Developing Mathematics Learning Kits Using the RME Approach for Students of Marine Vocational High School

Uke Ralmugiz¹*, Pika Merliza², Desy Kumala Sari³, St Muthmainnah Yusuf¹ and Ryan Nizar Zulfikar¹

¹Department of Mathematics Education, Universitas Muhammadiyah Kupang, Indonesia.
²Department of Mathematics Education, IAIN Metro, Indonesia
³Department of Physics Education, Universitas Musamus, Indonesia

*Corresponding author e-mail: ukeralmugiz@unmuhkupang.ac.id

Abstract. This study aims to produce a mathematics instructional kits for students of Marine Vocational High School using Realistic Mathematics Education (RME) approach and oriented to mathematics reasoning, connection, and curiosity which is valid, practical, and effective. This study was a research and development study. It developed instructional kits using Plomp development model which consisted of three main steps, that is: (1) preliminary research, (2) development or prototyping phase, and (3) assessment phase. The subjects of the study were 28 students of grade X in Marine Major class of SMK Negeri 7 Kupang. The validity of the instruments used was a validation sheet. The practicality of the instruments used was a teacher assessment sheet, students assessment sheets, and observation sheets of learning implementation. Then, the effectiveness of the instruments consisted of a test for measuring students’ reasoning and connection, meanwhile a questionnaire was to measure students’ curiosity. Data analysis was conducted by converting quantitative data of assessment scores, students’ scores of test, and questionnaire to qualitative data. This research resulted mathematics learning kits for students of Marine Vocational High School using Realistic Mathematics Education approach and oriented to mathematics reasoning, connection, and curiosity in the form of lesson plan and student worksheet which have met the criteria of validity, practicality, and effectiveness.

1. Introduction

Indonesia is an archipelagic country that has abundant marine resources, nevertheless the potential of this marine has not been fully utilized, this is evidenced by the incessant maritime development by the government presently. One effort to utilize Indonesia marine is by the establishment of Marine Vocational High School (Marine SMK). Minister of Education and Culture 2014-2015, Anies Baswedan, and Minister of Marine Affairs Coordinator 2014-2015, Indroyono Susilo, in mid-2015 agreed to optimize the 900 Marine SMKs in this country. It is conducted to create human resources that support the development of marine Indonesia [1].

To make students of Marine SMK able to compete in national and international work world, and can maximize abundant marine potency in Indonesia, SMK students need to be equipped with good cognitive, affective and skill ability. This can be conducted by maximizing the learning process in the class. One of the important skills possessed by students of Marine SMK is reasoning, reasoning ability must be possessed by students at the intermediate level.
Mueller and Maher [2] argue that reasoning is a process that allows reviewing previous knowledge used to create a new argument. The ability in reasoning is important owned by students of Marine SMK because in solving a problem requires a good thinking skill in drawing a conclusion of what should be conducted. Besides reasoning skills, the connection skills are also important owned by the students. The connection skills are the skills to connect between various information and knowledge. In the world of work, the students of Marine SMK will face problems that can be solved not only by relying on a knowledge only, but also require some knowledge at once in solving it. The Students need connection skills to connect one's knowledge to another, and also connect knowledge possessed with the world of work.

The importance of reasoning and connections skills, both skills need to be developed. One of the efforts is through mathematics learning. Bjuland [3] describes mathematical reasoning activities by analyzing mathematical situations, predicting, constructing arguments logically and evaluating. While the mathematical connections according to Sugiman [4] refers to, (1) connecting between concepts or principles within the same mathematical topic; (2) connecting topics in mathematics that relate between material in a particular topic with material in other topics; (3) connecting mathematical material with science other than mathematics; and (4) connecting mathematics with everyday life.

Regarding to reasoning and connections in mathematics learning, the National Council of Teachers of Mathematics [5] states that in mathematics learning there are several skills to be achieved: communication, reasoning, problem solving, connections, and representation. This is reinforced by Permendiknas Number 22 of 2006 which contains the objectives of mathematics education, among others, so that students have skills to think logically, analytically, systematically, critically, creatively, understanding concept, connections, reasoning, problem solving, communication, and Mathematical disposition. Maarif [6] says that "reasoning and mathematics are two aspects that cannot be separated as understood through mathematical reasoning", mathematics is understood through reasoning and reasoning can be understood or trained with mathematics. Sugiman [4] says that the ability of mathematical connections is one of the goals of mathematics learning. Furthermore, Sugiman states that China emphasizes its curriculum standards for elementary and secondary schools on mathematical connections in the form of applications, mathematical connections to the real world, and mathematical connections with other lessons. Besides China, Singapore also emphasizes learning on mathematical connections, as Hoong [7] said that "in Singapore, there also been recent development that are in keeping with the emphasis on the importance of making connections in mathematics teaching and learning."

NCTM [5] states that "when students can connect mathematical ideas, their understandings deeper and more lasting". If students can connect mathematical ideas, then students' understanding will be more profound lasting. If students can connect between previously known concepts with new concepts to be learned then the students will be easier in understanding the concept.

Reasoning and connections are important and can be developed through mathematics learning, but all of that would be wasted without the curiosity of students to learn mathematics. Driscoll [8] states that "curiosity, in children and adults alike, is a strong motivator of learning". It means that curiosity in children and adults is a powerful motivator in learning. The strong curiosity will make students feel persistent to keep learning mathematics that will impact the development of reasoning and connections. Elliott, Kratochwill, Cook, & Travers [9] states that learning activities that can sustain and develop students' curiosity is the one which engaging the students to participate in meaningful projects with connections mathematics concepts and daily life.

Based on the explanation before, it can be seen that between reasoning, connections, and curiosity have interrelationship one another, which is all refer to mathematics learning that connects mathematics with the real world. Mathematics learning in the classroom tends to be too monotonous where students are only taught solving the problems, rather than motivating students to think. Teachers tend to solve some mathematics problems with their own instructions, then the students should follow those way [10]. That learning makes the students' motivation decline to
mathematics learning, students unlike to learn mathematics because it does not look usefulness in the world of work or in everyday life. As the consequently the reasoning, connections, and curiosity of students also did not increase. This is reinforced by the opinion of van den Heuvel-Panhuizen [11] who says that when the students learn mathematics apart from their daily experience, they will fast to forget and cannot apply mathematics.

One approach in mathematics learning that relates mathematics to everyday life is Realistic Mathematics Education (RME). In Indonesia, RME is known as Pendidikan Matematika Realistik Indonesia (PMRI) that already developing since 1994 [12]. RME is a mathematical learning approach that first presents realistic situations in the learning process; this situation is useful as a resource for developing mathematical concepts, tools and procedures, and in the forward stages as a context where students can apply their mathematical knowledge, which then gradually becomes more formal and general [13]. Furthermore, van den Heuvel-Panhuizen and Drijvers argue that the ‘realistic’ situation in RME has a broader meaning than just the ‘Real world’, but it also has a student-sense meaning. RME does not put mathematics as a finished product, nevertheless it is a process that often called “guided reinvention”.

Webb et al. [10] says that RME is not just a way to motivate students when making the transition from concrete to abstract. The command sequence contains in the mathematics learning with contextual problem used as the starting point for obtaining an informal explanation from the students. RME approach can be used with local conditions [14]. Therefore, for Vocational High School students, the contextual issues in accordance with marine vocation are expected to be attractive starting points for them, as well as their application in daily problems are expected to enrich their knowledge about various approaches and techniques to solve problems in the world of work. Facilitating students’ with context situation can provide them in meaningful mathematics learning [15].

To conduct learning using RME, precise preparation is needed to ensure that all goes well according to expectations. One of the things that should be the attention of learning is learning kits in the form syllabus, lesson plan (RPP), and student worksheet (LKS). RPP aims to direct the learning activities of learners in an effort to achieve learning objectives, while LKS is a student guide that is used to conduct investigation or problem solving activities. Both of these are very important in the planning of the learning process. Based on a preliminary survey conducted by interviewing mathematics teacher in SMK 7 Kupang who is one of the Marine SMK, the results indicate that teacher had difficulty in developing mathematics learning kits of marine contextual problem. Furthermore, some teachers were also still difficult in making the mathematics learning kits, especially focus on reasoning, connections, and curiosity. Teacher often edited the kits from the internet, which is most of the RPP and LKS found in the form of Senior High School RPP and LKS, not for Vocational School usage particularly for marine major.

Based on the explanation above, the researcher aims to develop a mathematics learning kits using RME approach oriented to the reasoning, connections, and curiosity of the students in Marine SMK, those are feasible to be used, valid, practical, and effective criteria.

2. Methodology
The type of this research was development research using model adapted from Plomp development model [16] which consists of preliminary research, development or prototyping phase, and assessment phase. This research was conducted at SMK 7 Kupang. The subjects of the study were 28 students of grade X in Marine Major class of SMK 7 Kupang. The steps taken in this development procedure was as follows.

2.1 Preliminary Research
At this stage, information was collected through a literature review of concepts and theories related to reasoning, connections, and curiosity as a basis for constructing indicators and studied of appropriate learning theories, to obtain relevant learning models.
2.2 Development or Prototyping Phase
At this stage, the design and development of products in the form of RPP, LKS, test of reasoning and connections, and questionnaire of students’ curiosity in accordance with the analysis that had been conducted in the first stage.

2.3 Assessment Phase
Initial products are learning kits that had been developed, subsequently validated by two experts. After the products met the valid criteria, then it tested to determine the practicality and effectiveness of the products.

In this study, data collection techniques used consisted of two, namely: non-test techniques and test techniques. The non-test techniques used validation, assessment, and observation sheets and student curiosity questionnaire. The test techniques used multiple and essay tests. Further, the data was described to measure students’ reasoning and connections.

In this study, researchers used several instruments to determine the validity, practicality, and effectiveness of the product. The instruments are as follows.

2.3.1 Instrument of products validity
The product validation instrument was a validation sheet of RPP and LKS in the form of a questionnaire consisting of five scoring scales: excellent (score 5), good (Score 4), enough (score 3), less (score 2), and very less (score 1). Questionnaire of RPP and LKS validation consisted of 26 statements.

2.3.2 Instrument of product practically
The product practically assessment instrument consisted of a practicality assessment sheet by teachers on RPP and LKS, students’ practicality score sheet on LKS, and instructional learning observation sheet. Teacher assessment sheets for RPP and LKS were both questionnaires. The questionnaires consisted of 20 items that were arranged on a five scale with very good (score 5), good (score 4), enough (score 3), less (score 2), and very less (score 1) criteria. The students’ assessment sheets were questionnaire. The questionnaire consisted of 20 items that was arranged on a scale of five with very good (score 5), good (score 4), enough (score 3), less (score 2), and very less (score 1) criteria. This observation sheet was contained the characteristics of the RME approach and the learning process stages in the class and filled in the observation sheet by checking the checklist.

2.3.3 Instrument product effectiveness
Instruments used to assess the effectiveness of developed learning products were the students’ reasoning and connections test, and students’ curiosity questionnaire. The questionnaire was consisted of 20 items that was arranged on a scale of five with very agreed criteria (score 5), agree (score 4), agree (score 3), disagree (score 2), and strongly disagree (score 1).

The research data were divided into two, which were quantitative and qualitative data. Quantitative data obtained from the results of students’ learning tests and students’ curiosity questionnaire, while the qualitative data obtained from the validation sheet, teacher and students’ assessment sheets, and implementation of learning observation sheet.

For qualitative data were converted into quantitative data using the formula that presents in Table 1.

| Score Interval | Classification |
|----------------|----------------|
| $x < x_i + 2,1 Sb_i$ | Very good |
| $x_i + 1,2 Sb_i < x \leq x_i + 2,1 Sb_i$ | Good |
| $x_i + 0,3 Sb_i < x \leq x_i + 1,2 Sb_i$ | Enough |
| $x_i - 0,6 Sb_i < x \leq x_i + 0,3 Sb_i$ | Less |
| $x \leq x_i - 0,6 Sb_i$ | Very Less |
5th PROFUNEDU (ALPTK-PTM) 2020 IOP Publishing
Journal of Physics: Conference Series 1720 (2021) 012016 doi:10.1088/1742-6596/1720/1/012016

with:
\[ x = \text{actual score} \]
\[ x_i = \text{the average of ideal score} = \frac{1}{2} (\text{maximum score} + \text{minimum score}) \]
\[ S_{bi} = \text{ideal standard deviation} = \frac{1}{6} (\text{maximum score} - \text{minimum score}). \]

Maximum score = the number of items x the highest score
Minimum score = the number of items x the lowest score

2.3.3.1 Analysis of Product’s Validity

Criteria of Product’s Validity is presented in Table 2 and Table 3.

| Table 2. The Criteria of RPP’s Validity |
|----------------------------------------|
| Score Interval                         | Classification   |
| \[ x > 114.4 \]                        | Very Valid       |
| \[ 98.8 < x \leq 114.4 \]             | Valid            |
| \[ 83.2 < x \leq 98.8 \]              | Enough           |
| \[ 67.6 < x \leq 83.2 \]              | Less Valid       |
| \[ x \leq 67.6 \]                     | Very Less Valid  |

| Table 3. Criteria of LKS’s Validity |
|-------------------------------------|
| Score Interval                      | Classification   |
| \[ x > 114.4 \]                     | Very Valid       |
| \[ 98.8 < x \leq 114.4 \]          | Valid            |
| \[ 83.2 < x \leq 98.8 \]           | Enough           |
| \[ 67.6 < x \leq 83.2 \]           | Less Valid       |
| \[ x \leq 67.6 \]                   | Very Less Valid  |

Overall, the developed products were said to be valid if the results of the RPP and LKS assessment were in the minimum category, valid.

2.3.3.2 Analysis of Product’s Practicality

Criteria of Media’s Practicality by teacher and students can be seen in Table 4 and Table 5.

| Table 4. The Criteria of Teacher’s Practicality to RPP and LKS |
|---------------------------------------------------------------|
| Score Interval                                               | Classification     |
| \[ x > 88 \]                                                  | Very Practical     |
| \[ 76 < x \leq 88 \]                                         | Practical          |
| \[ 64 < x \leq 76 \]                                         | Enough             |
| \[ 52 < x \leq 64 \]                                         | Less Practical     |
| \[ x \leq 52 \]                                               | Very Less Practical|

| Table 5. The Criteria of Student’s Practicality               |
|---------------------------------------------------------------|
| Score Interval                                               | Classification     |
| \[ x > 88 \]                                                  | Very Practical     |
| \[ 76 < x \leq 88 \]                                         | Practical          |
| \[ 64 < x \leq 76 \]                                         | Enough             |
| \[ 52 < x \leq 64 \]                                         | Less Practical     |
| \[ x \leq 52 \]                                               | Very Less Practical|

Analysis of the implementation of learning observation data was by calculating the percentage of learning implementation using the following formula.

\[
(1) = \frac{\text{acquisition score}}{\text{maximum score}} \times 100\% 
\]
The product was said to be practical if the average score of at least the criteria of practicality by the teacher and the practicality criteria by students in the "Practical" category, as well as the percentage of learning \( t \geq 80\% \).

2.3.3.3 Analysis of Product’s Effectiveness
The effectiveness of the product was seen from learning mastery based on students’ reasoning and connections tests. Then the score was converted to values ranging from 0 to 100. The value of each student is subsequently compared to standard score of students’ (KKM) = 75.

The effectiveness of the product was also seen from the level of students’ curiosity. Data from the questionnaire of curiosity were then converted into qualitative data, as in Table 6.

| Score Interval | Classification   |
|----------------|------------------|
| \( x > 88 \)   | Very Good        |
| \( 76 \leq x \leq 88 \) | Good            |
| \( 64 \leq x \leq 76 \) | Enough          |
| \( 52 \leq x \leq 64 \) | Less            |
| \( x \leq 52 \)   | Very Less        |

The criteria of the developed effectiveness products in terms of students' reasoning and connections was if the percentage of students' learning mastery \( \geq 75\% \), and the percentage of students with a minimum level of curiosity was either \( \geq 75\% \).

3. Results and Discussion
Based on development procedure previously, this development research consisted of three main stages. The results of each stage are as follows.

3.1 Preliminary Research
After analyzing the various sources related to the results obtained that the problem of reasoning, connections, and curiosity should be developed by students of SMK Marine, a learning approach that is believed to be able to develop reasoning, connections, and curiosity that was by using RME approach, a good learning kit as which had been specified in Permendikbud of Republic Indonesia Number 22 Year 2016 on Standards of Basic and Secondary Education process, as well as the theories of research development. After that, the researcher conducted a field survey which the results were (a) Students were not yet accustomed to building their own knowledge. The material delivered directly given by the teacher to the students without providing information and direction to students to find the mathematics concept using their own prior knowledge; (b) Mathematics learning was not related to daily experience, the learning began with definitions and theorems directly; (c) Most of the students of grade X SMK N 7 Kupang had low academic skills, but there were some students who also have medium and high skills. Thus, learning activities needed the improvement so that students' mathematics learning achievement was more optimal; (d) Teachers still rarely associated mathematical learning with reasoning and connections. Relating to the problems given during the learning, teacher often referred to the problems that exist in the student-handbook and also a problem that often came out at the National Examination (UN); (e) Students learned mathematics by waiting explanation from teacher, did not have initiative to read or learn the new concept first. The students also considered mathematics to be a difficult lesson, so that the students were lazy to re-study mathematics at home. Based on the information indicates that the students ‘curiosity in mathematics learning was still lacking and must be improved; (f) There was no LKS for students’, especially related to marine problem; (g) The RPP used was not a result of teachers’ design, so that the design had not yet concern to the competence and school environment, which was marine major; (h) In terms of teachers' understanding of reasoning and connecting skills,
teachers were aware of the importance of these skills, but teachers were still difficult to develop the abilities in the learning process.

3.2 Development or Prototyping Phase
The Lesson Plan (RPP) developed in this study refers to Permendikbud Number 22 of 2016 on the Standards Process which contains the components that should be in the RPP, namely: (a) Identity of school / madrasah, subject, and class / semester; (b) Time allocation; (c) Core competence (KI); (d) Basic competence (KD), indicators of competency achievement; (e) Learning materials; (f) Learning activities; (g) Assessment; (h) Media / tools, materials, and learning resources. The learning activities contain the learning steps with the RME approach, among others (a) understanding the contextual problem; (b) modeling; (c) using linkages; (d) carry out formalization and interactivity; and (e) application to other issues.

The student worksheet (LKS) was designed based on the basic competence and adapted to the learning activities listed in the RPP. The contents of the LKS should be prepared based on indicators of achievement that had been determined. The content of the material contained in the LKS is taken from the relevant references. This LKS was developed by RME approach by adopting its characteristics put forward by Treffers [17], namely, (a) the use of context; (b) the use of models for progressive mathematization; (c) the use of student construction; (d) interactivity, and (e) intertwining. In addition to the characteristics of the RME approach, this LKS also pays attention to the idea of icebergs floating in the middle of the sea put forward by Moerlands [18]. In the iceberg model there are four levels of activity, namely (1) Mathematical environmental orientation; (2) Model props; (3) Foundation making (building stone); and (4) Formal mathematics. The process of forming icebergs in the sea always starts from the bottom below sea level and so eventually forms the tip of the iceberg visible from the sea level. The base of the iceberg is wider than its peak, thus the construction of the iceberg becomes sturdy and stable. In addition, LKS aimed to develop students' reasoning, connection and curiosity.

The starting point of the material in learning on the LKS was given contextual problems. This section was a characteristic RME of context usage. The problem used was a problem close to the students that was related to the marine world. This context was a starting point in learning, as the use of this context could provide students with an opportunity to demonstrate their skills, as van den Heuvel-Panhuizen [19] discloses "context problem offer the students more opportunity for demonstrating their abilities" Which means that context issues can give students more opportunities to demonstrate their abilities. The use of close context with students also allows for more interesting and meaningful learning for students [20]. In this case the problem used was a problem close to the world of students of SMK Marine.

Further, the LKS facilitated student activities to model the contextual problems that had been given earlier in the early learning. The use of the model serves as a bridge from concrete level knowledge and mathematics to formal level mathematical knowledge [21]. Thus the term model related to situations and self-developed mathematical models of the student, which were the bridges for students to create their own models from real situations to abstract or from informal to formal situations. In this section, students were asked to solve problems and questions using their own way then developed to find a formal mathematical.

LKS was also provided activities where students have the freedom to develop problem-solving strategies, so that it was expected to get a variety of strategies to solve. The results of students’ work and construction were used for the foundation of the development of mathematical concepts. By completing a context of mathematical problems, the students could use their own strategy of drawing the image or diagrams, then using mathematical symbols to indicate the settlement strategies. This was in accordance with the characteristics of RME that is the use of students’ construction.

The LKS also provided students activities that include other RME characteristics of interactivity, in which the students were led to discuss both with their friends and ask the teacher to find solutions to problems and questions. Group discussions were made to give students an opportunity to express ideas. From mutual ideas, there would be interaction between group
members in understanding a given context. Students’ ideas were a step in problem-solving. Once they had exchanged ideas, then they would find out themselves the true result of their agreement. In the process of completing the context presented, of course, students were guided to use the knowledge, they already had. This was a characteristic of RME relatedness, in which the students’ linked the prior knowledge possessed with the presented context to solve the problem.

Additionally, LKS also aimed to improve students’ mathematical reasoning and connection, where in this section, there were activities to predict students' mathematical reasoning improvement, as well as to include activities that relate the material learned with other material as well as daily issues that aims to improve students' mathematical connection ability.

LKS also provided exercise questions that aimed to deepen and strengthen students' understanding of what was learned and also the opportunity to utilize the students' construction results undertaken in the students’ activities section. This section contained other RME characteristics that were the use of student construction. In addition, this section also aimed to increase students' curiosity towards mathematics, especially in the deeper exploration.

The reasoning and connection tests were developed to determine the extent to which students had mastered or achieved the competence of the material they have learned, and the extent to which students' reasoning and connections had. The issues developed referred to the indicators of each of the basic competencies that have been determined. The form of this test was an essay form.

Questionnaires were developed by defining conceptual and operational definition, after that the curiosity indicators were developed. From these indicators, the questionnaire was made into questionnaire that was containing statements to measure students' curiosity. This questionnaire consists of 20 items of statement.

3.3 Assessment Phase

Expert evaluation or assessment was conducted to obtain inputs used as materials for improvement of developed RPP and LKS. Besides, the evaluation or assessment of experts also aimed to determine whether the RPP and LKS were valid or feasible to use. Expert evaluation or assessment on the LKS and RPP was conducted after consultation with supervisor. After that, the product was validated by an expert or a validator. In this research validation was conducted by two lecturers as experts in pure mathematics and mathematics education.

Besides, the evaluation or assessment by the experts, the assessment of RPP and LKS was also developed by practitioners or teachers of grade VII and grade VII students. Assessment of mathematics teachers and students were served as data to see the practicality of the developed product. In this research, the teacher and students in question were the mathematics teacher of grade X SMK class and the students of SMK in class X. Meanwhile, the assessment to see the effectiveness of developed RPP and LKS was conducted through a trial process. Data obtained from these trials consisted of the results of reasoning, connection tests, and filling questionnaires of students' curiosity.

Trials were conducted to get the data used as a basis for revising the product. The trial consisted of two stages, namely expert and field trials.

3.3.1 Expert Trial

Expert trial were conducted to determine the feasibility of learning products developed in terms of validity. The Analysis Results of RPP and LKS Validity Data is presented in Table 7.

| Validator | The Score of Validity Results |
|-----------|-------------------------------|
|           | RPP  | LKS  |
| 1         | 107  | 108  |
| 2         | 128  | 129  |
| Total Score | 235  | 237  |
| Average   | 117,5| 118,5|
| Criteria  | Very Valid | Very Valid |
Based on Table 7, it is known that the average RPP validation score obtains 117.5 > 114.4. The LKS validation score obtains 118.5 > 114.4. The RPP and LKS are in very valid category, meaning RPP and LKS in the valid criteria

3.3.2 Field Trials
Field trials were conducted to determine the feasibility of developed learning products, which include the practicality and effectiveness of product development. Description of field trials based on the learning steps with the RME approach used in this study.

3.3.2.1 Understanding Contextual Problems
The first step was the use of contextual problems as the starting point of learning. In this step, the students were asked to understand the problems presented in the LKS then trying to dig up the existing information to solve the problem. An example of a contextual problem is given in Figure 1. In this section, it was presented a context close to the Marine Vocational Steering Wheel. Steering wheel shaped round and how to use it is rotated used as a starting point in learning material angle size.

![Figure 1. The Process of Contextual Problem Applications Process in Modeling](image)

Seorang nakhoda kapal harus memutar roda kemudi kapal dengan benar dan perhitungan sudut yang tepat agar haluan kapal sesuai dengan yang diinginkan. Semakin kecil sudut yang dibentuk dari putaran roda kemudi kapal, maka haluan kapal yang terjadi juga semakin kecil, demikian juga sebaliknya.

Pada gambar di atas, diketahui bahwa sudut yang dibentuk oleh putaran roda kemudi kapal adalah 45°; namun namun banyak ahli yang mengatakan bahwa besar sudut yang dibentuk adalah $\frac{1}{4}\pi$ rad.

In the modeling step, the students were asked to model the problem presented in the first step. However, to facilitate this process, researcher has provided a model of the problem presented, then asked students to observe, understand, and asked if the students did not understand. One example of modeling step is presented in Figure 2.

![Figure 2. Modeling Process](image)
3.3.2.2 The Using of Relevance

This step facilitates the students to build their own understanding using the knowledge that students have before. In this heading, the students used the information that has been obtained from the previous steps, and in this study, this step is carried out in conjunction with the interaction step. Given some questions that help students construct their understanding as in Figure 3.

The question as in Figure 3, the students relate his understanding to the existing information to solve it, the students can easily get results if the angle being asked is still in a multiple of 45°. From this process, found some informal answers to students as presented in Figure 4.

![Figure 3. Question that Help to Construct Students’ Understanding](image1)

![Figure 4. The Students’ Answer Results of Constructing Process](image2)
Based on Figure 4, it is known that the students associate the knowledge of the sum and multiplication that they have to use their own way to solving the question. There are students who work $\frac{5}{4}\pi \text{ rad} = 5 \times 45^\circ = 225^\circ$ and there are also students who work $\frac{5}{4}\pi \text{ rad} = 45^\circ + 45^\circ + 45^\circ + 45^\circ + 45^\circ = 225^\circ$. But the students find it difficult if the asked angle is not a multiple of 45°, from where the students will formalize through interactivity activities.

3.3.2.3 Conducting Formalization and Interactivity

Interaction in this case, group discussion, was made to give the students an opportunity to express their ideas. From mutual ideas, there is interaction between group members in understanding a given context. The students’ ideas are a step in problem-solving. Once they have exchanged ideas, then they find out for themselves the true result of their agreement. This process is also assisted by the teacher as a facilitator in learning. The interaction process is given in Figure 5.

Furthermore, the students are asked to present their group work in front of the class, then the other group respond. Then with the help of the teacher, the correct answer will be summarized and also summarizes the formal means used to solve the problem simultaneously. The process of communicating is given in Figure 6.
From this step, the students can conclude the relationship of degrees and radians. The students' conclusions are presented in Figure 7.

![Figure 7. Student’s Conclusion](image)

According to the above figure, student had concluded the relation between degree and radian as follow: (1) Conversion of degree $x$ into radian to produce $x\pi \times \frac{\pi}{180}$; (2) Conversion of radian $\chi$ into degree to produce $x \times \frac{180}{\pi}$.

### 3.3.2.4 Application to Other Problems

After the students get the conclusion about what is learned in the form of relationship radians and degrees, students are directed to solve the existing exercise problems in the LKS, but this section is used as homework for students to be able to practice themselves at home and also instill the students’ own curiosity. The students solve these problems using what they have gained from previous RME learning steps. An example of student answers in this step is presented in Figure 8.

![Figure 8. Student’s Answer on The Exercise](image)

The practicality of the product is determined by 3 things, namely the teacher's assessment sheet, the student's assessment sheet, and the percentage of instructional learning. The teacher's assessment data on the products is presented in Table 8, the students' assessment data on the products is presented in Table 9, and the percentage of instructional learning is presented in Table 10.
Table 8. Teacher’s Assessment Result

| The Assessed Components       | Score |
|-------------------------------|-------|
| RPP                           | 35    |
| LKS                           | 41    |
| The Application of Kits       | 20    |
| Total                         | 96    |

| Category                     |
|-------------------------------|-------|
| Very Practical               |

Table 9. Students’ Assessment Result

| The Number of Students | Percentage | Category      |
|------------------------|------------|---------------|
| 17                     | x > 88     | Very Practical|
| 8                      | 76 ≤ x ≤ 88| Practical     |
| 3                      | 64 < x ≤ 76| Enough        |
| 0                      | 52 < x ≤ 64| Less Practical|
| 0                      | x ≤ 52     | Very Less Practical |

| The Average | 88,43 | Very Practical |

Table 10. The Learning Implementation Results

| Meeting | Percentage |
|---------|------------|
| 1       | 94.74%     |
| 2       | 88%        |
| 3       | 89.74%     |
| 4       | 84.21%     |
| 5       | 86.96%     |
| 6       | 89.47%     |
| 7       | 88%        |

| The Average | 88.69% |

Based on Table 8, it is known that the score of assessment by the teacher to RPP and LKS is 96> 88 means that the developed product in the practical criteria according to the teacher. Result of data analysis of students appraisal that mean score reach 88.43> 88 (Table 9), it indicate LKS fulfill the practical criterion according to students. The criteria of practicality is also determined by the percentage of learning activities. Based on Table 9 it is known that the average percentage is 88.69> 80% (Table 10). Based on these three things can be said that the product in the form of this learning device meets the practical criteria. However, product development is still being improved. Improvements are made based on inputs provided by teachers and students

Effectiveness is determined by reasoning, connections tests, and a questionnaire of curiosity. The results of data analysis of reasoning tests and connection tests are presented in Table 11, then the students questionnaire analysis is presented in Table 12.

Table 11. The Results of Reasoning Test and Connection Test

| Test Types       | Student’s number | The number of student achieved | Percentage |
|------------------|------------------|--------------------------------|------------|
| Reasoning        | 28               | 22                             | 78.57%     |
| Connections      | 28               | 24                             | 85.71%     |

Table 12. The Results of Curiosity Questionnaire

| Category        | Student’s Number | Percentage |
|-----------------|------------------|------------|
| Very Good       | 8                | 28.57%     |
| Good            | 14               | 50%        |
| Enough          | 6                | 21.43%     |
| Less            | 0                | 0%         |
| Very Less       | 0                | 0%         |
| Total           | 28               | 100%       |
Based on Table 11, it is known that the percentage of students who reached KKM for reasoning test was 78.57% > 75%, as well as connection test which reached 85.71%. Based on Table 12, it is known that students who have a minimum curiosity level reaching 78.57%. Based on these two results, it can be said that the products in the form of RPP and LKS meet the criteria effective.

4. Conclusion
Based on the results of the research, it can be concluded that the learning kits of mathematics in the form of RPP and LKS with RME approach developed valid, practical, and Effective to develop students' reasoning, connections, and curiosities.

References
[1] Murdaningsih D 2015 Bangun sektor maritim smk kelautan bakal dioptimalkan, URL: http://www.republika.co.id/berita/pendidikan/eduation/15/03/01/nkik73-bangun-sektor-maritim-smk-kelautan-bakal-dioptimalkan
[2] Mueller M and Maher C 2009 Learning to reason in an informal math after-school program Mathematics Education Research Journal 21(3) 7-35.
[3] Bjuland R 2007 Adult students' reasoning in geometry: Teaching Mathematics through collaborative problem Solving in Teacher Education The Montana Mathematics enthusiast 4(1) 1 - 30.
[4] Sugiman 2008 Koneksi matematik dalam pembelajaran matematika di SMP Pythagoras 4(1) 56-66.
[5] National Council of Teacher of Mathematics (NCTM) 2000 Principles and standards for mathematics (Virginia: NCTM).
[6] Maarif S 2016 Improving Junior High School Students’ Mathematical Analogical Ability Using Discovery Learning Method International Journal of Research in Education and Science 2(1) 114-124.
[7] Hoong L Y 2012 Presenting Mathematics as Connected in the Secondary Classroom Reasoning, Communication and Connections in Mathematics Ed Kaur B and Lam T T Ed (Singapore: World Scientific) 239-260.
[8] Driscoll M P 1994 Psychology of Learning Instruction (Needham Heights: Allyn Bacon).
[9] Eliot S N, Kratchwill T R, Cook J L and Travers J F 2000 Educational Psychology: Effective Teaching, Effective Learning (3rd ed) (Singapore: McGraw-Hill Book).
[10] Webb D C, Van der Kooij H and Geist M R 2011 Design Research in the Netherlands: Introducing Logarithms Using Realistic Mathematics Education Journal of Mathematics Education at Teachers College 2 47-52.
[11] Van den Heuvel-Panhuizen M 2000 Mathematics Education in the Netherlands: A guide tour (Netherlands: Utrecht University).
[12] Zulkardi Z, Putri R I I and Wijaya A 2020 Two Decades of Realistic Mathematics Education in Indonesia International Reflections on the Netherlands Didactics of Mathematics ICME-13 Monographs Ed van den Heuvel-Panhuizen M (Cham, Switzerland: Springer).
[13] Van den Heuvel-Panhuizen M and Drijvers P 2014 Realistic Mathematics Education Encyclopedia of Mathematics Education Ed S Lerman (London, UK: Springer) 521-525.
[14] Farida, Hartatiana and Joemsittiprasert W 2019 The use of realistic mathematics education (RME) in improving mathematical analogical ability and habits of mind Al-Jabar: Jurnal Pendidikan Matematika 10(2) 177–186.
[15] Nuraida E M, Ilma R and Putri I 2020 The context of archipelago traditional cake to explore students’ understanding in integers division class VII Jurnal Pendidikan Matematika 14(1) 91–100.
[16] Plomp T 2013 Educational design research: An Introduction Educational Design Research Ed Van den Akker J, Bannan B, Kelly A, E, Nieveen N and Plomp T (Netherland: Enschede, National Institute for Curriculum Development) 10-51.
[17] Cowan P 2006 Teaching mathematics: A Handbook for Primary and Secondary School Teachers. (New York, NY: Routledge).
[18] Sugiman 2011 Peningkatan pembelajaran matematika dengan menggunakan pendekatan realistik, URL: http://staff.uny.ac.id/sites/default/files/tmp/2011_PPM_Iceberg_0.pdf
[19] Van de Heuvel-Panhuizen M 2003 The didactical use of models in realistic mathematics education: an example from a longitudinal trajectory on percentage "Educational Studies in Mathematics" 54 9-35.
[20] Arsaythamby V and Zubainur C M 2014 How a realistic mathematics educational approach affect students’ activities in primary schools? "Procedia - Social and Behavioral Sciences" 159 309-313.
[21] Wijaya A 2012 Pendidikan Matematika Realistik. Suatu alternatif pendekatan pembelajaran matematika (Yogyakarta, Indonesia: Graha Ilmu)