from the analysis of student mathematics learning outcomes test data. The test results were analyzed by calculating the students' mathematics learning outcomes. The method for calculating the final grade of a student is as follows:

$$N = \frac{\text{skor perolehan}}{\text{skor masksimal}} \text{ X } 100$$

with N as the final value.

The roadmap design is said to be effective if the student's mathematics learning achievement test is above the KKM, namely: >65%. Determination of the percentage based on the learning completeness interval proposed by Arikunto, 2012 as shown in table 5.

Table 5: *Completeness Interval*

No.	Achievement Rate (%)	Category
1	0 – 39	Very less
2	40 – 55	Not enough
3	56 – 65	Enough
4	66 – 79	Well
5	80 – 100	Very good

Source: Arikunto (2012)

To determine the percentage of students who complete the formula:

$$\text{Persentase mahasiswa yang tuntas} = \frac{jumlah\ peserta\ didik\ yang\ tuntas}{jumlah\ seluruh\ peserta\ didik} \times 100\%$$

The assessment of learning outcomes tests is based on the test scoring rubric.

Results and Discussion (70%)

The results of research on the development of road maps and applied mathematics textbooks for electrical engineering majors using the Plomp development model which consists of 3 stages, namely the preliminary research stage, the development or prototyping phase and the assessment phase. phases). The results of development research can be described as follows.

Results of the preliminary research phase (preliminary research)

Preliminary research stage. At this preliminary research stage there are several activities carried out before developing or designing products, namely 1). Results of needs analysis, At this stage information is collected about applied mathematics learning. In the needs analysis activity, the researcher carried out several activities such as interviews with applied mathematics lecturers and students, giving questionnaires to students and observing mathematics learning to collect information about mathematics learning at Padang State University. Based on interviews and supported by the results of learning observations, it can be seen that the basic mathematical abilities of students are still not strong because of their previous educational background, then students' interest and motivation in learning applied mathematics is still low because the thought of mathematics as a scary subject is still the mindset of students. While from The results of the questionnaire given concluded that some students did not like mathematics, students had difficulty understanding mathematics learning materials, students wanted more interesting learning resources. Based on the problems found, strategic steps are needed to overcome these problems. One of them is by developing a road map of applied mathematics and textbook of applied mathematics.

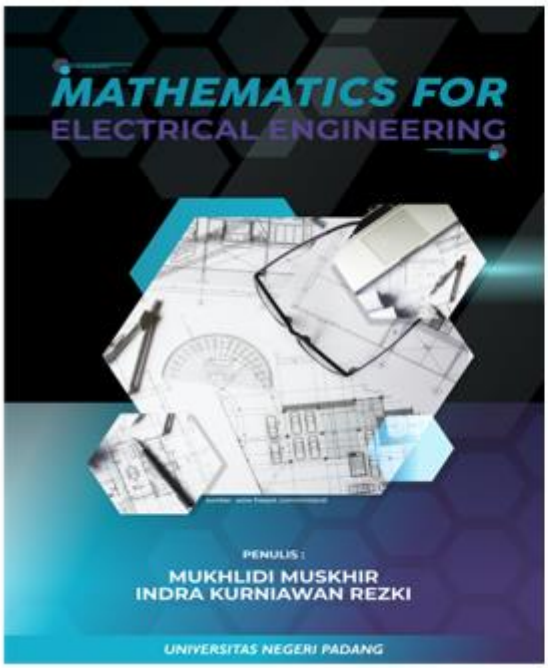
Next 2). curriculum analysis results. This curriculum analysis is carried out by examining the curriculum used. Curriculum analysis is carried out to see the suitability of Core Competencies (KI) and Basic Competencies (KD), Competency Achievement Indicators and learning objectives. Based on the results of the curriculum analysis that has been carried out, the researcher has determined the sequence and scope of the material according to the competencies to be achieved. The researcher at the same time has analyzed the syllabus that has been available. 3). concept analysis results. Concept analysis is carried out so that students can more easily understand the material to be studied. Concept analysis aims to identify the main concepts being taught, detail and organize them systematically to achieve indicators of competency achievement. The results of the concept analysis based on the curriculum contained twelve chapters that were studied. 4). the results of the student analysis, the characteristics of the students analyzed included academic ability, group work ability, background experience, fondness for colors and images and student attitudes. Based on the answers to the student questionnaire, it is known that most students consider mathematics as a subject that is quite difficult to understand. This is because students think that there are too many formulas in mathematics. For activities during class, the participation of students is quite active. For learning methods, students prefer to study in groups. So it can be concluded that students are accustomed to studying in groups to do certain tasks given by the teacher.

Results of the Development or Prototyping Phase

Development Phase (Development or Prototyping Phase). The results of the preliminary research serve as a guide for researchers to carry out the planning stage of the products developed, namely the road map of applied mathematics and applied mathematics textbooks. In detail the development process through several stages, namely

a. Prototype Design

Prototype Design, Prototype design is translated into characteristics of the developed mathematics learning books, namely the road map of applied mathematics and applied mathematics textbooks. The Applied Mathematics Road Map has characteristics including Title, Road Map Identity, and purpose. Meanwhile, applied mathematics textbooks have characteristics including cover, table of contents, table list, picture list, learning materials and bibliography.



DAFTAR ISI

Halaman

Figure 1: *Cover Page and Table of Contents*

BAB I

DASAR BILANGAN KOMPLEKS

Tujuan :

1) *Mahasiswa dapat memahami asal bilangan kompleks dan pangkat*
   Mahasiswa mampu menuliskan bilangan kompleks kedalam bentuk grafis
2) *Mahasiswa mengenal bentuk-bentuk bilangan kompleks*
3) *Mahasiswa mampu mengoperasikan persamaan bilangan kompleks pada operator penjumlahan dan pengurangan*

Pendahuluan

Bilangan kompleks merupakan bilangan yang banyak digunakan dalam teknik elektro untuk menyelesaikan berbagai persoalan analitik. Berbagai macam masalah dibidang teknik elektro yang bisa diselesaikan dengan menggunakan bilangan kompleks.

Bilangan kompleks berasal dari akar-akar persamaan kuadrat yang tidak dapat didefinisikan lebih lanjut. Biasanya akar-akar persamaan kuadrat pada kondisi tersebut dikatakan sebagai bilangan imajiner atau bilangan khayal. Bilangan khayal merupakan kesepakatan para ahli matematika untuk menyelesaikan persamaan yang memiliki akar $\sqrt{-1}$ atau $\sqrt{-1}$

Dari mana munculnya $\sqrt{-1}$?, akar-akar persamaan kuadrat diperoleh dengan menggunakan **rumus abc**.

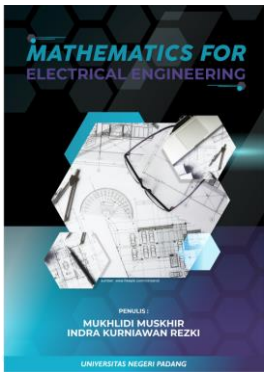
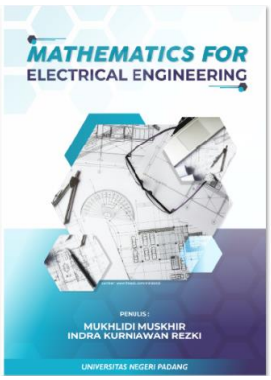
Figure 2: *Learning Materials*

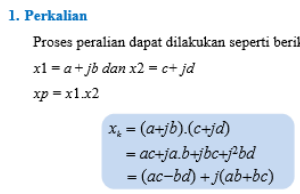
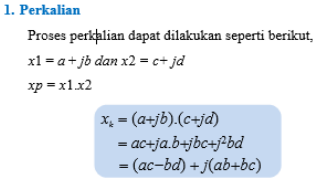
b. Validation Test

Based on the results of the preliminary research called prototype I. The results of prototype I were validated through 2 stages, namely the self-evaluation stage and the expert review stage.

1). In the self-evaluation stage, the researcher re-examined the results of prototype I. The re-examination was carried out by the researcher and with the help of colleagues from the same department as the researcher. Self-evaluation is carried out using self-evaluation guidelines based on material, graphic and language aspects in the form of typos, use of punctuation marks in sentences, clarity of images used if there are images, suitability of material in textbooks.

Table 6: *Improvements to Road Map and Textbooks Based on Results Self Evaluation*

On Textbooks	
Cover dominated by black	Cover dominated by white
	

There are some wrong words in writing	Wrong word fixed
	

2). Expert review stage, In the expert review validation stage, the road map and applied mathematics textbooks are validated by experts by consulting what has been made so that they can discuss refining the road map and applied mathematics textbooks that have been compiled. The suggestions from the validator will be used as material to revise the road map and applied mathematics textbooks that have been designed.

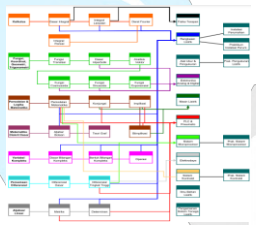
The road map validation was carried out by 3 mathematics lecturers. The following can be seen the results of the road map validation in Table 25.

Table 2: *Validation Results*

NNo	Rated aspect	Validity Index	Category
1	Content Aspect	3.70	Very Valid
2	Language Aspect	3.83	Very Valid
Average validity index		3.28	Very Valid

Table 25, it can be concluded that the RPP based on the constructivism approach in every aspect is valid. Overall, the average validity of the developed lesson plans is 3.28 with a valid category. So it can be concluded that the constructivism-based lesson plans are valid. Even though it is valid, based on suggestions from the validator, there are some parts that still need some improvement. The improvements made can be seen in Table 26.

Table 3: *Improvements to Road Map Based on ResultsExpert Review*

Before Revision	After Revision
On the Road Map	
	

Furthermore, forThe textbooks were validated by 34 experts or experts, of which 1 lecturer in Electrical Engineering, 1 lecturer in Mathematics Education at UNP, 1 lecturer in Indonesian at UNP, and 1 lecturer in educational technology at UNP. The following are the results of the applied mathematics textbook with 4 validators in Table 27.

Table 4: *Applied Mathematics Textbook Validation Results*

No	Rated aspect	Validity Index	Category
1	Presentation	3.29	Valid
2	Content Eligibility	3.14	Valid
3	Graphics	3.09	Valid
4	Language	3.50	Very Valid
Average validity index		3.45	Very Valid

Based on Table 27, it can be concluded that the textbooks in every aspect are valid. Overall the average validity of the developed book is 3.45 with a very valid category. So it can be concluded that the developed textbook is valid. Even though it is valid, based on suggestions from the validator, there are some parts that still need some improvement. The improvements made can be seen in Table 28.

Table 5: *Improvements to Textbooks Based on ResultsExpert Review*

Suggestions from validators	Before	After Revision
The size of the letters in the textbook is bigger	**Pendahuluan** Matematika teknik bukan sekedar belajar matematika saja, kemudian selesai tanpa bekasapa-apa. Matematika teknik merupakan sarana terpenting dalam membekali para mahasiswa agar memahami persoalan-persoalan keteknikan. Pemahaman yang mendalammengenai teknik elektro tidak lepas dari konsep matematika. Jadi matematika merupakanlangkah awal atau dasar pijakan untuk membuka cakrawala dalam memahami materiketeknik-elektroan.	**Pendahuluan** Matematika teknik bukan sekedar belajar matematika saja, kemudian selesai tanpa bekasapa-apa. Matematika teknik merupakan sarana terpenting dalam membekali para mahasiswa agar memahami persoalan-persoalan keteknikan. Pemahaman yang mendalammengenai teknik elektro tidak lepas dari konsep matematika. Jadi matematika merupakanlangkah awal atau dasar pijakan untuk membuka cakrawala dalam memahami materiketeknik-elektroan.
The layout has been tidied up again	**Operasional Penjumlahan dan Pengurangan** **Operasional matematika penjumlahan dan pengurangan** merupakan konsep yang umum dan sederhana. Namun bagian ini merupakan bagian yang terpenting dan mendasar. Prinsip penjumlahan dan pengurangan adalah sama, memenuhi sifat-sifat aljabar penjumlahan dan pengurangan. Sifat penjumlahan dan pengurangan seperti berikut, $x1 = a + jb$ $x2 = c + jd$ $xt = x1 \pm x2$ *atau* $xt = (a \pm c) + j(b \pm d)$ ……(1.7)	**Operasional Penjumlahan dan Pengurangan** **Operasional matematika penjumlahan dan pengurangan** merupakan konsep yang umum dan sederhana. Namun bagian ini merupakan bagian yang terpenting dan mendasar. Prinsip penjumlahan dan pengurangan adalah sama, memenuhi sifat-sifat aljabar penjumlahan dan pengurangan. Sifat penjumlahan dan pengurangan seperti berikut, $x1 = a + jb$ $x2 = c + jd$ $xt = x1 \pm x2$ *atau* $xt = (a \pm c) + j(b \pm d)$ ……(1.7)
The foreign language in the textbook is italicized	tidak dapat menjumlah atau mengurangkan p tidak sejenis. Bilangan kompleks adalah peng real dan imajiner maka harus memenuhi kriteria	tidak dapat menjumlah atau mengurangkan pa tidak sejenis. Bilangan kompleks adalah pengg *real* dan *imajiner* maka harus memenuhi kriteria

c. Practicality of prototype 2

The practicality test of prototype 2 was carried out through 3 stages, namely one to one evaluation, small group. Each stage is revised before proceeding to the next stage. The following can be seen a description of the stages of the prototype 2 practical activity.

1). One To One Evaluation, The one to one evaluation activity was carried out with 3 UNP electrical engineering students (students). The three students were selected based on their level of mathematical ability. One to one evaluation activities are carried out on different days, but for students with moderate and low abilities there is one day they carry out one to one evaluation simultaneously, but still carried out at different times. The one to one evaluation activity was carried out from May 16, 2022 to May 31, 2022 which was held during free lecture hours at the Padang State University. This activity lasts about 1.5-2 hours. Before starting the one to one evaluation activity, the researcher first gave an explanation to students about how to use and structure the textbooks that had been distributed to each student. Then the researcher explained about the learning objectives, instructions for use, concept maps and activities to be carried out to students. Students are asked to assess textbooks by assessing the ease and difficulty in understanding the material presented in the textbook, paying attention to examples of questions and practice and evaluation questions, use of terms, writing, pictures, and various aspects that they feel need to be improved in order to produce a more comprehensive textbook. good. The one to one evaluation activity was carried out for 12 meetings with different learning topics for each meeting.

Figure 3: *Documentation of One to One Evaluation*

Based on interviews with each student, the results showed that the textbooks used could facilitate students in the learning process. The problems given in the textbooks are not too difficult nor too easy according to the students so that they are able to solve all the problems in the textbooks. The language used is communicative, the instructions for the process are clear enough, and the questions contained in the textbook are quite easy to understand. However, the obstacles faced by students are the processing time which sometimes exceeds the time provided. In terms of appearance and color, students express their interests, colors, writings and designs that are light and comfortable to look at make students interested in reading and understanding them. So, Overall, the results of observations at the one to one evaluation stage showed that the textbooks were easy to understand and work on, although there were still some improvements. This is in accordance with the theoretical study that a mathematics textbook can be said to be practical if it can be used and understood by students easily.

2). Small Group Evaluation, carried out with 6 students. Students are selected based on the consideration of the educator with 2 high ability students, 2 medium ability students, and 2 low ability students. Students in the small group evaluation activity are students who are different from students in the one to one evaluation stage. Students were divided into 3 groups with each group having 1 high ability student, 1 medium ability student, and 1 low ability student. Small group evaluation activities are also carried out from June 13, 2022 to July 8, 2022, in the electrical engineering department of Padang State University and sometimes in one meeting only 2 students from each group, this is because students do not participate in school activities due to illness or extracurricular activities. Educators who teach in small group evaluation activities are researchers themselves using learning steps designed in textbooks. During the small group evaluation activity, the researcher was assisted by college friends in the same study program. Observers are tasked with observing the implementation of learning with textbooks. . The small group evaluation activity was carried out for 12 meetings with different learning topics for each meeting. Following is the documentation. Educators who teach in small group evaluation activities are researchers themselves using learning steps designed in textbooks. During the small group evaluation activity, the researcher was assisted by college friends in the same study program. Observers are tasked with observing the implementation of learning with textbooks. . The small group evaluation activity was carried out for 12 meetings with different learning topics for each meeting. Following is the documentation. Educators who teach in small group evaluation activities are researchers themselves using learning steps designed in textbooks. During the small group evaluation activity, the researcher was assisted by college friends in the same study program. Observers are tasked with observing the implementation of learning with textbooks. . The small group evaluation activity was carried out for 12 meetings with different learning topics for each meeting. Following is the documentation.

Figure 4: *Small Group Evaluation Implementation Documentation*

Based on the results of interviews with students regarding the presentation of mathematics textbooks, students from both groups stated that the instructions for use in the textbooks were clear and complete so that the textbooks were easy to use. According to students, every activity in the textbook can help them understand the material. Then according to students, the existence of story questions in textbooks helps students to improve group mathematical abilities. The difficulty of students in working on textbooks is only in the allocation of time, sometimes in several meetings students must have more time to do all the exercises and evaluations in the textbook. In addition to conducting interviews with students, The researcher also asked the students to fill out the student response questionnaire sheet which aims to see the practicality of the textbooks used by students during the learning process. Practicality questionnaires were given to class students after participating in learning using mathematics textbooks to improve mathematical abilities. This practicality questionnaire

was filled out by 6 students in order to measure the practicality of textbooks. Based on the results of the recapitulation of textbook practicality questionnaires by students, it was found that the average value of the practicality questionnaire was 88.44% with a very practical category based on practicality criteria. From the results of the analysis of questionnaires filled in by students, it can be concluded that the mathematics textbooks developed are practical.

d. Effectiveness Test

Effectiveness according to Nieveen in Ploomp (2013: 28) refers to product interventions designed to obtain results in accordance with research objectives. Effectiveness is also carried out to see whether after using mathematics textbooks can improve students' understanding of mathematical concepts. In this study, the effectiveness of mathematics textbooks was tested on students in small groups.

The final test was carried out in the form of a mathematical concept understanding ability test with 4 essay questions.

The results of the student's mathematical concept understanding ability test can be seen in Table 10.

Table 6: *Mathematical Ability Test Results*

Student	**Question Number**				**Score**	**Score**	**Information**
	1	2	3	4			
1	16	16	13	15	60	93.75	Complete
2	16	16	12	15	59	92.19	Complete
3	14	16	12	15	57	89.06	Complete
4	12	14	12	16	54	84.38	Complete
4	12	14	10	16	52	81.25	Complete
5	10	15	11	13	49	86.56	Complete
6	16	16	13	11	56	87.50	Complete

The mathematical ability test at the small group stage was checked using the existing rubric. Based on table 26, information is obtained that 6 students who took the test in the small group where the students were declared complete if they obtained a score of 70. The percentage of completeness on this mathematical ability test was 100%. This mathematics textbook is said to be effective if the level of achievement of the value of effectiveness >60 So it can be concluded that learning with textbooks is very effective.

This development has produced a road map and a valid applied mathematics textbook. Basically, this development can also provide an overview of learning mathematics to be easier and more effective and can be used as an alternative to improve students' mathematical abilities. This road map and applied mathematics textbook can make learning more practical and effective. Therefore, educators can use the development of road maps and applied mathematics textbooks for other courses so that they can help students understand the concepts given and increase student creativity.

Based on all the studies above, it can be stated that this development has produced a road map and a valid applied mathematics textbook. This road map and applied mathematics textbook can make learning more practical and effective. Therefore, educators can use the development of road maps and applied mathematics textbooks for other courses so that they can help students understand the concepts given and increase student creativity.

CONCLUSION

Based on the results of the study, it can be concluded that the characteristics of the road map and applied mathematics textbooks are valid, practical and effective. A valid road map and textbook of applied mathematics is a road map and textbook of applied mathematics that corresponds to all indicators in each aspect, namely aspects of content, presentation, language, and graphics. In the content aspect, the road map and applied mathematics textbooks are in accordance with the mathematics curriculum for electrical engineering, learning activities and subject matter. In the aspect of presentation, the road map and applied mathematics textbooks have a systematic learning steps, and the completeness of the learning components. In the linguistic aspect, road maps and applied mathematics textbooks are in accordance with the use of language with good and correct rules. In terms of graphics, The road map and applied mathematics textbooks are correct in terms of cover design, font type and size, image layout, relevance of problems to images, use of color, and display design. For the characteristics of the road

map and practical applied mathematics textbooks, they have met the practical criteria, both in terms of implementation, convenience and time required.

Suggestions that can be given to other researchers are to develop road maps and applied mathematics textbooks for other subjects. As well as for mathematics educators, this road map and applied mathematics textbook can be used as a guide in developing road maps and other applied mathematics textbooks.

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