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DEVELOPMENT OF A PROBLEM-BASED LEARNING TEACHING MODULE TO FACILITATE STUDENTS' MATHEMATICAL COMMUNICATION ABILITY

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ABSTRACT Mathematical communication ability is one of the important abilities in mathematics learning because it enables students to express mathematical ideas, represent contextual problems into mathematical models, use appropriate mathematical symbols, and write conclusions from problem-solving. However, students' mathematical communication ability remains relatively low, especially in solving contextual problems related to statistics. This study aimed to develop a Problem-Based Learning teaching module on measures of central tendency and data dispersion that is valid and practical for facilitating students' mathematical communication ability. This research used a Research and Development approach with the 4D model, consisting of define, design, develop, and disseminate stages. The teaching module and its supplementary student worksheets were validated by three experts and evaluated through one-on-one evaluation, small group trial, and large group trial at SMP Negeri 3 Mandau. The validation results showed that the teaching module obtained an average score of 3.65 and was categorized as very valid, while the student worksheets obtained an average score of 3.61 and were also categorized as very valid. The practicality results showed that the student worksheets obtained an average score of 3.52 in the small group trial and 3.53 in the large group trial, both categorized as very practical. These findings indicate that the developed teaching module meets the criteria of validity and practicality and can be used as a learning resource to facilitate students' mathematical communication ability.

Keywords: mathematical communication ability, teaching module, measures of central tendency and data dispersion, problem-based learning

ABSTRAK Kemampuan komunikasi matematis merupakan salah satu kemampuan penting dalam pembelajaran matematika karena memungkinkan siswa mengungkapkan ide matematika, merepresentasikan masalah kontekstual ke dalam model matematika, menggunakan simbol matematika yang tepat, dan menuliskan kesimpulan dari penyelesaian masalah. Namun, kemampuan komunikasi matematis siswa masih relatif rendah, terutama dalam menyelesaikan masalah kontekstual yang berkaitan dengan statistika. Penelitian ini bertujuan untuk mengembangkan modul ajar berbasis Problem-Based Learning pada materi ukuran pemusatan dan penyebaran data yang valid dan praktis untuk memfasilitasi kemampuan komunikasi matematis siswa. Penelitian ini menggunakan pendekatan

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Research and Development dengan model 4D yang terdiri atas tahap define, design, develop, dan disseminate. Modul ajar beserta lampiran berupa lembar kerja peserta didik divalidasi oleh tiga orang ahli dan dievaluasi melalui one-on-one evaluation, uji coba kelompok kecil, dan uji coba kelompok besar di SMP Negeri 3 Mandau. Hasil validasi menunjukkan bahwa modul ajar memperoleh skor rata-rata 3,65 dengan kategori sangat valid, sedangkan lembar kerja peserta didik memperoleh skor rata-rata 3,61 dengan kategori sangat valid. Hasil praktikalitas menunjukkan bahwa lembar kerja peserta didik memperoleh skor rata-rata 3,52 pada uji coba kelompok kecil dan 3,53 pada uji coba kelompok besar, keduanya berada pada kategori sangat praktis. Temuan ini menunjukkan bahwa modul ajar yang dikembangkan telah memenuhi kriteria validitas dan praktikalitas serta dapat digunakan sebagai sumber belajar untuk memfasilitasi kemampuan komunikasi matematis siswa.

Kata-kata kunci: kemampuan komunikasi matematis, modul ajar, ukuran pemusatan dan penyebaran data, problem-based learning

INTRODUCTION

Mathematical communication ability is a very important ability for students to have in learning mathematics. The National Council of Teachers of Mathematics states that communication is a crucial aspect of mathematics learning because it allows students to construct and express their mathematical ideas clearly (Kisma & Sutirna, 2019). This is in line with the Decree of the Head of BSKAP No. 032 of 2024, which emphasizes that one of the learning objectives in mathematics is students' ability to convey ideas through symbols, tables, diagrams, and other media to explain a problem. Therefore, mathematical communication ability needs to be improved in mathematics learning at schools.

According to Baroody (Sholihin et al., 2024), there are two important reasons why communication in mathematics learning needs to be developed. First, mathematics functions as a language, meaning that communication serves as a tool to express ideas clearly, correctly, and precisely. Second, mathematics functions as a form of social interaction, meaning that there is interaction between students and their peers or with teachers through discussion processes to understand the mathematical concepts being studied. Mathematical communication plays a crucial role in mathematics learning because it helps students connect ideas with mathematical symbols, exchange ideas, and discuss mathematical concepts, so that students' understanding and learning outcomes can be improved (Astuti & Leonard, 2020). Therefore, it is important to train and improve students' mathematical communication ability so that they are able to organize and convey mathematical ideas in a structured and understandable manner.

However, various studies show that students' mathematical communication ability in Indonesia is still relatively low. Based on the 2022 Programme for International Student Assessment data, Indonesia ranked 70th out of 81 countries, with a mathematics score of 366 (OECD, 2023). This score is far below the OECD average of 472. According to Wardhani and Rumiati (in Ananda & Khabibah, 2021), one aspect of the Programme for International Student Assessment is mathematical communication ability, particularly the ability to present problem-solving steps using mathematical models to understand and clarify problems. Referring to these results, students' mathematical communication ability in Indonesia can be considered unsatisfactory. Previous studies also revealed that students' mathematical communication ability in Indonesia remains at a low proficiency level (Niasih et al., 2019; Hidayati et al., 2025; Sanda et al., 2024).

Based on interviews with the mathematics teacher at SMPN 3 Mandau, students faced difficulties in solving contextual problems that required systematic step-by-step solution strategies. Students had difficulty transforming everyday life problems into mathematical models using appropriate symbols and often did not include conclusions from the results obtained. The learning process involved students listening to the teacher's explanation and discussing problems together in class, after which students were given exercises from the publisher's textbook. This process indicates that learning was still teacher-centered. Learning resources were limited to textbooks and worksheets from publishers, without student worksheets created by teachers themselves. Furthermore, there was no available teaching module that specifically supported students' mathematical communication ability, so this ability had not been optimally facilitated in the learning process. Hendriana (2018) also explained that students' low mathematical communication ability is caused by learning activities that require students to listen more to the teacher's explanation, making students tend to memorize formulas and example questions without understanding the concepts. In fact, learning that is centered on the teacher tends to make students passive during learning activities (Putri & Sundayana, 2021).

One effort to develop students' mathematical communication ability is to improve the design of learning activities by placing students at the center of learning and encouraging them to actively communicate mathematical ideas both orally and in writing. The success of the learning process and the achievement of learning objectives depend heavily on the teaching tools used by teachers (Yuliani et al., 2022). Therefore, teachers need to prepare teaching tools in the form of teaching modules that can facilitate students' mathematical communication ability. According to Yuanita et al. (2025), teaching materials that contain learning objectives, a series of learning activities, assessments, and learning resources are called teaching modules. Teaching modules are useful for teachers as guides in implementing student-centered learning activities that are structured based on the flow of learning objectives in the Merdeka Curriculum (Indrasari et al., 2023).

In developing teaching modules to facilitate students' mathematical communication ability, a learning model that actively engages students is needed. Problem-Based Learning is an appropriate choice because students learn to solve real-life problems by clearly expressing mathematical ideas through group discussions. Madhavia et al. (2020) stated that Problem-Based Learning improves mathematical communication

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ability through active participation in the presentation of contextual problems, such as explaining ideas, discussing, developing appropriate solution steps, and presenting discussion results. In addition, the Problem-Based Learning model can develop students' mathematical communication ability through group discussions that provide opportunities for students to express, share, and explain mathematical ideas (Sanda et al., 2024). According to Kurniati et al. (2019), Problem-Based Learning also trains students to design mathematical models from contextual problems and transform ideas into mathematical symbols. Therefore, Problem-Based Learning has a positive impact on students' mathematical communication ability.

The development of Problem-Based Learning-based teaching modules requires content that supports mathematical communication ability. One type of content related to contextual issues is statistics, specifically measures of central tendency and data dispersion. Statistics content trains students to present, process, and communicate data analysis through mathematical explanations using symbols, tables, or diagrams (Niasih et al., 2019). In line with the Decree of the Head of BSKAP No. 032 of 2024, one of the objectives of mathematics learning is that students can communicate ideas through tables, diagrams, symbols, or other media to clarify a problem. Thus, this content can be used to facilitate mathematical communication ability because it includes activities to present data in tabular form and calculate the mean, median, mode, and quartile using appropriate mathematical symbols. Based on the explanation above, this research focuses on developing a Problem-Based Learning-based teaching module on measures of central tendency and data dispersion that meets valid and practical criteria for facilitating students' mathematical communication ability.

METHODS

This research was development research, also known as Research and Development. The model used in product development was the 4D model formulated by Thiagarajan et al. (1974), which consists of four stages: define, design, develop, and disseminate. The define stage included several activities, namely initial-final analysis, student analysis, concept analysis, task analysis, and formulation of learning objectives. The design stage produced an initial prototype as the first representation of the product being developed. This stage included preparing criterion-referenced tests, selecting media, selecting formats, and preparing the initial prototype of the product. In the develop stage, the researchers carried out a series of activities to produce a valid and practical teaching module through a formative evaluation process adapted from Tessmer (1993), consisting of expert validation, one-on-one evaluation, small group trial, and large group trial. The disseminate stage included packaging and distributing the developed product, namely a Problem-Based Learning-based teaching module designed to facilitate students' mathematical communication ability.

The validation and practicality instruments used a Likert scale adapted from Sugiyono (2019). The validation instrument contained three assessment aspects: format, content, and language. The teaching module was validated by three experts, consisting of two mathematics education lecturers and one mathematics teacher with a master's degree. The validators were a lecturer from STKIP PGRI Jombang, a lecturer from UIN Suska Riau, and a Guru Penggerak from SMAN 12 Pekanbaru. They completed the validation questionnaire and provided suggestions for improving the draft of the teaching module and student worksheets. The practicality instrument was completed by students during the small group and large group trials.

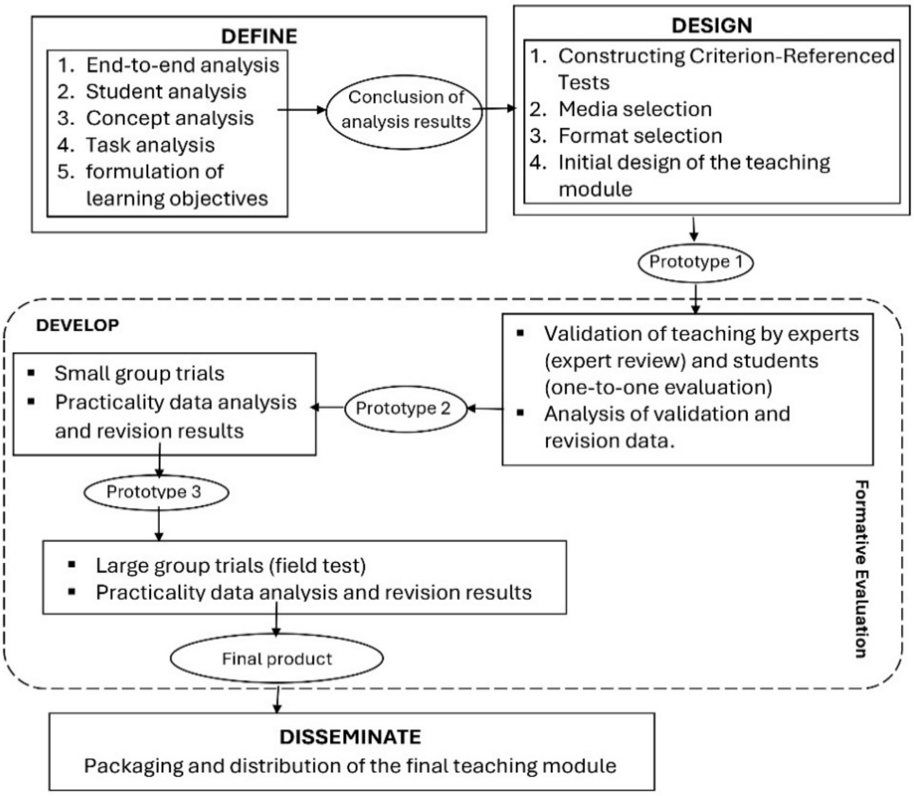

Figure 1. Teaching Module Development Procedure Chart

The research subjects were eighth-grade students at SMP Negeri 3 Mandau with heterogeneous ability levels. The data collection techniques used in this study were interviews and the distribution of research instruments. The instruments consisted of validation sheets addressed to expert validators and practicality sheets addressed to students. The research data were divided into two types. Qualitative data were obtained from comments, criticisms, and suggestions from validators and students regarding the teaching module and student worksheets. Quantitative data were obtained from the scores given by validators on the validation sheets and from student response questionnaires regarding the practicality of the teaching module and student worksheets.

The validity of the teaching module was analyzed using the formula adapted from Sudijono (2016) as follows.

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$$\bar{V}_a = \frac{\sum_{i=1}^{n} \bar{M}_i}{n}$$

The symbol $\bar{V}_a$ indicates the average total validation score, $\bar{M}_i$ indicates the average validation score from the i-th validator, and n indicates the number of validators. Based on the average validator assessment, the validity criteria for the teaching module are presented in Table 1.

Table 1. Validity Criteria for Teaching Modules

Interval	Validity Category
$3.25 \leq \bar{V}_a \leq 4.00$	Very valid/can be used without revision
$2.50 \leq \bar{V}_a < 3.25$	Valid/can be used with minor revision
$1.75 \leq \bar{V}_a < 2.50$	Less valid/should not be used because major revision is needed
$1.00 \leq \bar{V}_a < 1.75$	Invalid/should not be used

Source: Sudijono (2016)

A teaching module is considered valid if the validity score reaches a minimum of 2.50 or is categorized as valid, so that it can be tested on students.

The practicality of the teaching module was analyzed using the formula adapted from Sudijono (2016) as follows.

$$\bar{T}_P = \frac{\sum_{i=1}^{n} \bar{P}_i}{n}$$

The symbol $\bar{T}_P$ indicates the average total student response, $\bar{P}_i$ indicates the average response of the i-th student, while n indicates the number of students. Based on the total average results, the next step is to determine the practicality criteria for the teaching module which are shown in Table 2.

Table 2. Practicality Criteria for Teaching Modules

Interval	Practicality Category
$3.25 \leq \bar{P} \leq 4.00$	Very practical
$2.50 \leq \bar{P} < 3.25$	Practical
$1.75 \leq \bar{P} < 2.50$	Less practical
$1.00 \leq \bar{P} < 1.75$	Impractical

Source: Sudijono (2016)

The student worksheets, as attachments to the teaching module, are considered practical if the practicality score reaches a minimum of 2.50 or is categorized as practical, so that they can be used in classroom learning activities to facilitate students' mathematical communication ability.

FINDING AND DISCUSSION

This study produced a Problem-Based Learning-based teaching module on measures of central tendency and data dispersion to facilitate students' mathematical communication ability. The developed product met the criteria of validity and practicality. The development of the teaching module used the 4D model, with detailed stages described as follows.

Define

The initial activity of the define stage was initial-final analysis, which aimed to determine the basic problems that required the development of a teaching module to facilitate students' mathematical communication ability. Based on literature reviews and interviews, it was found that students' mathematical communication ability was still in the low category. The research results of Niasih et al. (2019) and Sanda et al. (2024) revealed that students' mathematical communication ability remained low. Based on interviews with mathematics teachers at a junior high school in Mandau District, it was found that students had difficulty expressing contextual problems into mathematical models and using mathematical symbols accurately. Most students failed to include conclusions from their calculations and only focused on numerical answers without interpreting the results in the context of the problem. The learning resources used were printed textbooks and student worksheets from publishers. Furthermore, there were no available teaching modules specifically designed to facilitate students' mathematical communication ability.

Based on these problems, the necessary solution was to design learning activities that could train students' mathematical communication ability. These learning activities were designed in the form of teaching modules, requiring the implementation of a learning model that supports mathematical communication ability. One suitable learning model for this purpose is Problem-Based Learning. This is in line with Madhavia et al. (2020) and Kurniati et al. (2019), who stated that the Problem-Based Learning model can help students become active and effective in developing their mathematical communication ability.

The second activity was student analysis to determine the characteristics of students. The students were in the age range of 13 to 14 years. At this age, students are in the formal operational stage according to Piaget (in Ibda, 2015), so they are able to perform mathematical calculations, think abstractly, reason logically, and draw conclusions. Emotionally, however, they are still unstable, so their learning motivation often changes and causes difficulties in learning. The interviews and observations showed that students were less active in mathematics learning because they tended to view mathematics as very complicated.

The third activity was concept analysis. The concept was structured based on the learning outcomes outlined in the Decree of the Head of BSKAP No. 32 of 2024. The concept map for measures of central tendency and data dispersion was developed based on the student textbook and teacher guidebook in the revised 2022 Merdeka Curriculum and was divided into four meetings. The fourth activity was task analysis, which detailed student tasks during the learning process. The content in each meeting sequentially discussed the mean of single data, median and mode of single data, quartiles of single data, and quartile range and quartile deviation of single data. The fifth activity was formulating learning objectives. The researchers developed a flow of learning objectives for each learning session.

Design

The design stage was the phase of creating the initial prototype of the teaching module. This stage began with the preparation of validation sheets and practicality sheets as instruments to assess the module's validity and practicality. The assessment aspects on the validation sheet included format, content, and language. The assessment aspects on the practicality sheet included the appearance of the student worksheet, the content of the student worksheet, and the ease of use of the student worksheet. The second activity involved selecting the media for developing the teaching module. The media used were A4-sized printed media, created using Microsoft Office Word 2021. The third activity was selecting the teaching module format, which was adjusted in accordance with the 2022 Guidelines on Learning and Assessment by Kemendikbudristek. The module format consisted of three main components: general information, core components, and appendices. The teaching module included appendices in the form of student worksheets containing learning activities with Problem-Based Learning steps to facilitate students' mathematical communication ability. At the end of this stage, the initial design of the teaching module was prepared based on the media and format that had been determined, resulting in Prototype 1.

This module was designed by integrating the syntax of Problem-Based Learning to facilitate indicators of mathematical communication ability. In the problem orientation stage, students were introduced to contextual problems, which were then followed up in the organization stage by writing down the known information and what was being asked. This activity represented the indicator of expressing problems into specific written mathematical ideas. In the guiding investigation stage, students were encouraged to communicate their understanding by transforming everyday events into mathematical models, such as presenting them in table form and using appropriate mathematical symbols. Next, in the development and presentation of work results stage, students communicated their thought processes by writing logical conclusions as part of the indicator of drawing conclusions from problem-solving. Finally, in the analysis and evaluation stage, teachers and students reviewed discussion results to ensure that mathematical ideas were communicated effectively. Thus, this module design not only applied the learning model theoretically but also concretely facilitated each indicator of mathematical communication ability in a structured and measurable manner.

Figure 2. Initial Design of the Cover Page of the Teaching Module and Student Worksheet

Develop

The development stage included expert review activities, one-on-one evaluation, small group trial, and large group trial. The initial activity carried out by the researchers was the validation of the teaching module and its appendices, in the form of student worksheets, by three validators. The validation assessment covered three aspects: format, content, and language. The validation results were then analyzed and revised according to the validators' suggestions. Table 3 displays a summary of the results of the teaching module validation assessment.

Table 3. Teaching Module Validation Assessment Recap

Assessment Aspects	Average from Validators				Average	Criteria
	1	2	3	4		
Format	3.73	3.73	3.71	3.69	3.72	Very Valid
Content	3.63	3.59	3.52	3.52	3.57	Very Valid
Language	3.67	3.67	3.67	3.67	3.67	Very Valid
Average	**3.67**	**3.66**	**3.63**	**3.63**	**3.65**	**Very Valid**

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The overall validation assessment of the teaching module, covering the aspects of format, content, and language, obtained an average score of 3.65, with the criterion of "very valid". Table 4 displays a summary of the student worksheet validation assessment.

Table 4. Student Worksheet Validation Assessment Recap

Assessment Aspects	Average from Validators				Average	Criteria
	1	2	3	4		
Format	3.87	3.87	3.77	3.80	3.83	Very Valid
Content	3.63	3.60	3.50	3.58	3.58	Very Valid
Language	3.50	3.50	3.33	3.33	3.42	Very Valid
Average	**3.67**	**3.66**	**3.53**	**3.57**	**3.61**	**Very Valid**

The student worksheet validation assessment, covering the aspects of format, content, and language, obtained an average score of 3.61, with the criterion of "very valid". Based on the validation results provided by the validators, it was concluded that the teaching module on measures of central tendency and data dispersion was suitable for trial with students. The product was declared suitable for testing after meeting the valid criterion, but improvements were still made according to the suggestions and comments provided by the validators to obtain a better version of the teaching module (Heleni et al., 2022).

In line with the validation process, the researchers also conducted a one-on-one evaluation involving three students of SMP Negeri 3 Mandau as product users to assess the readability of the student worksheets as attachments to the teaching module. The results of the one-on-one evaluation showed that students provided comments regarding writing errors in the student worksheets. This feedback served as a reference for the researchers in refining the student worksheets to make them more suitable for use in learning activities.

After the teaching module had undergone validation and one-on-one evaluation, it was revised based on suggestions and comments from the validators and students. The researchers corrected spelling errors in English in the module description, which should have been italicized. In the assessment section, the validator suggested correcting the school name because it was out of context and unfamiliar to students. Furthermore, the validator recommended adding narratives to the questions to provide more complete and clear information. Regarding the student worksheet cover, the validator suggested replacing the image on the cover with a picture of public school students. In the "Let's Collect Information" section, which contains steps for presenting data in a table, the validator suggested adding an initial step, namely sorting the data from the smallest to the largest. Although revisions were made, the revised results are not displayed in this article.

The teaching module resulting from improvements in the validation and one-on-one evaluation process was called Prototype 2. Next, a small group trial was conducted at SMP Negeri 3 Mandau with six students. The practicality questionnaire was given to students to complete after they had worked on the student worksheets. The student response questionnaire covered three assessment aspects: the appearance of the student worksheet, the content of the student worksheet, and the ease of use of the student worksheet. Table 5 displays a summary of the results of the small group trial assessment.

Table 5. Summary of the Small Group Trial Assessment

Assessment Aspects	Average from Validators				Average	Criteria
	1	2	3	4		
Student Worksheet Appearance	3.54	3.54	3.46	3.58	3.53	Very Practical
Content of the Student Worksheet	3.56	3.52	3.44	3.48	3.50	Very Practical
Ease of Using the Student Worksheet	3.72	3.56	3.44	3.39	3.53	Very Practical
Average	**3.61**	**3.54**	**3.45**	**3.48**	**3.52**	**Very Practical**

The practicality assessment of the student worksheet in the small group trial yielded an average score of 3.52, categorized as "very practical". The average score for the appearance aspect of the student worksheet was 3.53, indicating that its design was very practical, with an attractive color combination, clear images, readable font type and size, and sufficient space for writing answers. However, some students suggested enlarging the answer columns, so the researchers revised the student worksheet.

The content aspect of the student worksheet obtained an average score of 3.50, indicating that the content was very practical. The problems presented in the student worksheet were related to everyday life and encouraged students to discuss. In addition, the student worksheet activities were able to facilitate students' mathematical communication ability. The ease-of-use aspect obtained an average score of 3.53, indicating that the student worksheet was very practical. This was reflected in the clear instructions and easy-to-understand language, which helped students work on the worksheets. After improvements were made based on students' suggestions and comments, the product was then tested in the large group trial.

The large group trial was conducted at SMP Negeri 3 Mandau with 31 students. Table 6 presents a summary of the assessment results from the large group trial.

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Table 6. Summary of the Large Group Trial Assessment

Assessment Aspects	Average from Validators				Average	Criteria
	1	2	3	4		
Student Worksheet Appearance	3.62	3.63	3.56	3.56	3.59	Very Practical
Content of the Student Worksheet	3.57	3.57	3.40	3.44	3.50	Very Practical
Ease of Using the Student Worksheet	3.63	3.61	3.42	3.45	3.53	Very Practical
Average	**3.60**	**3.59**	**3.45**	**3.48**	**3.53**	**Very Practical**

The practicality assessment of the student worksheet in the large group trial showed that it achieved the "very practical" criterion, with an average score of 3.53. For the appearance aspect, the student worksheet received an average score of 3.59, indicating that its design was very practical, with appropriate colors, clear images, and readable text. For the content aspect, the average score was 3.50, indicating that the content was very practical, with problems that were easy to understand and relevant to real-life situations. In addition, students were able to solve the problems presented in the student worksheet. For the ease-of-use aspect, the student worksheet received an average score of 3.53, meaning that it was very practical, with clear instructions and understandable language.

Based on the analysis of the validation results and the evaluations from both small group and large group trials, it can be concluded that the module developed by the researchers satisfied the standards of validity and practicality. This finding corresponds with the view of Nuraini et al. (2020), who stated that a learning tool is considered high-quality if it meets the criteria of validity and practicality. These findings indicate that the Problem-Based Learning-based teaching module met the valid and practical criteria, so it can be used to facilitate students' mathematical communication ability. The Problem-Based Learning model encourages students to communicate their mathematical ideas through group discussions and supports the indicators of mathematical communication ability, namely the ability to express problems into written mathematical ideas, transform everyday events into mathematical models, present mathematical ideas using mathematical symbols in solving problems, and write conclusions in problem-solving.

These findings indicate that students' mathematical communication ability can be facilitated through the implementation of Problem-Based Learning in learning activities. These results support the findings of Fitriah et al. (2023), Mirna et al. (2023), Ermida et al. (2024), and Rahman and Fauzia (2020), which state that the Problem-Based Learning model can improve students' mathematical communication ability. Thus, the Problem-Based Learning-based teaching module on measures of central tendency and data dispersion is able to facilitate students' mathematical communication ability because it meets valid and practical requirements, making it suitable for implementation in learning activities.

The advantage of this research is the availability of a teaching module designed to facilitate students' mathematical communication ability. In addition to the teaching module, there are also appendices in the form of student worksheets as learning resources for students to practice mathematical communication. However, despite its strengths, this study also has a limitation: it did not conduct an effectiveness test due to the researchers' limited time in developing the teaching module. Therefore, the teaching module in this study still requires further study regarding its effectiveness.

Disseminate

The developed product is a Problem-Based Learning-based teaching module on measures of central tendency and data dispersion to facilitate students' mathematical communication ability. The product was packaged in printed book format. The researchers then submitted the teaching module to the school where the research was conducted. The researchers hope that the teaching module can be used in learning activities and serve as a reference for teachers in independently preparing teaching modules.

CONCLUSIONS AND RECOMMENDATIONS

The product developed in this research is a Problem-Based Learning-based teaching module on measures of central tendency and data dispersion designed to facilitate students' mathematical communication ability. The teaching module was developed through the 4D development procedure, consisting of define, design, develop, and disseminate stages. Based on the expert validation results, the teaching module obtained an average score of 3.65 and was categorized as very valid, while the student worksheet as an attachment to the teaching module obtained an average score of 3.61 and was also categorized as very valid. The practicality test showed that the student worksheet obtained an average score of 3.52 in the small group trial and 3.53 in the large group trial, both of which were categorized as very practical. These results indicate that the developed teaching module meets the criteria of validity and practicality and can be used as a learning resource to facilitate students' mathematical communication ability.

Based on these findings, mathematics teachers may use the developed teaching module as an alternative learning resource, especially in teaching measures of central tendency and data dispersion through contextual problems and group discussion activities. The student worksheets attached to the module can also be used to guide students in expressing mathematical ideas, transforming contextual problems into mathematical models, using mathematical symbols, and writing

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conclusions. Since this study was limited to validity and practicality testing, further research is recommended to examine the effectiveness of the teaching module in improving students' mathematical communication ability through broader implementation and appropriate effectiveness testing.

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