Jurnal Gantang IX (1) (2024): 49-64

JURNAL GANTANG

e-ISSN: 2548-5547
p-ISSN: 2503-0671

http://ojs.umrah.ac.id/index.php/gantang/index

Development of student worksheets based on local wisdom in the Riau Islands Province using realistic mathematics education to facilitate mathematical reasoning abilities

Yodiatmana, Atma Murni*, Nahor Murani Hutapea

Universitas Riau, Pekanbaru, Riau Province, 28293, Indonesia
*Corresponding Author : atma.murni@lecturer.unri.ac.id

Submission: July 23rd, 2024; Accepted: October 24th, 2024; Published: October 31st, 2024
DOI: https://doi.org/10.31629/jg.v9i1.7050

Abstract
This research is motivated by students' low mathematical reasoning ability due to conventional teaching methods and the lack of learning resources that support students' reasoning skills. Local wisdom-based student worksheets were developed using the Realistic Mathematics Education approach to address this issue. Local wisdom from Tanjungpinang, Riau Islands, such as Otak-otak and Batik Gonggong, was used as the context for learning Systems of Linear Equations in Two Variables. The research method used is Research and Development (R&D) with a 4D development model (define, design, develop, disseminate). The instruments for assessing validity and practicality were expert validation questionnaires and student response questionnaires using a Likert scale. The effectiveness instrument used was a set of four essay questions. Data obtained on the Likert scale were analyzed using the Method of Successive Interval (MSI). Validation results showed that the student worksheets were categorized as valid, with an average expert validation percentage of 76.2%. Practicality tests yielded an average percentage of 77.59% (small group) and 67% (field test), both categorized as practical. The effectiveness test results showed an average score of 79.8 in the high category, and the mathematical reasoning ability test was deemed effective, with a classical mastery level of 90%. This study highlights the effectiveness of local wisdom-based worksheets using the Realistic Mathematics Education approach to facilitate students' mathematical reasoning skills and encourages teachers to integrate local wisdom into student worksheets.

Keywords: student worksheet; realistic mathematics education; mathematical reasoning ability

How to cite: Yodiatmana., Murni, A., & Hutapea, N, M. Development of student worksheets based on local wisdom in the Riau Islands Province using realistic mathematics education to facilitate mathematical reasoning abilities. *Jurnal gantang, 9*(1),49 – 64. https://doi.org/10.31629/jg.v9i1.7050

I. Introduction

The System of Linear Equations in Two Variables is one of the most vital topics to study. Generally, the material on systems of linear equations in two variables is closely integrated with students' daily lives (Purnamasari & Setiawan, 2019). The concepts taught are closely related to everyday life. This is because context can transform abstract mathematical concepts into more tangible and easily understandable ideas (Nuraida et al., 2020). Students also learn to relate these concepts to their experiences during this process. Reasoning skills are essential for understanding and effectively applying these concepts in learning.

Mathematical reasoning skills are one of the key aspects of acquiring mathematical knowledge. Establishing mathematical reasoning as a goal in the vision of mathematics learning demonstrates that this skill is crucial for students to possess (Mandasari & Kusnanto, 2023). However, the fact is that the average scores for students' reasoning abilities in Indonesia are relatively low. Organization for Economic Cooperation and Development 2023 Reportedly, the PISA 2022 results showed that the average score of Indonesian students in mathematical reasoning ability was 354, whereas the average score for OECD countries was 473. The significant score difference indicates that the low quality of mathematical reasoning skills among Indonesian students requires special attention from the government and national education stakeholders.

Mathematical reasoning skills are thinking systematically and drawing conclusions or making new statements based on facts and relevant sources (Sumartini, 2015; Saleh et al., 2018). Indirectly, the involvement of mathematical reasoning skills greatly influences problem-solving. Reasoning skills enable students to provide reasons and actions to draw conclusions based on the problems they want to solve.

Triawan & Zanthy (2019). States that mathematical reasoning skills have three indicators, which include (1) the ability to present mathematical statements in written form as models, (2) the ability to analyze mathematical situations using patterns and relationships, and (3) the ability to draw conclusions or answers from existing problems. One of the research findings mentioned that students' weaknesses lie in analyzing mathematical situations using patterns and relationships, with the lowest percentage being 45%. Sofyana and Kusuma (2018) explain that problems presented by teachers cause weaknesses that students cannot analyze, thereby preventing them from making assumptions about the given problems. Students are not accustomed to solving nonroutine problems (Tatiriah et al., 2016; Diana & Fauzan, 2018). Moreover, teachers frequently employ lecture methods, So students have fewer chances to cultivate their knowledge (Chisara et al., 2018).

Beyond selecting methods or approaches in the learning process, choosing instructional materials significantly impacts mathematical reasoning skills development. The availability of instructional materials to train mathematical reasoning skills, such as worksheets, is still insufficient (Agustiani, 2019). This statement is also supported by Umaroh et al. (2022), who found that teachers have not yet designed their worksheets to accommodate students' specific mathematical needs. Indraningtias and Wijaya (2017) assert that many schools rely solely on government-printed textbooks, and the teaching teachers do not directly craft worksheets.

Student worksheets are a type of instructional material that plays a crucial role in the learning process, particularly in training mathematical reasoning skills. This is because worksheets are structured with more operational, logical, and systematic steps (Kosasih, 2021). Furthermore, worksheets guide students in discovering concepts, allowing them, based on constructivist principles, to construct their own knowledge through problem-solving outcomes (Suanto et al., 2023).

Based on the facts and supporting arguments presented, teachers need to design a learning scenario by applying a teaching approach that involves structuring activities or tasks in student worksheets that stimulate reasoning and thinking activities to construct knowledge. Implementing teaching methods or approaches aims to organize student activities, which can assist learners in thinking logically and actively, thereby enabling students to build their knowledge to develop their reasoning abilities. This statement is corroborated by Arsoetar and Sugiman (2019), who stated that the teaching methods or approaches used significantly impact students' activities and active participation, allowing them to discover their own understanding. Several previous studies recommend using worksheets based on RME for teaching, as this approach connects mathematical concepts with real-life situations, making them easier to understand and more relevant for students (Yanti et al., 2022; Sari & Putri, 2021; Indar, 2019).

The RME approach is a teaching method that, when applied, has the potential to address students' low mathematical reasoning abilities. This is because the learning process in the RME approach focuses on reasoning skills, practical thinking, logical thinking, and critical thinking in problem-solving (Nabila & Putri, 2022). In the learning process using the RME approach, real-world contexts are presented as the starting point for the learning process (Rohman et al., 2019). The function of real-world contexts in RME is to motivate students to learn mathematics and to develop their ideas and experiences (Atika & MZ, 2016). This RME approach is based on real-world problems or student experiences, emphasizing processing skills, collaboration, discussion, and sharing opinions with classmates to discover their mathematical concepts and solve problems using mathematics (Zulkardi & Putri, 2010). Through real-world contextual problems, students are encouraged to make connections between their existing knowledge and acquire new knowledge and skills from the context and the process of self-construction, preparing them to solve everyday life problems (Maryati, 2018).

Based on its application, according to Afriansyah (2016), RME has three principles: (1) guided reinvention through didactical phenomenology, which means that students are expected to rediscover mathematical concepts through learning that begins with contextual problems, where the given situations consider possible applications in learning and serve as the starting point for mathematization; (2) progressive mathematization, students are given the opportunity to experience the process of discovering mathematical concepts; (3) self develop models, the models are created by the students themselves during the problem-solving process.

Prahmana et al. (2023) state that learning using the RME approach has four levels referred to as the iceberg, including (1) situational, the level at which specific situational knowledge and strategies are used in the context of the situation; (2) model of, the level at which the model and strategy refer to the situation described in the problem; (3) model for, the level at which mathematical focus on strategy dominates the reference to the context; (4) formal, the level at which a person works with conventional procedures and notation. The iceberg is a metaphor that illustrates the role of context, models, representations, and strategies in facilitating the development of students' mathematical understanding (D. C. Webb et al., 2008). The iceberg is used to illustrate various methods of mathematical representation that aid in understanding formal mathematics (D. Webb & Abels, 2011). The peak of the iceberg symbolizes formal mathematics that will be studied or understood. In this part, students' reasoning reaches the level of formal mathematics. Meanwhile, a much larger ice volume is below the iceberg or beneath the water's surface. This section includes various informal and pre-formal mathematical representations related to formal mathematics to be understood.

In learning using the RME approach, phenomenologically rich situations are used to reach formal knowledge. As in didactic phenomena, situations must be selected so that they can be organized by mathematical objects built or constructed by students (Larsen, 2018). Related to the previously described didactical phenomenology, many didactic phenomena are related to learning mathematics. However, few people pay attention to and utilize them, even though these phenomena are rich in mathematical principles. Efforts are needed to optimize this potential so that learning becomes more meaningful, students' understanding of mathematics can be well established, and scientific institutionalization can occur within them. One way to create meaningful learning is by incorporating cultural values already known to some communities and students, such as the local wisdom of the Riau Islands Province.

Local wisdom is a norm that binds a community whose truth is believed by that community, and its existence is used as a reference in daily activities and behavior (Suastra et al., 2017). According to Pesurnay (2018), local wisdom is a kind of cultural knowledge a particular community possesses that includes managing natural resources. The people of Tanjungpinang, many of whom work as fishermen, utilize the abundant marine resources to meet their economic needs. This has made Tanjungpinang in the Riau Islands famous for traditional Malay cuisine, including otak-otak. Otak-otak is one of the distinctive dishes found in Tanjungpinang. Otak-otak is a seafood-based culinary dish that comes in three different varieties: fish otak-otak, squid otak-otak, and fish bone otak-otak (Paramita et al., 2022). In addition to Otak-otak, several other traditional Malay foods spread across Tanjungpinang in the Riau Islands, such as Deram-deram cake, Bangkit cake, Luti Gendang, and Tarempa noodles.

Not only cuisine, but the people of the Riau Islands also have a distinctive craft called Batik Gonggong. Batik Gonggong is one of the unique crafts from the city of Tanjungpinang. According to Prasmi et al. (2022), the Batik Gonggong motif has an exclusive uniqueness as it is only marketed at one store called Batik Gonggong, located in Tanjungpinang City. Batik Gonggong features 35 variations of motifs, including snail gonggong motifs, kemuning flower motifs, consecutive gonggong motifs, crab motifs, and bamboo shoot motifs.

Based on the description above emphasizes that worksheets based on local wisdom using the RME approach can facilitate students' mathematical reasoning abilities. Additionally, worksheets assisted by the RME approach in systems of linear equations with two variables characterize realistic situations relevant to systems of linear equations with two variables material that often connect real-world contexts. Realistic contexts or problems will be created based on the local wisdom applicable in Tanjungpinang, Riau Islands, using word problem concepts. Therefore, researchers are developing worksheets based on the local wisdom of Tanjungpinang, Riau Islands Province, using the RME approach to facilitate students' mathematical reasoning abilities in systems of linear equations with two variables material that meet valid, practical, and effective criteria.

II. Research Method

This study aims to evaluate the validity, practicality, and effectiveness of Student Worksheets based on local wisdom using the RME approach to facilitate mathematical reasoning abilities in Systems of linear equations with Two Variables. The type of research conducted is Research and Development (R&D), which aims to develop and produce a product while testing its effectiveness (Sugiyono, 2015).

The development model used is the 4D model consisting of four stages: Define, Design, Development, and Disseminate. Validators are three faculty members from the Faculty of Education, Universitas Riau, Universitas Maritim Raja Ali Haji, and Universitas Negeri Padang. The testing is conducted in three stages: one-to-one, small group, and field test. In the one-to-one stage, the RME based student worksheets are tested with 3 high-ability students who have studied systems of linear equations with two variables. This aims to evaluate readability, clarity of diagrams, difficulty completing the worksheets, and gather feedback through interviews to revise the worksheets product. The small group test involves 2 high-ability, 2 medium-ability, and 2 low-ability students to further evaluate readability before proceeding to the field test stage.

After revisions from the small group test, the researcher conducts a large-scale test by implementing the local wisdom-based worksheets using the RME approach with 30 students to evaluate its practicality and effectiveness through a mathematical reasoning test related to systems of linear equations with two variables using 4 open-ended questions. The student worksheet product is considered effective if the student reaches the minimum completion criteria score set by the school, where the research location is 73, and reaches a minimum classical mastery level of 75%. The hypothesis used in this research is as follows:

a. $H_0: Z_{score} \leq Z_{table}$, (The number of students achieving at least the minimum score on the mathematical reasoning test is no more than 75%)
b. $H_1: Z_{score} > Z_{table}$, (The number of students who achieve at least the minimum score on the mathematical reasoning test is more than 75%)

The data collection technique involves providing a series of written statements or explanations to validators and respondents/students, which will be answered based on their assessment and experience using the student worksheets. The research instrument employed is a set of questionnaires. The validity of the student worksheets and the practicality questionnaire is measured using a Likert scale with five rating levels. Details of the measurement scale used can be seen in Table 1.

Table 1. Guidelines for Likert scale levels

Level	Description	Score
SS	Strongly agree	5
S	Agree	4
C	Quite agree	3
TS	Disagree	2
STS	Disagree	1

Setiawati et al. (2013) explained that the Likert scale can be transformed into an interval scale using the Method of Successive Interval (MSI) transformation method. The following are the steps involved:

1. Calculate the frequency score (f), the total frequency of responses in each category for each statement.
2. Convert the frequency score (f) into a proportion score (p) by dividing the frequency (f) by the total number of respondents.
3. Calculate the cumulative proportion (pk) for each category for each statement.
4. Calculate the midpoint of the cumulative proportion obtained by adding the proportion value in the category to the previous cumulative proportion.
5. Calculate the deviation value (z) by converting the midpoint of the cumulative proportion score into a z-score using the standard curve as a reference.

Data obtained from the questionnaire were analyzed using percentage scores with the following formula adapted from (Ramadhona et al., 2023)

$$p = \frac{\sum x}{\sum x_i} \times 100\%$$

Description:
p = percentage
$\sum x$ = Total score obtained
$\sum x_i$ = Ideal score

The percentage score criteria adapted from Hayati et al. (2022) can be seen in Table 2 below.

Table 2. Categories of validity and practicality

Validity Category	Interval	Practicality Category
Very valid	$81\% - 100\%$	Very practical
Valid	$61\% - 80\%$	Practical
Quite valid	$41\% - 60\%$	Quite practical
Validity Category	**Interval**	**Practicality Category**
Less valid	$21\% - 40\%$	Less Practical
Invalid	$0\% - 20\%$	Impractical

III. Results and Discussion

Student Worksheets based on local wisdom using the RME approach in systems of linear equations with two variables material are developed based on the 4D model, namely the define, design, development, and disseminate stages. Here is an explanation of each stage:

1. Define

This stage aims to identify issues and gather essential information about the product to be developed. At this stage, the researcher found that teachers use printed books rather than instructional materials like student worksheets. The discovered student worksheet designs have not been sufficient in optimizing mathematical reasoning abilities. The lack of effort in developing student worksheets to facilitate mathematical reasoning abilities results in a learning process that remains teacher-centered. Students are seldom allowed to interact with the material through contextual problems directly. As a result, mathematical reasoning activities cannot occur optimally because the contextual problems presented in printed books have not adequately trained students' mathematical reasoning abilities.

The researcher also analyzed students to identify weaknesses in solving a system of linear equations in two variable problems. At this stage, the researcher found that some students still cannot properly model problems in a system of linear equations in two variables material. Modeling problems in a system of linear equations in two variables is crucial for accuracy in results by analyzing mathematical situations using patterns and relationships. According to Hutauruk (2018) and Maarif et al. (2020), students are unable to model problems into systems of linear equations with two variables because they cannot grasp the problems.

In solving systems of linear equations with two variables, students commonly use the combination (elimination-substitution) method because it is considered easier. Meanwhile, the graphical method is rarely used in the solving process because it is perceived as difficult and time-consuming due to visualizing pictures in line graphs, and the accuracy of the graph will affect the solutions obtained. Related to this issue is a prerequisite subject, namely linear equations, which students should understand before entering systems of linear equations with two variables material but have not been well understood.

Typically, students are asked to draw logical conclusions at the end of solving systems of linear equations with two variables (SLETV) problems. Students perceive that in the problem-solving process involving 4 methods where the final result is values of x and y, these values represent the final answers of the solving process.

In addition, the researcher performed concept analysis by identifying and mapping the concepts students need to grasp to solve problems in systems of linear equations in two variables. Concepts covered in systems of linear equations in two variables material include the graphical method, substitution method, elimination method, and combined method (elimination-substitution).

The task analysis is formulated based on the Learning Outcomes, which state, "By the end of phase D, students can solve systems of linear equations with two variables through various problem-solving methods. The verb "solve" is used as the basis or minimum competency to achieve the learning objectives.

The specification of learning objectives is derived from analyzing relevant concepts in systems of linear equations with two variables material. The developed learning objectives refer to the criteria of the Merdeka curriculum, namely competencies and content. The learning objectives are organized sequentially and referred to as the Learning Objective Sequence (LOS), as shown in Table 3.

Table 3. Learning objective sequence

Student worksheet for meetings 1 to 4	Learning Objective Sequence
Student worksheet-1 (Graphic method)	Solve systems of linear equations with two variables related problems

	using graphical methods.
Student worksheet-2 (Substitution method)	Solve systems of linear equations with two variables related problems using the substitution method.
Student worksheet-3 (Elimination method)	Solve systems of linear equations with two variables related problems using the elimination method.
Student worksheet-4 (Combined method)	Solve systems of linear equations with two variables related problems using a combined method.

2. Design

The design stage in this research consists of 3 phases, including the Constructing Criterion-Referenced Test, the selection of media, the selection of format, and the initial design. Here's the explanation:

a. Constructing criterion-referenced test

The researcher prepared a validity questionnaire as a reference for validators to assess the validity of the developed student worksheets and to provide suggestions, comments, and feedback. The researcher also prepared a practicality questionnaire for the small group and field test trials with students to assess the practicality of the developed student worksheets and to gather responses such as suggestions, comments, and feedback. In the final stage of development, the researcher developed a mathematical reasoning ability test instrument in the form of test questions related to systems of linear equations with two variables material to assess the effectiveness of the developed student worksheets.

b. Selection of media

The developed student worksheets result in printed worksheets in the form of a permanent bound book (A4 size) and a PDF file. In the development process, Canva is used to design the layout to make the student worksheets more visually appealing.

c. Selection of format

Choosing a format that facilitates students' mathematical reasoning abilities, such as contextual learning that combines contextual problems with the RME approach. The format for developing student worksheets is structured into 3 components. First, the introduction includes (1) a main cover, (2) a foreword, (3) a table of contents, (4) a concept map, and (5) learning objectives and learning outcomes. Second, the content includes: (1) student worksheets cover representing 4 sessions, (2) instructions for using and learning objectives of student worksheets, (3) supporting information containing local wisdom content from Tanjungpinang, Riau Islands, (4) steps of the RME approach including understanding contextual problems, planning problem-solving processes, solving problems, comparing and discussing answers, drawing logical conclusions. Third, the conclusion includes practice questions and the back cover.

d. Initial design

At the Initial Design stage, researchers began to design the student worksheet using the RME approach based on the previous stages, namely constructing criterion-referenced tests, media selection, and format selection. At this stage, researchers completed the initial product or design in the form of a student worksheet based on local wisdom in Tanjungpinang, Riau Islands Province, using the RME approach before being assessed or validated by experts.

3. Development

This stage comprises four phases: expert appraisal, one-to-one, small group, and field test. Each phase serves distinct purposes and objectives. In this study, the expert appraisal and one-to-one phases are conducted concurrently. The initial three phases involve validating the developed student worksheet, resulting in multiple prototypes until arriving at the final prototype. This ultimate prototype undergoes testing during the field test phase to evaluate the potential impact of the student worksheet on students' mathematical reasoning abilities.

JURNAL GANTANG. December 2024; IX(1): 49 – 64
p-ISSN. 2503-0671
e-ISSN. 2548-5547

a. Expert appraisal stage

The expert validators for the material consisted of three mathematics education from UNRI, UNP, and UMRAH. They utilized a validation sheet to assess the student worksheet across several key aspects: 1) content aspect, evaluating alignment with the curriculum, the approach used, and suitability for enhancing students' mathematical reasoning abilities; 2) presentation aspect, focusing on the accuracy of usage instructions, presentation layout, and graphics; 3) graphic design aspect, assessing the attractiveness of graphics based on color, ensuring the main cover reflects the content adopting local wisdom from Tanjungpinang as the context for understanding systems of linear equations with two variables and ensuring readability through proportional font type and size usage; and 4) Language aspect, aiming to control the language used in the student worksheet to be simple, appropriate for students' developmental stages, and facilitating comprehension of the student worksheet content. These four aspects were detailed into 43 statement items. Subsequently, the validation results were processed by calculating the average percentage using Microsoft Excel 2021. The data processing revealed a validity percentage of 76.2%. Below are the validation results for each aspect.

Table 4. Results of expert validation

No	Aspect	Average (%)	Criteria
1	Content aspect	74,3	Valid
2	Presentation aspect	78,7	Valid
3	Visual aspect	72,75	Valid
4	Language aspect	78,7	Valid
Overall outcomes of expert validation		**76,2**	**Valid**

The validation process was conducted parallel to the one-to-one stage. During the one-to-one stage, the researcher made revisions based on feedback from expert validators and interviews with students. Specifically, the researcher revised the cover page images of the student worksheet that were deemed inconsistent with the student worksheet content.

Figure 1. Cover view before revision

Before the revision, the cover of the students' worksheet looked like the image above in Figure 1. After the revision, the cover of the electronic student worksheet contains an image representing the phenomenon of the discussed local wisdom content. This change was made to avoid misconceptions regarding the use of images and aims for greater consistency.

Figure 2. Cover view after revision

In addition, the researchers revised one of the characteristics of RME in the student worksheets based on feedback from the validator, specifically regarding intertwining. The validator suggested adding a column for students to explain the interrelation of concepts after solving the problems in each student worksheet. The revisions made can be seen in Figure 3.

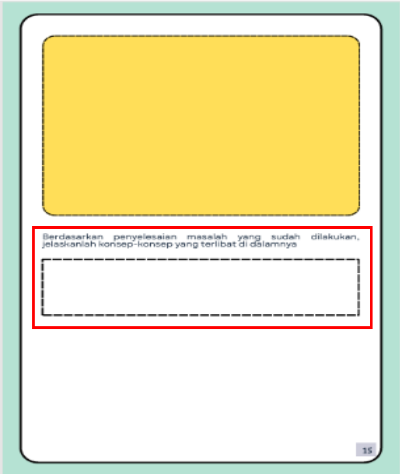

Figure 3. Addition of intertwining after revision.

b. One-to-one stage

In this stage, prototype I was provided to three eighth-grade students from Maitreyawira Middle School, Tanjungpinang, who were identified for their high cognitive abilities based on their mathematics teacher's assessment. The activity took place from March 4 to 5, 2024, to identify challenges in using the student worksheet and gather feedback from students on their experience with it—additionally, the one-to-one stage aimed to test the readability of the student worksheet product. The three students were coded as JE, PY, and MA. Below are the inputs and suggestions from the three students during the one-to-one phase after completing the student worksheet.

Table 5. Feedback and suggestions at the one-to-one stage

Student code	Feedback and suggestions
JE	Tampilan LKPD sudah cukup bagus. Jika gambar pada LKPD-2 tidak kabur akan lebih bagus lagi
PY	Soal-soal lumayan mudah untuk dipahami
	Masalah yang diberikan bagus dan menarik
MA	Masalah yang diberikan sangat menantang *skill* matematika saya.
	Pada tabel penjualan Bu Rahmi dan Pak Aji, disarankan katerangan jumlah perbungkus kue Deram-deram dan jumlah perbungkus kue Bangkit dibalikkan posisinya. Karena pada teks yang dibahas pertama adalah kue Bangkit

Based on the feedback and suggestions from the one-to-one stage, the researcher made several revisions. These revisions included updating the quality of images to improve clarity and adjusting the position of text in contextual problems to align them more logically and make them easier to understand. With these revisions completed, the researcher proceeded to the small group stage.

a. Small group stage

The small group stage was conducted after revising the validation and one-to-one stage, resulting in prototype 2. The small group stage was tested with 2 high ability students, 2 moderate ability students, and 2 low ability students. The activities were carried out from March 7th to 8th, 2024. Students were asked to work on each student worksheet for 1 class period (40 minutes), after which they were requested to fill out a questionnaire regarding their response to the student worksheet they had completed. The goal was to obtain feedback from students on how they felt about the student worksheet and suggestions for improvement. The feedback and suggestions for the student worksheet product in the small group phase are presented in Table 6.

Table 6. Feedback and suggestions at the small group stage

No	Feedback and suggestions
1	Siswa berkemampuan tinggi: a. LKPD ini sangat membantu saya dalam proses pembelajaran di sekolah b. Soal tergolong sulit dan butuh waktu lebih untuk memahami soal dengan baik

2	Siswa berkemampuan sedang: a. Soalnya agak susah, soal yang diberikan sulit dalam penalaran saya b. Waktu yang diberikan tidak cukup c. Terdapat *typo* pada LKPD-3
3	Siswa berkemampuan rendah: a. Masalah atau soal yang disajikan terlalu sulit b. Waktu yang diberikan sangat sedikit

Based on feedback and suggestions from the small group phase, the researcher corrected typos in Student Worksheet-3. Additionally, the researcher revised the time allocation for each Student Worksheet, extending it from 1 class period (JP) to 2 class periods (JP).

In this stage, the researcher also administered a student response questionnaire to assess the practicality of the student worksheet in the small group phase based on three aspects: (1) ease of use based on appearance; (2) ease of understanding the material in the student worksheet; and (3) suitability of the student worksheet with the interests, needs, and conditions of the students. These three aspects were elaborated into 37 statement items. The practicality score obtained in the small group phase was 77.59%.

Table 7. Practicality at the small group stage

Aspect	Average (%)	Criteria
Ease of use based on appearance	76,7	Practical
Ease of understanding the material in the student worksheet	77,3	Practical
Suitability of the student worksheet with the interests, needs, and conditions of the students	80,8	Practical
Aspect	**Average (%)**	**Criteria**
The average total (%)	**77,59**	Practical

b. Field test stage

In this phase, prototype 3 was tested with 30 students from class VIII B of SMPS Maitreyawira Tanjungpinang over 2 days on March 20 and 21, 2024. The large group trial consisted of 4 sessions, each lasting 2 hours. The topics covered in each session were the graphical method for the first meeting, the substitution method for the second meeting, the elimination method for the third meeting, and the combination method for the fourth meeting. Prior to the large group trial, the 30 students were divided into 5 groups of 6 members each. The field test followed the RME approach steps, including understanding contextual problems, explaining contextual problems, solving contextual problems, comparing and discussing answers, and drawing conclusions. After conducting the field test, the average mathematical reasoning ability of the students was assessed based on the answers collected and analyzed by the researcher, encompassing student worksheet-1 to student worksheet-4, as presented in Table 8.

Table 8. The average mathematical reasoning ability during the field test phase for each indicator

Indicator of Mathematical Reasoning Ability	Average (%)
The ability to articulate mathematical statements in written form as models	79,17 %
The ability to analyze mathematical situations using patterns and relationships	62,5 %
The ability to conclude given problem situations	62,5 %

During the field test activities, the researcher summarized several findings, including using local wisdom contexts from Tanjungpinang that are familiar to students. The context here is interpreted as the initial situation used in the learning process to familiarize students with the material to be taught (Dwirahayu et al., 2020). Consistent with previous research, integrating everyday life contexts into mathematics education can influence their mathematical reasoning abilities (Yanti et al., 2022; Nabila & Putri, 2022) because the presentation of the problems demands students to engage in problem-solving (Risdiyanti & Prahmana, 2020).

Based on its application in the field, each group was allowed to investigate and resolve the problems. This was done to allow students to discover mathematical ideas through learning processes using situations that contain mathematical concepts and are fundamental to students (Indar, 2019). Developing and applying everyday problems related to mathematical concepts is part of the learning process (Tanujaya et al., 2017). It was found that students in group 2 could understand the problems and solve them by explaining them in mathematical model representations. This statement is supported by Triawan and Zanthy (2019), who states that one indication of mathematical reasoning ability is the ability to present mathematical statements in written form using models.

Further findings revealed that students identified as capable of reasoning were in group 3, which applied a different model of linear equations compared to group 2, as previously described. To solve the same problem, Group 2 and Group 3 employed different approaches. The difference is evident in the mathematical models they used. The difference indicates that the information and the way both groups organize information are different, thus enabling them to create their mathematical models. Irawan (2014) describes someone's ability in mathematical reasoning to utilize numbers, think logically in mathematical contexts, organize information, and use abstract concepts to identify relationships between various elements. This indicates that the student worksheets were developed following three main principles of RME-guided reinvention, didactical phenomenology, and self-developed models (Afriansyah, 2016).

Based on the calculation results of the questionnaire responses from students after completing the entire sequence of learning activities, Table 9 presents the average practicality of each aspect in the field test phase.

Table 9. The practicality of each aspect of the student worksheets in the field test stage

Aspect	Average (%)	Criteria
Ease of use based on appearance	63,3	Practical
Ease of understanding the material in the student worksheet	67,9	Practical
Suitability of the student worksheet with the interests, needs, and conditions of the students	71,4	Practical
The average total (%)	**67%**	Practical

In addition, the researcher conducted an effectiveness test on Friday, March 22, 2024, involving 30 participants from Grade VIII. The effectiveness test was conducted by administering an individual learning outcome test. The learning outcome test aimed to assess students' mathematical reasoning abilities after learning using the locally based student worksheets from Tanjungpinang, Riau Islands Province, employing the RME approach. The mathematical reasoning test aimed to determine whether the locally based student worksheets using the developed RME approach effectively supported students' mathematical reasoning abilities in learning systems of linear equations with two variables. The analysis of the mastery data from 30 students' presented in Table 10.

Table 10. Analysis of the completeness of students' mathematical reasoning ability test

Minimum passing criteria	Total student	Percentage (%)	Average score
≥ 73	27	90%	79,8
< 73	3	10%	

Based on Table 10, the test results showed that 27 students passed and 3 did not. 90% of the students were declared to have passed because they scored above 73. The number of students who did not pass, who scored below 73, was 3. The average score of the 30 students was 79.8. Based on these results, a Z-test for the difference of a single proportion was conducted for statistical analysis.

Wijayanto & Santoso (2018) stated that the Z test for the difference of a single proportion is conducted as follows:

1) Formulating the hypothesis
   H_0: $Z_{score} \leq Z_{table}$, (The number of students who achieve the minimum score for mathematical reasoning skills is not more than 75%)
   H_0: $Z_{score} > Z_{table}$, (The number of students who achieve the minimum score for mathematical reasoning skills is more than 75%.
2) Determining the level of significance, $\alpha = 0{,}05$
3) Determining the critical value, $Z_{score} > Z_{0,05} = 1{,}645$
4) Determining the test statistic, obtained $\frac{X}{N} = 90\% = 0{,}90$
   $$Z_{score} = \frac{0{,}90 - 0{,}75}{\sqrt{\frac{(0{,}75)(0{,}25)}{30}}} = \frac{0{,}15}{0{,}079} = 1{,}898$$
5) Decision criteria
   Because Z_{score}=1,898> $Z_{0,05} = 1{,}645$, H_0 is rejected, and it can be concluded that more than 75% of students achieved the minimum score for mathematical reasoning skills.

Based on the results of the mathematical reasoning ability test and the proportion test, the developed student worksheets are effective in terms of mathematical reasoning ability. The results of this study also support the findings of Diana and Fauzan (2018), who state that classical mastery can be considered effective if it is more than 75%. Based on the mathematical reasoning ability test results, it is declared effective because the classical mastery obtained is 90%.

4. Disseminate

The dissemination stage is conducted after the student worksheets based on local wisdom of Tanjungpinang, Riau Islands, using the RME approach, are deemed valid, practical, and effective. Dissemination is carried out by distributing the student worksheets product to schools that have contributed to this research.

The implications of this study indicate that using student worksheets based on local wisdom and applying the Realistic Mathematics Education approach has proven effective in facilitating students' mathematical reasoning abilities. Therefore, teachers are encouraged to integrate local wisdom into the development of teaching materials to create more relevant and engaging learning experiences for students.

IV. Conclusion

This study demonstrates that student worksheets developed based on local wisdom and the Realistic Mathematics Education (RME) approach effectively facilitate students' mathematical reasoning abilities. The worksheets utilize culturally relevant contexts from Tanjungpinang, such as Otak-otak and Batik Gonggong, to connect abstract mathematical concepts with real-world experiences. The validation and practicality tests showed satisfactory results, with an average validation score of 76.2% and practicality ratings meeting the practical criteria across various stages. Furthermore, effectiveness tests revealed a high mastery level, with 90% of students meeting the minimum competency standard, confirming the worksheets' ability to support the achievement of learning objectives.

These findings emphasize the importance of integrating local wisdom into teaching materials to create meaningful and engaging learning experiences. By aligning educational content with students' cultural backgrounds, the RME approach fosters a deeper understanding of mathematical concepts while developing active reasoning and problem solving skills. Teachers are encouraged to adopt contextually enriched materials like these to enhance their teaching practices and support students' development in mathematics.

References

Afriansyah, E. A. (2016). Makna realistic dalam RME dan PMRI. *Lemma : Letters of*

Mathematics Education, *2*(2), 96–104. https://core.ac.uk/download/pdf/229189196.pdf

Agustiani, S. (2019). Penerapan bahan ajar matematika berbasis RME terhadap kemampuan penalaran matematis siswa. *Jurnal PEKA (Pendidikan Matematika)*, *2*(2), 65–72.

Arsoetar, N., & Sugiman, S. (2019). Development of student worksheets based on Realistic mathematics education (RME) oriented to mathematical reasoning. *Journal of Physics: Conference Series*, *1397*(1), 1–9.

Atika, N., & MZ, Z. A. (2016). Pengembangan LKS berbasis pendekatan RME untuk menumbuh kembangkan kemampuan berpikir kritis matematis siswa. *Suska Journal of Mathematics Education*, *2*(2), 103–110. https://doi.org/10.24014/sjme.v2i2.2126

Chisara, C., Hakim, D. L., & Kartika, H. (2018). Implementasi pendekatan realistic mathematics education (RME) dalam pembelajaran matematika. *Prosiding Seminar Nasional Matematika Dan Pendidikan Matematika (Sesiomadika)*, 65–72. http://journal.unsika.ac.id/index.php/sesiomadika

Diana, F., & Fauzan, A. (2018). Pengembangan desain pembelajaran topik pola bilangan berbasis realistic mathematics education (RME) di kelas VIII SMP/MTs. *Jurnal Edukasi Dan Penelitian Matematika*, *7*(4), 43–52.

Dwirahayu, G., Sandri, M., & Kusniawati, D. (2020). Inquiry based RME terhadap kemampuan representasi matematik siswa. *Fibonaccii: Jurnal Pendidikan Matematika Dan Matematika*, *6*(1), 45–58.

Hayati, H. S., Astuti, P., & Febrian, F. (2022). Electronic student worksheets based on rigorous mathematical thinking for sequence and series materials in senior high school. *Jurnal Gantang*, *7*(2), 185–197. https://doi.org/10.31629/jg.v7i2.5331

Hutauruk, L. (2018). Kemampuan penalaran matematika siswa pada materi SPLDV dengan menggunakan budaya khas palembang yang berbasiskan taksonomi solo superitem siswa kelas IX. *Prosiding Seminar Nasional 21 Universitas Pgri Palembang*, 466–473.

Indar, H. (2019). Penerapan lembar kerja siswa (LKS) berbasis realistic mathematics education (RME) terhadap kemampuan penalaran matematis siswa. *Jurnal PEKA (Pendidikan Matematika)*, *2*(2), 27–33.

Indraningtias, D. A., & Wijaya, A. (2017). Pengembangan perangkat pembelajaran berbasis pendekatan matematika realistik materi bangun ruang sisi datar beorientasi pada kemampuan berpikir kritis siwa kelas VIII SMP. *Jurnal Pendidikan Matematika*, *6*(5), 24–36.

Irawan, A. (2014). Pengaruh kecerdasan numerik dan penguasaan konsep matematika terhadap kemampuan berpikir kritik matematika. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *4*(1), 46–55. https://doi.org/10.30998/formatif.v4i1.138

Kosasih, E. (2021). *Pengembangan bahan ajar*. Bumi Aksara.

Larsen, S. (2018). Didactical phenomenology: The engine that drives realistic mathematics education. *For the Learning of Mathematics*, *38*(3), 25–29.

Maarif, S., Setiarini, R. N., & Nurafni, N. (2020). Hambatan epistimologis siswa dalam menyelesaikan masalah sistem ersamaan linear dua variabel. *Jurnal Didaktik Matematika*, *7*(1), 72–89. https://doi.org/10.24815/jdm.v7i1.15234

Mandasari, N., & Kusnanto, R. A. B. (2023). Kevalidan modul ajar matematika berbasis seni visual geometri untuk mengingkatkan kemampuan penalaran matematis siswa sekolah dasar di Kabupaten Rejang Lebong. *Journal of Mathematics Science and Education*, *5*(2), 79–89.

Maryati, I. (2018). Peningkatan Kemampuan Penalaran Statistis Siswa Sekolah Menengah Pertama Melalui Pembelajaran Kontekstual. *Mosharafa: Jurnal Pendidikan Matematika*, *6*(1), 129–140.

Nabila, S., & Putri, R. I. I. (2022). Students' Mathematical Reasoning Skills On Number Pattern Using PMRI and Collaborative Learning Approach. *Jurnal Elemen*, *8*(1), 290–307. https://doi.org/10.29408/jel.v8i1.4733

Nuraida, E. M., Ilma, R., & Putri, I. (2020). The Context of Archipelago Traditional Cake to Explore Stud ents' Understanding in Integers Division Class VII. *Jurnal*

Pendidikan Matematika, *14*(1), 91–100.

OECD. (2023). *PISA 2022 Result (Volume I): The State of Learning and Equity in Education: Vol. I* (Issue 2). OECD Publishing. https://doi.org/10.1787/53f23881-en.

Paramita, B., Azzahra, F., & Vanesa, S. (2022). Otak-otak as a Local Traditional Food Product that is able to Increase the Income of Coastal Communities in the Riau Island. *Proceedings of the 2nd Maritime Continent Fulcrum International Conference, MaCiFIC 2022, September 28-October 1, 2022, Tanjungpinang, Indonesia*, 166.

Pesurnay, A. J. (2018). Local Wisdom in a New Paradigm: Applying System Theory to the Study of Local Culture in Indonesia. *IOP Conference Series: Earth and Environmental Science*, *175*(1), 1–8.

Prahmana, R. C. I., Arnal-Palacián, M., Risdiyanti, I., & Ramadhani, R. (2023). Trivium curriculum in Ethno-RME approach : An impactful insight from ethnomathematics and realistic mathematics education. *Jurnal Elemen*, *9*(1), 298–316.

Prasmi, J., Ibrahim, B., & Bunari, B. (2022). Perkembangan Motif Batik Gonggong Khas Kota Tanjungpinang (2010-2020). *Chronologia*, *4*(2), 83–89. https://doi.org/10.22236/jhe.v4i2.10118

Purnamasari, I., & Setiawan, W. (2019). Kemampuan Pemecahan Masalah Matematis Siswa SMP pada Materi SPLDV Ditinjau dari Kemampuan Awal Matematika (KAM). *Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang*, *3*(2), 207–215.

Ramadhona, R., Siregar, N. A. R., & Alpindo, O. (2023). The Practicality of Plane and Space Geometry Textbook as Teaching Materials in Mathematics Education Department of UMRAH. *Jurnal Gantang*, *8*(1), 65–73.

Risdiyanti, I., & Prahmana, R. C. I. (2020). The Learning Trajectory of Number Pattern Learning using Barathayudha War Stories and Uno Stacko. *Journal on Mathematics Education*, *11*(1), 157–166.

Rohman, S., Susanto, S., Hobri, H., Saiful, S., & Sahnawi, S. (2019). An Analysis of Students' Literacy Ability in Mathematics Teaching with Realistic Mathematics Education Based on Lesson Study for Learning Community. *Journal of Physics: Conference Series*, *1265*(1), 1–11.

Saleh, M., Prahmana, R. C. I., Isa, M., & Murni. (2018). Improving the Reasoning Ability of Elementary School Student Through the Indonesian Realistic Mathematics Education. *Journal on Mathematics Education*, *9*(1), 41–54. https://ejournal.unsri.ac.id/index.php/jme/article/view/5049

Sari, A., & Putri, R. I. I. (2021). Inductive Reasoning Ability of Students Using the Palembang Songket Fabric Context in Rotational Learning in Grade IX. *Jurnal Pendidikan Matematika*, *16*(1), 57–72. https://doi.org/10.22342/jpm.16.1.14304.57-72

Setiawati, F. A., Mardapi, D., & Azwar, S. (2013). Penskalaan Teori Klasik Instrumen Multipel Intelligences Tipe Thurstone dan Likert. *Jurnal Penelitian Dan Evaluasi Pendidikan*, *17*(2),259–274. https://doi.org/10.21831/pep.v17i2.1699

Sofyana, U. M., & Kusuma, A. B. (2018). Upaya Meningkatkan Kemampuan Penalaran Matematis Siswa Menggunakan Pembelajaran Generative pada Kelas VII SMP Muhammadiyah Kaliwiro. *Kontinu: Jurnal Penelitian Didaktik Matematika*, *2*(2),11–23. https://doi.org/10.30659/kontinu.2.1.14-29

Suanto, E., Hutapea, N. M., & Khainingsih, F. G. (2023). *Pengembangan Elektronik Materi Perbandingan Berkonteks Budaya*. Wawasan Ilmu.

Suastra, I. W., Jatmiko, B., Ristiati, N. P., & Yasmini, L. P. B. (2017). Developing Characters Based on Local Wisdom of Bali in Teaching Physics in Senior High School. *Jurnal Pendidikan IPA Indonesia*, *6*(2), 306–312. https://doi.org/10.15294/jpii.v6i2.10681

Sugiyono. (2015). Metode penelitian pendidikan. In *Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, dan R&D)*. Alfabeta.

Sumartini, T. S. (2015). Peningkatan kemampuan penalaran matematis siswa melalui pembelajaran berbasis masalah. *Jurnal Pendidikan Mosharafa*, *5*(1), 1–10.

Tanujaya, B., Prahmana, R. C. I., & Mumu, J. (2017). Mathematics instruction, problems, challenges and opportunities : a case study in Manokwari Regency, Indonesia. *World Transactions on Engineering and Technology Education*, *15*(3), 287–291.

Tatiriah, Cahyono, E., & Kadir. (2016). Peningkatan Kemampuan Penalaran Matematik dan Self Efficacy Siswa SMA melalui Penerapan Pendekatan Problem Posing. *Jurnal Pendidikan Matematika*, *8*(2), 129–139.

Triawan, E., & Zanthy, L. S. (2019). Peningkatan Kemampuan Penalaran Matematika Siswa SMK Kelas X Melalui Pendekatan Realistic Mathematics Education (RME). *Journal On Education*, *1*(3), 507–514.

Umaroh, U., Novaliyosi, N., & Setiani, Y. (2022). Pengembangan Lembar Kerja Peserta Didik Elektronik (E-LKPD) Berbasis Problem Based Learning (PBL) untuk Memfasilitasi Kemampuan Penalaran Peserta Didik pada Materi Lingkaran. *Wilangan: Jurnal Inovasi Dan Riset Pendidikan Matematika*, *3*(1), 61–70. https://doi.org/10.56704/jirpm.v3i1.13368

Webb, D., & Abels, M. (2011). *Restrictions in algebra. In P. Drijvers (Ed.), Secondary Algebra Education: Revisiting Topics and Themes and Exploring the Unknown*. SensePublishers.

Webb, D. C., Boswinkel, N., & Dekker, T. (2008). Beneath the Tip of the Iceberg: Using representation to support student understanding. *Mathematics Teaching in the Middle School*, *14*(2), 110–113.

Wijayanto, R., & Santoso, R. H. (2018). Pengembangan Bahan Ajar Matematika Dengan Pendekatan Problem Solving Berorientasi Pada Kemampuan Pemecahan Masalah. *Jurnal Pedagogi Pendidikan Matematika*, *7*(3), 95–104.

Yanti, F., Nurva, M. S., & Fikriani, T. (2022). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Realistic Mathematic Education (RME) Untuk Meningkatkan Kemampuan Penalaran Matematis Peserta Didik. *Edukatif : Jurnal Ilmu Pendidikan*, *4*(2),1743–1751. https://doi.org/10.31004/edukatif.v4i2.2132

Zulkardi, Z., & Putri, R. I. I. (2010). Developmentof a support blog to help Indonesian mathematics students and teachers learn Indonesian Realistic Mathematics Education (PMRI). *Journal of Educational Engineering and Innovation Research*, *2*(1), 1–24.