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A Contextual Approach-Based Teaching Module to Facilitate Students' Mathematical Communication Skills on the Topic of Straight Line Equations

Sri Yuliani, Maimunah* and Kartini

Mathematics Education Study Program, University of Riau, Pekanbaru, Indonesia
**E-mail:* maimunah@lecturer.unri.ac.id

Abstract. Mathematical communication skills are essential for students because they help convey their mathematical ideas through language, notation, symbols, or images. This study aims to develop a teaching module based on a valid, practical contextual approach to facilitate the development of mathematical communication skills among phase-D students. The research conducted was Research and Development (R&D) using a 4D model consisting of the define, design, develop, and disseminate stages. The development research instruments consisted of a validation sheet and a practicality questionnaire. The validation results stated that the teaching module was classified as very valid. Meanwhile, the results of the practicality test among 30 students were very practical. Thus, the teaching module, designed with a contextual approach, met the validity and practicality criteria and can be applied in the teaching and learning process to support students in understanding mathematical concepts through relevant examples from everyday life and in communicating mathematical ideas meaningfully.

Keywords: contextual approach; mathematical communication skills; straight line equation; teaching module

Abstrak. Kecakapan komunikasi matematis merupakan kecakapan yang perlu dikuasai oleh siswa, karena kecakapan komunikasi mempermudah siswa untuk menyampaikan ide matematikanya melalui Bahasa, notasi, simbol atau gambar. Penelitian ini bertujuan untuk mengembangkan modul ajar berbasis pendekatan kontekstual yang valid dan praktis untuk memfasilitasi kecakapan komunikasi matematis siswa fase-D. Penelitian yang dilakukan yaitu *Research and Development* (R&D) menggunakan model 4D yang terdiri dari tahap *define, design, develop,* dan *disseminate*. Instrumen penelitian pengembangan ini berupa lembar validasi dan angket praktikalitas. Hasil validasi menyatakan bahwa modul ajar tergolong sangat valid. Sedangkan hasil uji kepraktisan terhadap 30 siswa memperoleh kategori sangat praktis. Dengan demikian, modul ajar yang dirancang dengan pendekatan kontekstual terbukti memenuhi kategori valid dan praktis, serta dapat diterapkan dalam proses belajar mengajar yang bisa mendukung siswa memahami konsep matematika melalui contoh yang relevan dari kehidupan sehari-hari dan mendukung siswa untuk mengomunikasikan ide-ide matematis secara bermakna.

Kata kunci: kemampuan komunikasi matematis; modul ajar; pendekatan kontekstual; persamaan garis lurus

INTRODUCTION

In mathematics learning, several abilities are considered, including mathematical communication skills. According to Nurhasanah et al. (2019) many symbols and images are used to facilitate problem-solving, suggesting that this is related to written mathematical communication. Therefore, mastery of mathematical communication skills is also crucial for students. Communication skills will help students understand concepts and solve the given mathematical problems. Students' mathematical communication skills are crucial and affect classroom learning,

as they are asked to express their ideas using language, notation, and symbols. This allows students to understand, illustrate relationships, and solve contextual problems using mathematical models, both orally and in writing, so that mathematical communication skills become an indicator of the extent to which students' understanding is achieved (Lubis et al., 2023).

However, in reality, students' ability in mathematical communication is categorized as low. This problem can be seen from the assessment of the mathematical communication ability test conducted by Lestari & Utami (2023) at SMP Negeri 1 Surakarta, where several problems occurred, namely: 1) Students have difficulty reading problems in the form of tables or graphs, so that students have not been able to present the questions given in the form of graphs or tables; 2) Students have difficulty in explaining mathematical models; 3) Students experience difficulties when given story problems in everyday situations. In addition, according to Putri et al., (2020), the level of students' ability in mathematical communication is still categorized as low in line with the results of their observations at SMP 26 Padang, which showed that many students experienced difficulties in linking learning materials at school with their applications, and students were less able to communicate them.

In addition to students' low mathematical communication skills, linear equations are also difficult for them to understand. This is based on an interview conducted by the author with a Mathematics teacher at SMP Negeri 1 Pangean, who stated that students still poorly understand linear equations. Students still do not understand the properties of linear equations and have difficulty in modeling story problems into mathematical forms. In addition, the results of an interview by Utami & Fitri (2023) with a mathematics teacher at MTs An Najah Pekanbaru indicated that students' abilities in mathematical communication are not optimal, especially in Cartesian coordinates, a prerequisite for linear equations. In this material, students still have difficulty conveying their ideas or concepts and have not been able to present the results obtained in a clear, orderly manner, resulting in a less-than-optimal, inefficient learning process. According to research by Maulani et al. (2025) A study conducted at a junior high school in Tasikmalaya identified three main difficulties for students in understanding and solving linear equations. First, students struggled to accurately represent graphs. Second, students were unable to communicate mathematical explanations coherently and meaningfully. Third, many students failed to construct mathematical models from contextual problems, instead directly performing calculations without an appropriate symbolic representation, indicating weaknesses in mathematical modeling.

The problem of students' poor mathematical communication skills requires learning strategies that present real-world contexts to facilitate understanding and the application of concepts. According to Ananda, Khaeriyah & Firmansyah (2025), one of the relevant methods that can improve students' mathematical communication skills is through the contextual teaching and learning (CTL) approach, because CTL focuses on the relationship between teaching materials and students' daily activities, so that the learning process becomes easy to understand and applicable. In general, contextual learning emphasizes learning through concrete problems related to students' daily lives Antari et al., (2022). In addition, students' mathematical communication skills can be improved through a contextual approach because according to Sari & Yuniati (2018) a contextual approach can make students have self-confidence, mutual respect, and teamwork because in it students must work together in groups, and a contextual approach supports students to learn meaningfully, through the development of models, ideas, and images that are relevant to daily activities in solving mathematical problems. Based on research conducted by Ratnasari & Saefudin (2018) at SMP Negeri 3 Kasihan and research by Setiadi (2023) at a high school in Sukabumi, the results showed that the contextual approach or CTL was able to provide an influence on improving students' mathematical communication skills in the learning process compared to using conventional learning.

The application of a contextual approach in learning can be realized with the existence of learning tools such as teaching modules, because according to Fatkurochman et al. (2024) , modules based on a contextual approach can strengthen the connection between abstract concepts and real-

world situations, so that modules play an important role in the success of the application of a contextual approach. According to Rahimah (2022) a teaching module is the realization of Learning Outcomes (CP) in the form of a Learning Objective Flow (ATP) with the main focus being the profile of Pancasila students, and is designed according to the stages of student growth in accordance with the learning objectives to be studied and oriented towards long-term development. According to Vedianty & Arif (2023), a teaching module is a significant departure from the RPP, created to facilitate and direct teachers' learning. The results of Putri's research, et al. (2020) , stated that the existence of a context-based lesson plan (RPP) and student worksheet (LKPD) has been proven to meet the criteria for effectiveness as a mathematics learning tool, enabling students to understand the material in depth and improving their mathematical communication skills.

Based on the identified problems and the potential of the contextual approach, this study aims to develop a contextual-based teaching module on linear equations to facilitate valid and practical mathematical communication skills among phase D students.

METHOD

This research is a Research and Development (R&D), also known as development research, that uses the 4-D model. The 4-D model consists of four stages: define, design, develop, and disseminate (Al-tabany, 2015). In the define stage, five activities are carried out: initial-final analysis, student characteristic analysis, concept analysis, task analysis, and objective specification. The design stage consists of four activities: media selection, format selection, creating an initial design for the teaching module, and designing validation and practicability sheets. In the development stage, the teaching module validation process is carried out by the validator, followed by revisions based on the suggestions and input provided, and the implementation of trials. In the dissemination stage, the teaching module that meets valid and practical criteria is published in book form and disseminated to enable wider use.

This study used data collection instruments in the form of a teaching module validation sheet filled out by three expert validators, a teacher response questionnaire filled out by mathematics subject teachers as part of the practicality test of the teaching module, and a student response questionnaire filled out by students for the practicality test of the LKPD. Data collection techniques were through observation, interviews, and questionnaires. The data analysis techniques in this study were validity and practicality analyses. Validity analysis is a data analysis technique used to assess the feasibility of the product developed, based on the validation sheet completed by the validator. The formula used in the validity data analysis was adapted from Akbar and Holid (2016) and is shown in formula (1).

$$V_a = \frac{T_{se}}{T_{sh}} \times 100\%$$

where :

V_a *is the validity percentage*

T_{se} *is the total empirical score from the validator*

T_{sh} *is the maximum expected total score*

The validity assessment criteria are presented in Table 1.

Table 1. Validity Assessment Criteria

Interval	Category
$\mathbf{85\% < V_a \leq 100\%}$	Very Valid
$\mathbf{70\% < V_a \leq 85\%}$	Valid
$\mathbf{50\% < V_a \leq 70\%}$	Less Valid
$\mathbf{0\% < V_a \leq 50\%}$	Invalid

A teaching module is said to be valid if it reaches an interval of more than 70% and is considered less valid if it is less than or equal to 70%. The formula for analyzing practical data is adapted from Akbar and Holid (2016) and is given by (2).

$$V_p = \frac{T_{se}}{T_{sh}} \times 100\%$$

where :

V_p *is the percentage of practicality*

T_{se} *is the total empirical score of the students*

T_{sh} *is the maximum total score expected*

The criteria for assessing practicality are presented in Table 2.

Table 2. Practicality Assessment Criteria

Interval	Category
$\mathbf{85\% < V_p \leq 100\%}$	Very Practical
$\mathbf{70\% < V_p \leq 85\%}$	Practical
$\mathbf{50\% < V_p \leq 70\%}$	Less Practical
$\mathbf{0\% < V_p \leq 50\%}$	Impactical

Not Practical. A teaching module is said to be practical if it reaches an interval of more than 70% and is considered less practical if it is less than or equal to 70%.

RESULTS AND DISCUSSION

The results of this research are a contextual approach-based teaching module to facilitate students' mathematical communication skills on the topic of linear equations. The results of each 4D stage are explained in the following sections.

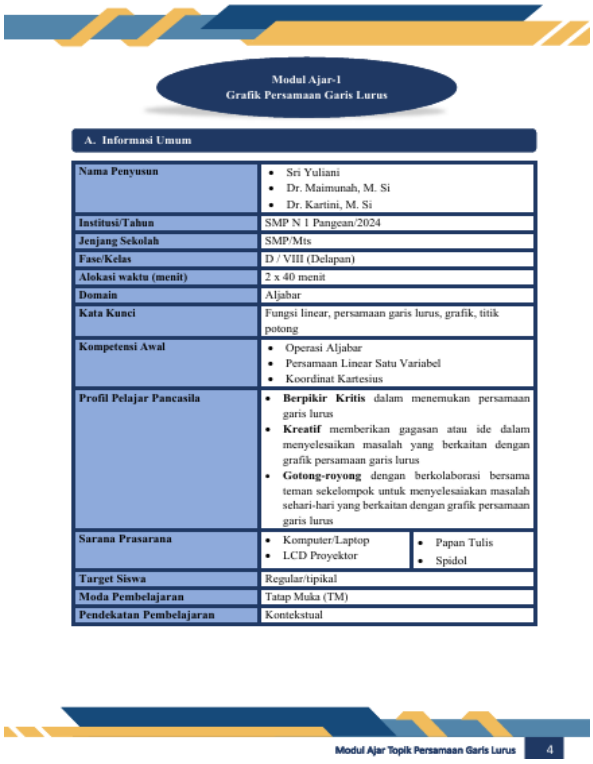
Define Stage

The purpose of the define stage is to establish and determine instructional requirements. This defines a stage as a needs analysis stage comprising five activities, as outlined by Harjanto (2022).). The first defined stage is conducting an initial and final analysis using interview techniques with several mathematics teachers in the Pangean sub-district. The information obtained: (1) the independent curriculum teaching module has not been fully realized in the learning process, and some teachers still have difficulty in designing the independent curriculum teaching module. Based on the research results of Anggraini et al. (2023) and Taufik et al. (2023) stated that teachers have difficulty in compiling learning tools such as teaching modules due to a lack of understanding of the components of the teaching modules in the form of ATP and CP development, Pancasila student profiles, dimensions, assessments, and others; (2) in learning, teachers more often use questions that are similar to examples that have been discussed rather than non-routine questions. Furthermore, the second stage defines a student character analysis to determine the characteristics of phase-D students during the learning process. According to Piaget, characteristics of students aged 14-16 years include the ability to think abstractly, logically, and mathematically. Student cognitive development is closely related to the development of knowledge, understanding, and thinking skills. However, observations by researchers at a junior high school indicate that these abilities are not fully reflected in the learning process because students' engagement in mathematics is limited. This aligns with the observations of Prayitno & Alphareno (2021), who state that students are less active and bored in learning mathematics because they still use conventional learning models. The next stage of defining is conducting a concept analysis. The fourth stage of defining is conducting a task analysis that aims to describe CP. There are several characteristics that differentiate the independent curriculum teaching module from the previous curriculum teaching

module, namely: (1) emphasis on Learning Outcomes (CP), which contain a collection of knowledge, skills, and attitude competencies that must be mastered by students at each level of education. (2) The learning process focuses on students, with the teacher acting as a facilitator. (3) the application of various learning approaches, for example, independent study, teamwork, projects, and others. (4) various assessments to measure student learning achievement. (5) technology integration (Nengsih et al., 2024). In the fifth stage of defining, the learning objectives for linear equations are formulated.

Design Stage

The design stage involves four activities, including media selection, format selection, initial design, and validation and practicality sheet design. The teaching module was created in Microsoft Word 2016, while the student worksheet (LKPD) was designed in Canva. The teaching module design was based on the Curriculum Standards and Education Assessment Agency of the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia (2022) regarding learning and assessment guidelines, which include three sections: general information, core components, and appendices. The initial design of the teaching module comprises three sections, depending on the selected format. The following displays the general information, core components, and appendices. The design of the teaching module components is shown in Figures 1, 2, and 3 below.



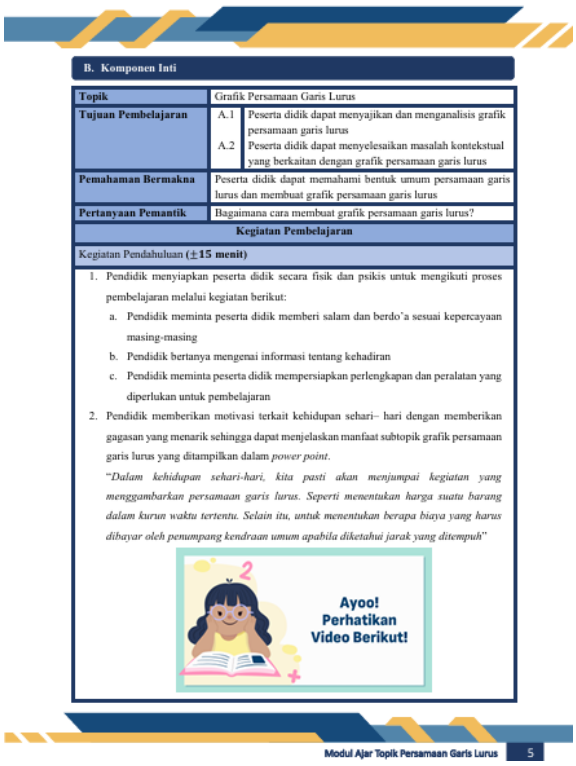
Modul Ajar-1
Grafik Persamaan Garis Lurus

A. Informasi Umum

Nama Penyusun	• Sri Yuliani • Dr. Maimunah, M. Si • Dr. Kartini, M. Si
Institusi/Tahun	SMP N 1 Pangean/2024
Jenjang Sekolah	SMP/Mts
Fase/Kelas	D / VIII (Delapan)
Alokasi waktu (menit)	2 x 40 menit
Domain	Aljabar
Kata Kunci	Fungsi linear, persamaan garis lurus, grafik, titik potong
Kompetensi Awal	• Operasi Aljabar • Persamaan Linear Satu Variabel • Koordinat Kartesius
Profil Pelajar Pancasila	• **Berpikir Kritis** dalam menemukan persamaan garis lurus • **Kreatif** memberikan gagasan atau ide dalam menyelesaikan masalah yang berkaitan dengan grafik persamaan garis lurus • **Gotong-royong** dengan berkolaborasi bersama teman sekelompok untuk menyelesaiakan masalah sehari-hari yang berkaitan dengan grafik persamaan garis lurus
Sarana Prasarana	• Komputer/Laptop • LCD Proyektor • Papan Tulis • Spidol
Target Siswa	Regular/tipikal
Moda Pembelajaran	Tatap Muka (TM)
Pendekatan Pembelajaran	Kontekstual

Modul Ajar Topik Persamaan Garis Lurus 4

Figure 1. General Information of the Teaching Module



B. Komponen Inti

Topik	Grafik Persamaan Garis Lurus	
Tujuan Pembelajaran	A.1	Peserta didik dapat menyajikan dan menganalisis grafik persamaan garis lurus
	A.2	Peserta didik dapat menyelesaikan masalah kontekstual yang berkaitan dengan grafik persamaan garis lurus
Pemahaman Bermakna	Peserta didik dapat memahami bentuk umum persamaan garis lurus dan membuat grafik persamaan garis lurus	
Pertanyaan Pemantik	Bagaimana cara membuat grafik persamaan garis lurus?	

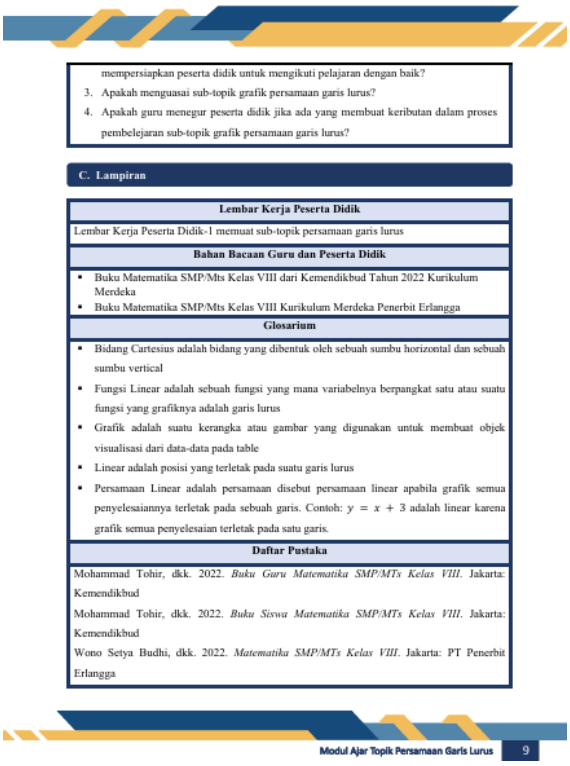
Kegiatan Pembelajaran

Kegiatan Pendahuluan (±15 menit)

1. Pendidik menyiapkan peserta didik secara fisik dan psikis untuk mengikuti proses pembelajaran melalui kegiatan berikut:
   a. Pendidik meminta peserta didik memberi salam dan berdo'a sesuai kepercayaan masing-masing
   b. Pendidik bertanya mengenai informasi tentang kehadiran
   c. Pendidik meminta peserta didik mempersiapkan perlengkapan dan peralatan yang diperlukan untuk pembelajaran
2. Pendidik memberikan motivasi terkait kehidupan sehari– hari dengan memberikan gagasan yang menarik sehingga dapat menjelaskan manfaat subtopik grafik persamaan garis lurus yang ditampilkan dalam *power point*.

"Dalam kehidupan sehari-hari, kita pasti akan menjumpai kegiatan yang menggambarkan persamaan garis lurus. Seperti menentukan harga suatu barang dalam kurun waktu tertentu. Selain itu, untuk menentukan berapa biaya yang harus dibayar oleh penumpang kendraan umum apabila diketahui jarak yang ditempuh"

Figure 2. Core Components of the Teaching Module



mempersiapkan peserta didik untuk mengikuti pelajaran dengan baik?
3. Apakah menguasai sub-topik grafik persamaan garis lurus?
4. Apakah guru menegur peserta didik jika ada yang membuat keributan dalam proses pembelejaran sub-topik grafik persamaan garis lurus?

C. Lampiran

Lembar Kerja Peserta Didik

Lembar Kerja Peserta Didik-1 memuat sub-topik persamaan garis lurus

Bahan Bacaan Guru dan Peserta Didik

- Buku Matematika SMP/Mts Kelas VIII dari Kemendikbud Tahun 2022 Kurikulum Merdeka
- Buku Matematika SMP/Mts Kelas VIII Kurikulum Merdeka Penerbit Erlangga

Glosarium

- Bidang Cartesius adalah bidang yang dibentuk oleh sebuah sumbu horizontal dan sebuah sumbu vertical
- Fungsi Linear adalah sebuah fungsi yang mana variabelnya berpangkat satu atau suatu fungsi yang grafiknya adalah garis lurus
- Grafik adalah suatu kerangka atau gambar yang digunakan untuk membuat objek visualisasi dari data-data pada table
- Linear adalah posisi yang terletak pada suatu garis lurus
- Persamaan Linear adalah persamaan disebut persamaan linear apabila grafik semua penyelesaiannya terletak pada sebuah garis. Contoh: $y = x + 3$ adalah linear karena grafik semua penyelesaian terletak pada satu garis.

Daftar Pustaka

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Mohammad Tohir, dkk. 2022. *Buku Siswa Matematika SMP/MTs Kelas VIII*. Jakarta: Kemendikbud

Wono Setya Budhi, dkk. 2022. *Matematika SMP/MTs Kelas VIII*. Jakarta: PT Penerbit Erlangga

Figure 3. Attachments to the Teaching Module

Figures 1, 2, and 3 display the components of the teaching module developed and designed based on BSKAP (2022) , which consists of three main sections: general information, core components, and appendices. Core activities are structured based on a contextual approach to facilitate mathematical communication skills. The result of the design phase is prototype I, which will be further developed in the development phase.

Development Stage

This stage includes validation, product revision, and trial testing. The instruments used to collect data were validation sheets, student response questionnaires, and teacher response questionnaires. The validation process was carried out by three validators, all mathematics education lecturers. Assessment of the teaching module and the Student Worksheet (LKPD), which is one of the teaching module attachments, covered aspects of format, content, and language. The validation results were analyzed to determine the product's validity. A summary of the teaching module validation results is presented in Table 3.

Table 3. Results of Teaching Module Validation

Average Rating of 3 Validators	Assessment Aspects			Average
	Format Validity	Content Validity	Language Validity	
Teaching Module -1	95,00%	97,22%	91,67%	94,63%
Teaching Module -2	93,33%	97,22%	87,50%	92,68%
Teaching Module -3	93,10%	100,00%	87,50%	93,53%
Teaching Module -4	93,57%	97,22%	87,50%	92,76%

Average	**93,57%**	**97,92%**	**88,54%**	93,40%
	Category			**Very Valid**

The average assessment of the teaching module was 93.40%, meeting the very valid criteria. A summary of the LKPD validation results is presented in Table 4.

Table 4. LKPD Validation Results

Average Rating of 3 Validators	Aspek Penilaian			Average
	Format Validity	Content Validity	Language Validity	
LKPD-1	95,00%	88,10%	91,67%	91,59%
LKPD-2	95,00%	91,67%	83,33%	90,00%
LKPD-3	95,00%	91,67%	83,33%	90,00%
LKPD-4	98,33%	96,43%	91,67%	95,48%
Average	**95,83%**	**91,97%**	**87,50%**	**91,77%**
	Category			**Very Valid**

The LKPD assessment obtained an average of 91.77%, indicating very valid criteria.

Table 6. Results of the Large Group Response Questionnaire

Aspect	Average Assessment of LKPD (%)				Total average rating (%)	Category
	1	2	3	4		
Instructions on LKPD	90,00	87,92	85,83	88,75	88,13	Very Practical
Content/Topic	80,67	83,83	83,83	82,50	82,71	Very Practical
LKPD display	88,33	87,92	87,08	87,08	87,60	Very Practical
Total Average	**86,33**	**86,56**	**85,58**	**86,11**	86,15	**Very Practical**

In a large-group trial conducted with 30 students and observed by one mathematics teacher, the average score was 86.15%, which was categorized as very practical.

Table 7. Results of Teacher Response Questionnaire

Assessment Indicators	Number of Items	Total Score	Total expected score	Average (%)	Category
Assessment Elements of Teaching Modules	5	17	20	85,00	Very Practical
LKPD Assessment Elements	7	26	28	92,86	Very Practical
Elements of Learning Implementation	5	18	20	90,00	Very Practical
Total Average		**61**	**68**	**89,29**	**Very Practical**

The results of the teacher response questionnaire regarding the practicality of the teaching module were 89.29% categorized as very practical.

Disseminate Stage

At this stage, the researchers packaged the product in book form, then submitted it to the school for educators to use in their teaching and learning activities and as a reference for developing independent teaching modules and publishing online.

Overall, the results of this development research corroborate those of Ananda et al (2021) which states that the development of contextual learning tools using the 4D model can produce valid, practical, and relevant products that meet the needs of mathematics learning. Therefore, the developed teaching module has the potential to provide theoretical contributions to the development of mathematics teaching materials and practical contributions to supporting the implementation of the Independent Curriculum in schools.

CONCLUSION

The research was conducted to develop a product in the form of a mathematics teaching module that refers to the independent curriculum based on a contextual approach to the topic of linear equations to facilitate the mathematical communication skills of Phase D students. In accordance with the results of the research and analysis carried out, it can be concluded that the answer to the problem formulation is that the designed teaching module has met the valid and practical requirements after being validated by three validators, three students in one-to-one trials, six students in small group trials, one teacher, and thirty students in large group trials. The topic of this research is linear equations; other mathematical topics can be developed by other researchers to maximize mathematics learning. This study still has limitations because the designed teaching module has not reached the effectiveness test stage to determine its effect on improving students' mathematical communication skills. For other researchers planning to develop teaching modules, they should do so through the effectiveness test stage.

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