ISSN:3026-0442

Proceedings of the 1st International Conference on Education, Science Technology And Health (ICONESTH 2023 Universitas Bina Bangsa Getsempena, Des 12-14, 2023, Banda Aceh, Indonesia)

APPLICATION OF A REALISTIC MATHEMATICS LEARNING APPROACH TO IMPROVE STUDENTS' NUMERACY LITERACY ON DATA AND UNCERTAINTY CONTENT

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ABSTRACT

This research aims to increase the Numeracy literacy of Agribusiness and Fisheries students on data and uncertainty content through the application of the PMRI learning approach in the context of fisheries production at PPI Oeba Kupang. The research method used is the Classroom Action Research Method (PTK). This research was carried out in the fisheries and marine department of the Agribusiness and Fisheries study program. The research subjects consisted of all 55 semester 1 students of the 2023/2024 academic year of the AGP study program. Based on the results of data analysis, it was found that the application of the PMRI Learning approach in the context of fisheries production at PPI Oeba Kupang was able to improve student learning outcomes regarding data and uncertainty content where the percentage of students who passed the classical completion standard continued to increase, from 50.90% in cycle 1, 72.72% in the second cycle, and 92.72% in the third cycle. 82.72% of students are categorized as having very high learning outcomes, and 82.13% of students are in the very high activeness category.

Keywords: *PMRI; RME; literacy numeracy, data and uncertainty content, RME in vocational college*

INTRODUCTION

Mathematics is well known as a monotonous, rigid, and complicated lecturer. Students always think that mathematics subjects relate numbers and formulas, so, they must memorize formulas and algorithms when solving mathematics problems. They are accustomed to solving any mathematics exercises by memorizing procedures without understanding the concepts. Therefore, many students don't like mathematics (Syafitri, Putra, & Noviana, 2020). Moreover, (Edo, 2021) says that the method of memorizing formulas and solving algorithms without understanding the concepts will kill students' creativity because they do not usually think in higher order. She also said that the lack of concept understanding causes students to make mistakes in solving math problems.

Vocational education such as polytechnics has been defined differently in several countries. The world's vocational education system currently faces the same challenges in different countries and has a common mission of preparing careers and jobs for graduates by focusing on developing specific job knowledge and skills, (Diaz, 2015). This means that after completing studies in vocational education, graduates are expected to have competitive skills that are useful for certain employment, (Rusmar, 2017; Diaz,15). Kupang State Agricultural Polytechnic (Kupang State Polytechnic) as one of the vocational education certainly has the same mission, which is to equip students with a certain amount of knowledge, skills, and attitudes in the context of preparing graduates who are ready for a career or work.

Wagner (2008) in his book The Globa Achievement Gap" has written seven skills that can be useful for survival in the modern era, including: 1). Critical Thinking and Problem Solving, 2). Cross-network collaboration and leading with influence, 3). Agility and Adaptability, 4). Initiative and entrepreneurship, 5) Effective oral communication and written communication skills, 6). Ability to Access and Analyze Information, and 7). Curiosity and imagination.

Maron (2016) said that all these skills will be achievable when the learner has good mathematical skills. The reason is that Mathematics plays an important role in producing the skills written by Wagner. Maron (2016) also states, most studies find that the nature of mathematics is to provide knowledge and learn to think. That is, those who have good learning outcomes in mathematics will survive well in the modern era.

Thus, mathematical skills are very important for vocational students in preparing themselves to enter the workplace after completing their studies. However, (Lindstrom, 2004) found that students often have difficulty transferring their understanding of mathematical theories to real-world applications.

Rusmar (2017) also said that students in vocational education such as at the Medan Industrial Chemical Technology Polytechnic have difficulty in receiving mathematical knowledge because all topics taught are difficult to implement in real life. Muhrman (2015) said that mathematics is an important science in agriculture, but based on the results of interviews it is known that many agricultural students have insufficient mathematical skills to enter the workforce after completing studies. Likewise, students majoring in fisheries and marine Department of Agricultural Polytechnic of Kupang did not understand the importance of mathematics in the marine and fisheries major (Edo, 2021). They are less interested in learning mathematics because they consider mathematics synonymous with complicated formulas.

PISA (2010, p. 4) defines mathematical literacy as an individual's ability to formulate, use, and interpret mathematics in various contexts. It includes mathematically and using concepts, procedures, facts, and mathematical tools in explaining and predicting phenomena. Mathematical literacy helps students to recognize the role of mathematics in the world and to make judgments and decisions needed as citizens.

Organization for Economic Co-operation and Development (OECD) found that measuring numeracy literacy ability includes the following: a. Communication skills; b. Expertise to represent; c. Expertise in mathematization; d. Expertise in choosing solution strategies, e. Expertise to reason; f. Expertise in using mathematical tools, g. Expertise to express symbolic, technical, and formal operations [6]. Meanwhile, Han (2017) said that the indicators of numeracy ability include: To find various solutions in everyday life, a person must be able to: a. use various types of symbols and basic numbers related to mathematics; b. Assess the data provided in various formats (diagrams, tables, charts, graphs, etc.); c. interpret the analysis findings to conclude. In the opinion of the experts above, the indicators of this study refer to the opinion of (Anggrieni and Putri (2018). a. communication skills; b. representational skills; c. mathematization skills; d. problem-solving competence, and e. reasoning ability

According to Stacey (2011), statistics is a topic that is usually used as a matter of tests in mathematical literacy, almost 33% or 26 of 85 items are used as a test of mathematical literacy. Therefore, statistical material should be a concern because PISA itself considers that literacy skills in statistics are very important. Thus, if Indonesian students want to achieve level 3 or 4 values in mathematical literacy, it is necessary to have competence in solving problems related to statistical literacy. mathematical literacy focuses on sharpening the skills of solving real-life problems compared to the concepts and axioms of the math lesson itself. However, to be able to achieve mathematical literacy requires understanding and skills in the school curriculum. (Sutisna and Noornia, 2018).

In the PISA Framework, Statistics topics related to data and uncertainty content which is one branch of mathematics and is the content of mathematical literacy tested in the PISA event. However, in the implementation of learning, this course is often taught using examples and data that have been tabulated in the form of regular or well-organized tables, so that students are not used to collecting data directly from the field, as well as tabulating and presenting data, checking, and processing data. They are accustomed to processing data that has been presented in the form of frequency distribution tables and others then processed or analyzed according to instructions. This reality is often a problem for students in processing field data or raw data they obtain from the field.

The realistic Mathematics Education (RME) approach is a mathematics learning approach that has improved vocational college students' achievement and motivation (Edo, 2019). They said that through learning with the PMRI approach, they not only learned mathematics but also learned fisheries science in the real context. Furthermore, (Kooij ,1998) argued that an important aspect of the RME learning approach is that students can learn a mathematical concept by starting from a contextual problem not only gives students the possibility to gain confidence and learn to understand the concept but can also serve as a basis for further development of that concept.

According to (Maher, Sigley, and Brunswick 2014), Realistic Mathematics Education(RME) is a concept that supports and motivates students to connect their knowledge with applying it in everyday life [10]. The RME approach seeks to inspire students to learn mathematical principles and connect these principles to problems that arise in everyday life. The RME method begins the learning process with the reality and experience of students. The use of realistic problems as a foundation for developing formal mathematical knowledge or mathematical concepts can encourage efforts to organize the subject matter and solve problems. The RME approach expresses a point of view on mathematics as a topic, how students should learn it, and how mathematics should be taught. This learning uses a "real world" context based on constructivist learning theory [11]. The steps of the RME approach according to Shoimin (2014), include, 1) Recognizing contextual problems, 2) Solving contextual problems, 3) Comparing the answers obtained and discussing them, and 4) Concluding using evidence [12].

The adaptation of the RME learning approach in Indonesia namely PMRI (Indonesian realistic mathematics). It should be implemented more flexibly according to the context and place in which it is used. Understanding a realistic context is adjusted to the characteristics of the environment in which this learning approach is used, as well as at the level of education and what type of education in which this approach is adopted. Especially in vocational college, the context as an initial problem can be in the form of natural phenomena, or real problems that occur in the business and the industry that can encourage students to find solutions through the learning process.

Based on previous research discussed, the PMRI approach is considered suitable to be applied to vocational education because it provides opportunities for students to learn mathematics through contexts that are relevant to the field of science they pursue as a starting point for learning. They are directed to understand the concept of the material they are learning, so that they understand the concept of each step of problem-solving algorithm, they also remember it more because they are involved in the process of mathematization. Thus, students understand the relationship between mathematics and the field of science they pursue.

Therefore, this study aims to improve the literacy and numeracy of students in the Fisheries Agribusiness study program through the application of PMRI approach in the context of fisheries production at PPI Oeba Kupang.

METHODS

This research was conducted at the Department of Fisheries and Marine of Fisheries Agribusiness study program (AGP), Kupang State Agricultural Polytechnic. The research subjects consisted of all 55 students in semester 1 of the 2023/2024 academic year of the Fisheries Agribusiness study program.

The research method used in the research is the Classroom Action research (PTK) method. Action research is divided into 3 stages, namely planning, action and observation, and reflection. The class action research model used in this study is using the Kemmis and Mc Taggart models as shown in figure 1.

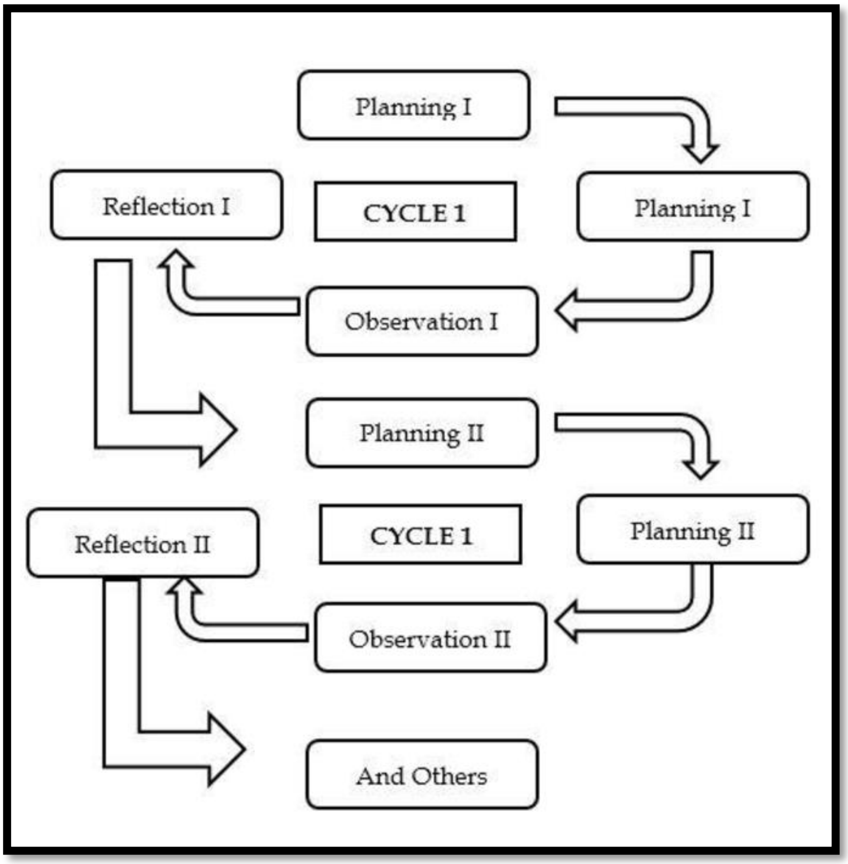


Figure 1. The spiral of classroom action research according to Kemmis & Mc Taggart

Data collection techniques include written tests, observations, documentation, and questionnaires. The test is used to measure the ability of students to master certain material. The instruments used the in instruments used in this study were the lesson plans (RPP), evaluation sheets, interview questions, observation sheets, and questionnaires. Observation sheets as a guide to observing student activity and the ability of lecturers to teach, questionnaire sheets to determine student responses to learning, and instrument validation, while documentation is used to get an overview of lecturer and student activities during learning and at the same time as evidence of research implementation.

Data analysis techniques to determine the improvement of learning outcomes are by calculating

1. Student Score

$NP = \frac{R}{SM} x100$

(Purwanto, 2004: 102).

Keterangan:

NP : Students Score

R : Student achievement scores

SM : Maximum score set

Category

A = 86 -100 = Very Good

B = 76 – 85 = Good

C = 65 – 75 = enough

D = 56 – 65 = bad

E < 56 = worse

2. Average score

Average score of students can be calculated using this formula

$$\frac{\sum_{i=1}^{n} X_1}{n}$$

$\bar{X}$: $Average\ score$

$\sum_{i-1}^{n} Xi$: $The\ cummulative\ of\ students'\ score$

n : $the\ number\ of\ student$

(Arikunto 2010 (264)

3. Student Learning

The indicator that a student fulfilled the minimal standard if he gets a score of 75. The following formula is used to calculate the percentage of learning completion

$$P = \frac{\sum the\ students\ who\ fulfilled\ standard}{Total\ number\ of\ students}$$

Table 1. Criteria for student ability level

Score	Level of ability
>80	Very high
60 – 79	High
40 - 59	Medium
20 – 39	Low
<20	Very Low

Source: Agip, 2006: 441

4. Minimum Completeness Criteria

The Minimum completeness criteria based on Zainal Aqib (2011: 41) are student activity indicators reaching 75%, at least 75% of students meet the minimum completeness, meants that obtaining a score of 75 out of a maximum score of 100.

5. Numeracy Literacy Ability

Table 2. The indicator of literacy numeracy skills

No	Literacy Numeracy skill	Indicator
1	Communication Skill	Write down the process for achieving results Make conclusion of mathematical result
2	Mathematization skill	Using understanding of context to solve mathematical problems
3	Representation skill	Connecting various kinds of representations when solving problems
4	Reasoning and interpretation skill	• Explain the justification and determine the processes and procedures for determining mathematical results or solutions • Concluding from various mathematical arguments
5	Skill to choose problem solving strategy	Using strategies through various procedures that lead to mathematical solutions and conclusions
6	Skill to use formal and technical symbolic languages and operation	Uses formal forms based on mathematical definitions and rules
7	Skill to use mathematical tools	Use mathematical tools to describe mathematical structures or describe mathematical relationships

RESULTS AND DISCUSSION

Classroom action research consists of 3 stages, namely the planning, action and observation stages, and finally the reflection stage. At the planning stage, researchers make learning tools in the form of teaching modules with the PMRI approach, initial test questions, final test questions, student worksheets, questionnaire instruments, observation sheets of teacher teaching abilities, and student activity sheets. Furthermore, research instruments and learning tools are validated by peers with walkthrough techniques. In addition, the test questions are also validated by students before use. The correction results at the validation stage are revised for use from the initial test.

The results of the instrument trial in the form of questions, namely validity analysis, and the level of difficulty of the questions can be seen in tables 3.

Tabel 3. Valid and not valid questions

	The questions numbers
Valid	1, 2, 3, 4, 5, 6,7, 8, 9,10, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 36, 38, 39, 40
Not valid	16,17,35,37

After analysis of questions validity, the next step is to test the difficulty level of the questions. The level questions difficulty can be seen in table 4.

Tabel 4. Analysis of the difficulty level of questions

Level of difficulty	**Question numbers**
Easy	1, 2, 3, 5, 6, 7, 8, 13, 14, 21, 24, 25, 26, 27, 28, 29, 30, 34, 35, 36, 37, 39, 40
Moderate	4, 9, 11, 12, 15, 18, 19, 20, 22, 23, 31, 32, 33, 38
Difficult	10, 16, 17

After making sure that all of the research instruments fulfilled the research requirements, the research continued to implement the PMRI approach in the teaching and learning process within the context of fisheries production at PPI Oeba Kupang. Figure 1 showed the context as starting point of teaching and learning.

context

Figure 2. Data collection activities at the situational stage

Initial Problem

The number of fish catches always increases from year to year along with the increasingly sophisticated fishing gear, the number of fleets is increasing, the GT of ships is getting bigger, human resources are getting higher. Whether the above statement is true, provide reasons or arguments based on valid data.

Furthermore, to answer the questions above, students collected data on fishermen, merchants / fish sellers, and took secondary data at UPTD PPI Oeba Kupang. At the situational stage, students conduct interviews to obtain real data in the field, while data from UPTD PPI Oeba Kupang is complete data or holistic capture data. The available data is monthly data. Student activities at the situational stage are as follows.

Figure 2. Data collection activities at the situational stage

At the model for stage, students tabulate data, data tabulation is in cycle 1 of PTK research. They focus on NTT's leading commodity fish species, namely tuna, grouper, snapper, and skipjack. Here are some examples of how students organize and tabulate data.

DATA PRODUKSI IKAN KERAPU TAHUN 2016-2021

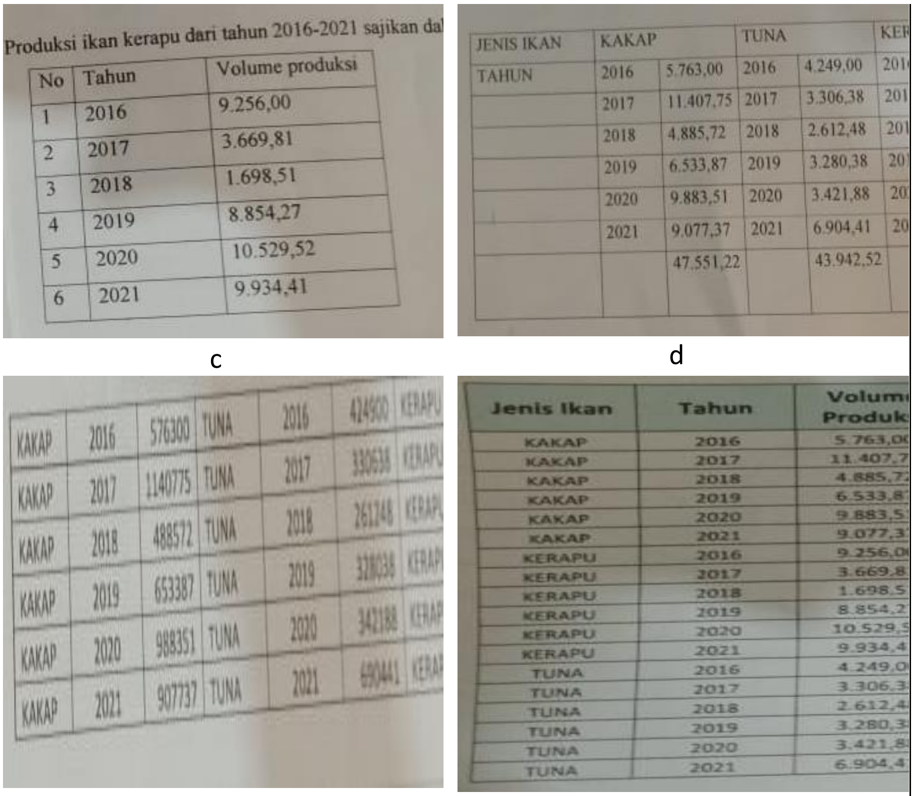
NO	JENIS IKAN	TAHUN	VOLUME PRODU
1	IKAN KERAPU	2016	9.256,00
2	IKAN KERAPU	2017	3.669,81
3	IKAN KERAPU	2018	1.698,51
4	IKAN KERAPU	2019	8.854,27
5	IKAN KERAPU	2020	10.529,52
6	IKAN KERAPU	2021	9.934,41
	JUMLAH		43.942,52

a.

Produksiikankerapudaritahun 2016-2021 dalam dia

volume produksi	jenisikan	tahun
9.256,00	kerapu	2016
3.669,81	kerapu	2017
1.698,51	kerapu	2018
8.854,27	kerapu	2019
10.529,52	kerapu	2020
9.934,41	kerapu	2021

b



c

Produksi ikan kerapu dari tahun 2016-2021 sajikan dal

No	Tahun	Volume produksi
1	2016	9.256,00
2	2017	3.669,81
3	2018	1.698,51
4	2019	8.854,27
5	2020	10.529,52
6	2021	9.934,41

d

JENIS IKAN	KAKAP		TUNA		KEI
TAHUN	2016	5.763,00	2016	4.249,00	201
	2017	11.407,75	2017	3.306,38	201
	2018	4.885,72	2018	2.612,48	201
	2019	6.533,87	2019	3.280,38	20
	2020	9.883,51	2020	3.421,88	20
	2021	9.077,37	2021	6.904,41	20
		47.551,22		43.942,52	

e

KAKAP	2016	576300	TUNA	2016	424900	KERAPU
KAKAP	2017	1140775	TUNA	2017	330638	KERAPU
KAKAP	2018	488572	TUNA	2018	261248	KERAPU
KAKAP	2019	653387	TUNA	2019	328038	KERAPU
KAKAP	2020	988351	TUNA	2020	342188	KERAP
KAKAP	2021	907737	TUNA	2021	690441	KERAP

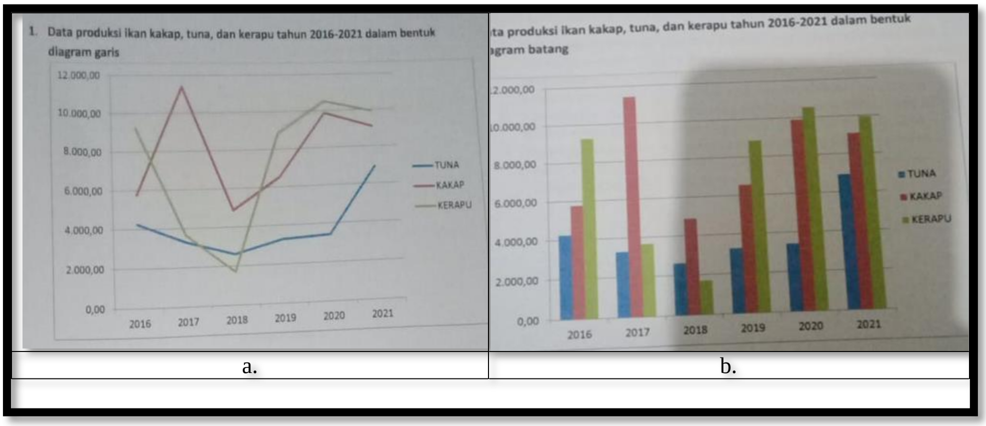
f

Jenis Ikan	Tahun	Volum Produk
KAKAP	2016	5.763,0
KAKAP	2017	11.407,7
KAKAP	2018	4.885,7
KAKAP	2019	6.533,8
KAKAP	2020	9.883,5
KAKAP	2021	9.077,3
KERAPU	2016	9.256,0
KERAPU	2017	3.669,8
KERAPU	2018	1.698,5
KERAPU	2019	8.854,2
KERAPU	2020	10.529,5
KERAPU	2021	9.934,4
TUNA	2016	4.249,0
TUNA	2017	3.306,3
TUNA	2018	2.612,4
TUNA	2019	3.280,3
TUNA	2020	3.421,8
TUNA	2021	6.904,4

Figure 3. Student Answers at the model of stage of

Based on the students' answers above, it can be seen that students have various ways to present data on the number of catches of tuna, skipjack, grouper, and snapper. From the answers in figures 3a, 3b, and 3c, students present data per one commodity, namely the number of grouper catches from 2016 to 2021, But the way data is organized looks complicated and ineffective. While the 3c image already provides well-organized information even if only per one commodity. Figures 3d, 3e, and 3f, showing 3 commodities at once, but each provides a different way of presenting, but all the organization of data in the table is ineffective, because the name of the fish and the same year are written repeatedly in one table. In general, figure 3 shows the complexity of students in presenting data in tabular form. However, after discussion, they realized and were able to change or correct the presentation table correctly.

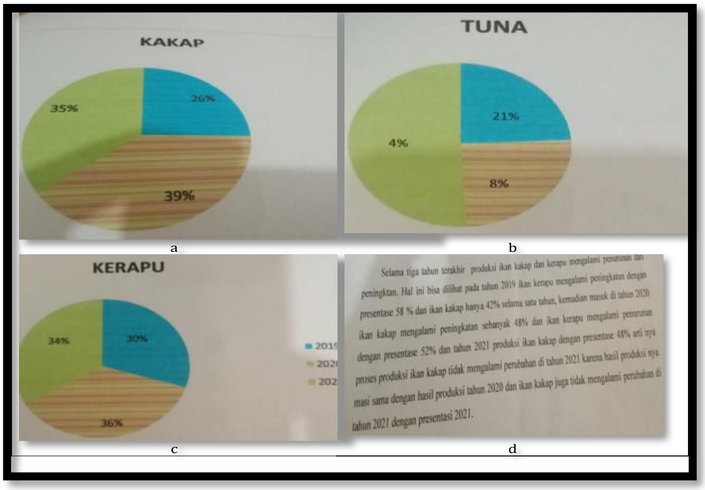
Furthermore, based on the final test of cycle 1, the percentage of completeness has not reached the success criteria so it needs to be continued to the second cycle, namely the presentation of data in bar charts and line charts. The students' answers can be seen in figure 4.



a. b.

Figure 4. Student answers at stage "FOR" part of the second cycle

While the pie chart can be seen in figure 5



a b c d

Figure 5. Student answers in cycle 3 and formal stage

Details of student learning outcomes for 3 consecutive cycles are presented in Table 6

Table 5. Student learning outcomes per cycle

Learning outcomes	**Cycles**		
	1	**2**	**3**
Average	68.36	75.01	83.63
Max Value	80	88	97
Min Value	50	63	63
The number of Students who completed KKM	28	40	51
The number of Students who not completed KKM	27	15	4
Percent of Students who completed KKM	50.90%	72.72%	92.72%
Percent of Students who not completed KKM	49.09%	27.27%	7.27%

Based on Table 5, it can be seen that the total scores of students continue to increase from first cycle to the third cycle, with class averages starting from 68.63 in cycle 1, 75.08 in cycle 2, and 83.71 in cycle three. Based on the minimum completeness standard of class (KKM) 75.40, 30% of students completed in cycle 1, 54% of students completed in cycle 2, and 88.05% of students completed in cycle three.

In cycle 1, 15 students have medium grade qualifications, ranging from 40-59, while in the 2nd and 3rd cycles, there are no students in that grade category. This means that there is an increase in student scores from cycle 1 to cycle 2. This can also be seen in the number of students who have high qualifications, namely in the range of 60-79 grades. In cycle 1, 24 students are in the high category, while in the 2nd cycle, it increased to 30 people. However, in the 3rd cycle, the number of students in the high category seems to decrease, but actually, students in the 2nd cycle in the high category have increased to the very high category with a range of 80-100 scores. This can be seen in the number of students who have very high score qualifications which increased from cycle 1, 16 people to 25 people in cycle 2 and 40 people in cycle 3. This means that the application of realistic mathematics learning can improve students' literacy and numeracy skills. This is in line with (Zulkardi, 2002, p. 29)) that RME will require students to master the skills in solving problems in the surrounding life with mathematical concepts (Zulkardi, 2002), and also relevant to (OECD, 2006) one aspect of mathematical literacy that seeks to measure students' ability to solve problems of formulating, using, and interpreting mathematics in various contexts which related to literacy numeracy.

In cycle 1, students are not familiar with learning that starts from the context as a starting point for learning. They don't use information in context to answer questions, but they instead look for information from Google. They are not familiar with solving challenge problems at the beginning of meetings. Because in general at the previous level of education, problem-solving questions were given at the end of learning as enrichment questions. They also need a long time to read and understand reading or information in the form of scientific texts in context.

In cycle 2 of the distribution of initial problem questions, student worksheets, and teaching materials are distributed by lecturers who care about courses through the WA group so that students are allowed to use mobile phones in the learning process. The consideration is that all students can access teaching materials and discuss materials independently before they discuss in groups. In this cycle, they begin to familiar with the learning pattern of the PMRI approach. They already understand the relationship between context, the initial problem, and the material. But some of them tend to look for examples of the same questions they get on the internet. So that these students do not use higher-order thinking skills in solving mathematical problems.

While in cycle 3, students have enjoyed the mathematics learning that is carried out. They not only learn in the classroom but directly practice at PPI and TPI Oeba. They were very enthusiastic in the learning process with PMRI's learning approach, they said that they not only learned mathematics but also learned about the capture fisheries sector. The use of real contexts that are in the field of fisheries agribusiness science makes them understand the importance of mathematics for the development of fisheries science.

Student numeracy literacy skills are assessed based on the indicators listed in Table 1. Communication skills are assessed from how students answer problems on student worksheets, and mathematical skills are assessed from how students solve problems according to context, for example in the case of the initial problem. Logically the initial problem is correct because the number of fish catches is supported by qualified infrastructure and human resources. But in the context of the capture fisheries sector, this statement is not true, because seasonal factors and oceanographic conditions determine the number of fish catches. Percentage ability is assessed by how students can represent data in various diagrams as well as how they can connect and interpret the results of various diagrams. The ability to reason and argue is assessed by how students can defend their answers based on logical reasoning, students' ability to present and interpret data, and the ability to use mathematical tools are also assessed by how students can use applications in presenting data and doing calculations. These results are in line with previous research (Kooij, 1998; Edo, 2019) improving student learning outcomes in vocational education, as well as (Lubis and Siregar, 2023) who said that the Realistic Mathematics Education approach greatly impacts students' reading and mathematics abilities.

CONCLUSION

Based on the results of the data analysis above, it can be concluded that the application of the PMRI learning approach can improve literacy numeracy of fisheries agribusiness students, fisheries and marine departments, Kupang State Agricultural Polytechnic which 92.72% of students passed minimum completion standard, with class averages starting from 68.63 in cycle 1, 75.08 in cycle 2, and 83.71 in cycle three. Based on the minimum completeness standard of class (KKM) 75.40, 30% of students completed in cycle 1, 54% of students completed in cycle 2, and 88.05% of students completed in cycle three. There are 82.13% of students with very high activity categories..

ACKNOWLEDGEMENT

The author would like to thank the Kupang State Agricultural Polytechnic for funding and facilitating this research activity. We would also like to thank our students who participated in this research and all lecturers and technicians in the Fisheries Agribusiness Study Program, Department of Fisheries and Maritime Affairs, Kupang State Agricultural Polytechnic, who in their own ways have provided a lot of input, suggestions as well as energy in this research process.

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