



Development of Problem-Based Learning-Based Teaching Module on Number Pattern Content to Facilitate Mathematical Problem-Solving Ability of Grade VII Students

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Abstract

The Merdeka Curriculum emphasize the importance of mathematical problem-solving ability (MPSA) to face the challenges of learning and everyday life. Previous studies have largely focused on learning models without developing contextual and specific teaching materials. This study aims to develop a teaching module based on Problem-based Learning (PBL) for number pattern content to enhance the MPSA of phase D students. The research employed the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). Research instruments included validation sheets and practicality questionnaires. The validation results indicated a very valid category with an average score of 3.65, while the LKPD practicality reached a very practical category with an average score of 3.35. Based on the research results, it can be concluded that the problem-based learning-based teaching module can facilitate the mathematical problem-solving skills of seventh-grade students. This research also shows a significant increase in the students' MPSA after the implementation of the PBL Teaching Module, marked by an increase in the average score from pre-test to post-test, and students also demonstrated a more positive attitude and higher self-confidence towards mathematics. The development of the PBL-based teaching module not only enhances the quality of mathematics learning but also helps students develop the Pancasila learner profile.

Keywords: Teaching Module; Number Pattern; Problem-Based Learning; Mathematical Problem-Solving Ability.

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Abstrak

Kurikulum Merdeka menekankan pentingnya kemampuan pemecahan masalah matematis (KPPM) untuk menghadapi tantangan belajar dan kehidupan sehari-hari. Penelitian sebelumnya lebih banyak menyoroti model pembelajaran tanpa mengembangkan perangkat ajar yang kontekstual dan spesifik. Penelitian ini bertujuan mengembangkan modul ajar berbasis Problem-Based Learning (PBL) untuk konten pola bilangan guna meningkatkan KPPM peserta didik kelas VII. Penelitian menggunakan model pengembangan ADDIE (Analysis, Design, Development, Implementation, Evaluation). Instrumen penelitian berupa lembar validasi dan lembar praktikalitas. Hasil validasi modul menunjukkan kategori sangat valid dengan rata-rata skor 3,65, sedangkan praktikalitas LKPD mencapai kategori sangat praktis dengan rata-rata skor 3,35. Berdasarkan hasil penelitian dapat disimpulkan bahwa modul ajar berbasis problem-based learning dapat memfasilitasi kemampuan pemecahan masalah matematis peserta didik kelas VII. Penelitian ini juga menunjukkan adanya peningkatan yang signifikan dalam KPPM peserta didik setelah penerapan Modul Ajar PBL, ditandai dengan peningkatan rata-rata skor dari pre-test ke posttest, serta peserta didik juga menunjukkan sikap positif dan kepercayaan diri yang lebih tinggi terhadap matematika. Pengembangan modul ajar berbasis PBL tidak hanya meningkatkan kualitas pembelajaran matematika, tetapi juga membantu peserta didik mengembangkan profil pelajar Pancasila.

INTRODUCTION

Mathematics is part of a discipline that plays an important role in the world of education and produces competent human resources (HR). In studying mathematics, students are expected to be able to use mathematics and mathematical thinking patterns in everyday life, develop reasoning skills, and form self-confidence and develop mathematical skills. Mathematical problem-solving ability (MPSA) is the general goal of teaching mathematics, which means that mathematics can help in solving problems both in other subjects and in everyday life (Purwasi & Fitriyana, 2019; Novita & Hartono, 2012). MPSA is not just a form of the ability to apply rules that have been mastered through previous learning activities, but more than that, it is a process of obtaining rules at a higher level.

MPSA is very important and must be demonstrated in the mathematics learning process. The importance of students' MPSA is characterized by: 1) the ability to solve problems is the general goal of mathematics teaching, 2) problem-solving which includes methods, procedures and strategies is the core and main process in the mathematics curriculum, and 3) problem-solving is a basic ability in learning mathematics

(Branca, 1980). This is also emphasized by (Purwasi & Fitriyana, 2019; Andayani & Lathifah, 2019) that the ability to solve problems is the general goal of mathematics teaching, which means that mathematics can help in solving problems both in other lessons and in everyday life. Therefore, MPSA becomes the general goal of mathematics learning

However, many students have not mastered MPSA so that they are not optimal in solving a problem. Teachers have a very important role in fostering mathematical problem-solving abilities in students, both in the form of learning methods used, and in evaluations in the form of creating supporting questions (Sri Sumartini, 2016; Mukuka et al., 2020). At the junior high school/MTs level, students' thinking skills are relatively low, especially in problem-solving competencies (Rochmad et al., 2016).

Based on the obstacles and low MPSA of students, teachers should be more creative and innovative in modifying learning that can make students active learning subjects, teachers must be able to develop teaching modules that are in accordance with the characteristics or needs of students, set classroom conditions so that they can create a sense of comfort and interest in students so that optimization of learning in the classroom can be achieved.

In the Decree of the Minister of Education and Culture Number 033/H/KR/2022, it is emphasized that one of the objectives of learning is to improve mathematical problem-solving abilities. This shows that MPSA is a crucial skill that students must have to effectively overcome real-world challenges. With MPSA, students are expected to be able to think logically, make the right decisions, and apply mathematical concepts in various situations. Therefore, learning strategies that encourage the development of MPSA are very important in the design of teaching modules (Ridwan *et al.*, 2021).

Actual conditions in the field show that students' problem-solving abilities are still low. Students in grades VIII-10 of SMP Negeri 4 Tambang took the initial MPSA test on the Number Pattern content to assess their level of proficiency. The test results showed that question understanding was in the range of 40–46.66%. Students' difficulties in recognizing problems, formulating solutions, and implementing problem-solving can be seen from the achievement of aspects that only reached 13.33–33.33%. Even in the aspect of drawing conclusions, no students wrote down the results in full.

The development of learning tools is an important part of the implementation of the Merdeka Curriculum, which encourages independent learning and strengthening the profile of Pancasila students. One of the essential tools is the teaching module, which functions as a structured guide in the learning process.

A teaching module is defined as a systematic teaching material that includes learning objectives, learning activities, assessments, and related learning resources. According to (Tinggi & Islam Binamadani, 2022) a teaching module is a learning tool or learning

design based on a curriculum that is applied with the aim of achieving predetermined competency standards. Teaching modules must be designed considering the characteristics of students, the relevance of the material to the real world, and the demands of 21st century learning. With teaching modules, educators can more easily develop problem-based learning and encourage students to think critically and independently to solve a problem. To support the development of these teaching modules, it is necessary to apply the right learning model so that the application of teaching modules can be realized with satisfactory results.

Based on the pre-test results that have been presented, there are problems in the class. The core of the problem lies in monodirectional learning, where students are less actively involved, and the main problem is the inability of students to solve problems using problem-solving, which results in their low MPSA. Overcoming this problem is important because MPSA has a significant impact on students' academic success and the application of mathematics in real life. The PBL model is one of the learning models that is appropriate and easy to correlate with number pattern material in everyday life (Osman & Kriek, 2021).

PBL is a learning model that uses real problems as a stimulus to encourage students to use their knowledge in solving problems and thinking creatively, analytically, systematically, and logically through empirical data exploration to foster a scientific attitude (Cahyo Winoto *et al.*, 2020; Kurniawati *et al.*, 2023). PBL requires teachers to design learning that is tailored to students' perspectives, namely based on what is known, used and organized in everyday life so that students can solve problems in real-world life (Suryanti & Nurhuda, 2021; Fardian &

Dasari, 2023). The importance of PBL is in line with the opinion of (Marchy et al., 2022; Ramadhani et al., 2019) that PBL learning is very important to improve students' high-level thinking skills so that it can improve student activity and learning outcomes. PBL is very important in learning because the PBL model encourages students to build their knowledge based on problems given by educators/teachers.

This learning is oriented towards students' ability to process information (Ati & Setiawan, 2020). Information processing refers to the ways in which people handle environmental stimuli, organize data, see problems, develop concepts and solve problems and use verbal and non-verbal symbols. The PBL model emphasizes concepts and information derived from academic disciplines.

Furthermore, this ability is also critical in preparing students to face future challenges, especially in an era marked by rapid change and increasing complexity of problems. One way that can be done to overcome this problem is to apply the PBL model. The PBL model is a learning method that focuses on solving a problem as the basis for learning activities (Santika et al., 2020). Problem-based learning is designed to support the development of problem-solving skills through the application of reflective, rational, analytical, and synthetic reasoning. Problem-based learning can improve problem-solving skills and mathematical connections (Armia, 2018). In addition, the application of problem-based learning has a significant effect on mathematical problem-solving skills compared to conventional learning (Brahim et al., 2023). This is reinforced by (Wildaniati, 2019) that the implementation of PBL has been proven to support improvements in

mathematical problem-solving skills. So it can be concluded that this will also increase learning outcomes.

Some of the advantages of the PBL model are (1) students better understand the mathematical concepts taught, because they themselves discovered the concept. (2) involving students actively solving problems and demanding higher thinking skills in students. (3) students can feel the benefits of learning mathematics, because the problems solved are related to real life. This can increase students' motivation and interest in mathematics. (4) making students more independent and more mature. (5) fostering students' inquiry (research) nature. (6) Concepts become strong. (7) problem discovery can increase creativity (Surya et al., 2017).

Meanwhile, some of the shortcomings of the PBL model are: (1) it cannot be applied to all mathematics learning materials. Only certain materials can be taught with problem-based learning. (2) requires thorough preparation. (3) takes a relatively long time, so that it can result in learning materials sometimes not being completed (Desi et al., 2019).

Mathematics learning with the PBL model provides students with the opportunity to explore their abilities. In addition, the PBL model has a gradual and systematic syntax of learning activities. According to (Rizky et al., n.d.) the syntax of PBL model learning is, (1) the stage of student orientation towards the problem, (2) the stage of organizing students to learn, (3) the stage of guiding individual and group investigations, (4) the stage of developing and presenting results, (5) the stage of analyzing and evaluating the problem-solving process.

The urgency of developing Problem-based Learning (PBL)-based teaching modules is increasingly evident to answer the challenges of mathematics

learning that requires high-level thinking skills. PBL focuses on providing authentic problems, encouraging students to build their own understanding, and practicing collaborative skills (Klegeris & Hurren, 2011; Merritt et al., 2017; Maidiyah et al., 2021). This model is very relevant in the Merdeka Curriculum which emphasizes learning based on real experiences. Thus, the development of PBL-based teaching modules is an effective solution in improving the quality of mathematics learning.

This condition shows the need for innovation in the preparation of learning tools, especially teaching modules that are able to direct students not only to understand concepts, but also to apply them in real contexts. The development of PBL-based teaching modules is a strategic effort to answer this challenge. PBL-based modules allow students to actively explore problems, collaborate to find solutions, and communicate their ideas critically and creatively.

Number pattern content was chosen as the focus of module development because of its relevance to everyday life and its great potential in training students' logical thinking. By studying patterns, students learn to recognize regularities, analyze data, and make generalizations. The PBL-based number pattern teaching module is expected to form strong mathematical thinking skills, while increasing students' self-confidence in facing new problems.

Thus, the development of a PBL-based teaching module is not only a response to the challenge of low KPMM students, but also a proactive effort in enriching mathematics learning strategies. This module is expected to be one of the innovations in teaching tools that support the implementation of the Merdeka Curriculum effectively and sustainably.

METHOD

This research is a research and development with the aim of producing a product in the form of a Problem-based Learning (PBL) teaching module for number pattern content for phase D students. The development method used is the ADDIE model, which consists of the Analysis, Design, Development, Implementation, and Evaluation stages.

In the Analysis stage, three main activities are carried out, namely curriculum analysis, learning achievement analysis, and student characteristic analysis. Curriculum analysis aims to understand the demands of the Merdeka Curriculum, especially in algebra elements and number pattern content. Learning achievement analysis is carried out to formulate specific, measurable, and contextual learning objectives. Meanwhile, student analysis helps identify the needs, characteristics, and challenges faced by grade VIII students, which are the basis for developing relevant and applicable modules.

The Design stage is the main strength in the development of this module. The uniqueness of the developed teaching module lies in the integration of number pattern exploration with the PBL approach based on authentic problems from everyday life. Each activity in the module is designed to contain elements of critical thinking, collaboration, and self-reflection. In addition, the module is equipped with contextual trigger questions, investigation-based student worksheets (LKPD), and formative assessments in the form of exploratory tasks. At this stage, the module format and systematics, validation instrument design, and practicality questionnaire are also prepared.

At the Development stage, the designed teaching module was then

validated by three mathematics education experts to assess aspects of content, design, completeness of components, and suitability of the PBL approach. Validation aims to test the extent to which the module meets the principles of active and problem-based learning. After validation, the module was revised according to the validator's input. Then a readability test (one-to-one evaluation) was carried out on three (3) heterogeneous students.

At the Implementation stage of the teaching module, a small group test consisting of 6 heterogeneous students will be conducted with the aim of obtaining input and evaluation of the product developed by the researcher, so that revisions and improvements can be made before being applied to a larger group. A large group trial (field group) was also conducted consisting of 30 students with heterogeneous academic abilities. The purpose of this large group test is to see the practicality of whether the product or program developed is easy to use and understand by students in real conditions so that the product developed can be more feasible to be tested in a larger group.

The Evaluation stage is carried out in each ADDIE phase to maintain the quality of development. Formative evaluation is carried out after the analysis, design, development and implementation stages through internal reflection and expert assessment. Summative evaluation is carried out at the final implementation stage through measuring the validity of the module and the level of practicality of the LKPD. This evaluation serves to ensure that the resulting product is not only theoretically feasible, but also practically used in learning.

The data collection instruments consisted of validation sheets and

practicality questionnaires. The validation sheets were designed to measure the clarity of the content, the suitability of learning objectives, the integration of activities with PBL principles, and the quality of language and appearance. The practicality questionnaire was used to measure readability, ease of use, attractiveness of appearance, and the relevance of the material to everyday life. Each instrument was compiled based on a previously developed indicator grid.

Data analysis was conducted quantitatively using a 4-point Likert scale. The average score of the validator's assessment and student responses was calculated to determine the validity and practicality categories. The teaching module is declared valid if the average score reaches at least 2.50 with a valid category, and is declared practical if the average score reaches at least 2.50 in the practicality assessment (Arikunto, 2012).

According to Sugiyono (2017), there are three ways to test validity, namely:

1. Construct validity testing, is a validity that constructs aspects that will be measured based on a certain theory. Construct validity testing can use expert opinions (judgment experts).
2. Content validity testing, this testing is done by comparing the contents of the instrument with the content of the lesson that has been taught.
3. External validity testing, this testing is done by comparing (to find similarities) between the criteria in the instrument with empirical facts that occur in the field.

The measurement of the validity of learning devices by Akbar (2017) consists of the syllabus, RPP and LKPD based on the 2013 Curriculum. While the measurement of the validity of the relevant research teaching module based on the Merdeka Curriculum consists of

ATP, teaching modules, LKPD. Based on the description above, the measurement of validity based on the 2013 Curriculum and the Merdeka Curriculum have similarities, especially ATP with the syllabus, RPP with teaching modules and LKPD in the appendix. Measurement of the validity of the teaching module by Widayanti (2023) which will be modified by researchers in this study.

The module is declared successfully developed if it meets both criteria, with valid and practical categories. Thus, the developed teaching module is expected to be a quality teaching tool to improve students' problem-solving abilities according to the demands of the Merdeka Curriculum.

The desired results obtained in this research are valid teaching modules and practical LKPD.

RESULT AND DISCUSSION

Results

This research produces a product in the form of a PBL-based teaching module with number pattern content to facilitate MPSA for phase D students. The results of the stages are as follows.

Analysis Stage

Curriculum analysis

During the curriculum analysis stage, the process involves identifying, providing detailed information, and organizing relevant topics to be taught. The content used is the number pattern for grade VIII SMP/MTs students. This teaching module refers to the Merdeka Curriculum for grade VIII SMP/MTs level as stipulated by the Head of the Education Standards, Curriculum and Assessment Agency of the Ministry of Education, Culture, Research and Technology Number

033/H/KR/2022.

The next stage is to examine the gap in educational resources between the Merdeka Curriculum and the 2013 Curriculum. According to (Surya & Pebrian, 2022) the 2013 Curriculum differs from the Merdeka Curriculum in various ways. The class-level organization ensures a comprehensive approach to attitudes, knowledge, and skills in the 2013 Curriculum. The phase-based Merdeka Curriculum emphasizes essential content. In addition, the 2013 Curriculum offers limited variety of materials, limiting teachers' ability to create contextual learning experiences. In contrast, the Merdeka Curriculum provides teachers with the opportunity to design teaching resources tailored to the needs and characteristics of their students.

Learning achievement analysis

At the learning achievement analysis stage, researchers determine specific material related to number patterns in algebraic elements and provide a complete picture of the learning objectives that must be achieved by students in stage D, grade VIII.

The learning achievements of grade VIII students in the content of number patterns in algebraic elements are as follows: At the end of phase D, students can recognize, predict, and generalize patterns in the form of arrangements of objects and numbers.

Researchers prepare a learning activity plan based on learning achievements which are arranged into three meetings with 2 lesson hours each.

Student analysis

This study involves analyzing students to determine their characteristics during the learning process. The findings of the

student analysis are used as an illustration in compiling a teaching module that is in accordance with the characteristics of the students.

The teaching module produced is specifically designed for grade VIII SMP/MTs students, aged between 12 and 14 years. Findings from interviews conducted by researchers indicate that the use of conventional models with lecture methods in classroom learning is not an effective approach for students to overcome problem-solving tasks. This learning approach fails to foster student independence and eliminates their opportunities to be actively involved in the learning process. To engage and motivate students, educators must have teaching techniques designed to stimulate students' problem-solving abilities.

The application of this PBL model helps increase students' confidence in articulating their perspectives and fosters their active involvement in the learning process, thus facilitating effective collaboration between students. PBL facilitates an in-depth learning experience, allowing students to independently overcome the challenges they face by utilizing their personal knowledge and experience. Furthermore, they can apply the knowledge they have gained in practical situations, thereby integrating their skills and knowledge together and applying them in relevant contexts. In addition, PBL promotes critical thinking, student autonomy, and intrinsic learning motivation, and enhances their ability to build interpersonal relationships in a group environment.

Design Stage

Selection and compilation of format

Researchers collected several references

related to number pattern content taken from several relevant sources, namely the Mathematics Book for Class VIII SMP/MTs Semester 1 Revised Edition 2017 from the Ministry of Education and Culture and the Mathematics Learning Module for Junior High Schools Number Patterns, Sequences and Series from the Directorate of Madrasah Teachers and Education Personnel, Ministry of Religion of the Republic of Indonesia 2020.

In this step, the learning objectives are described based on the results of the analysis of learning achievements and the analysis of the Pancasila student profile. These objectives are then combined with the development of teaching modules. The learning objectives of this module include: 1) Explaining the concept of number patterns, 2) Recognizing the elements of number patterns, 3) Recognizing examples of number patterns in everyday life, 4) Finding the next from an arrangement of objects or numbers, 5) Determining odd, even, square, rectangular and triangular sequence patterns, 6) Solving problems related to odd, even, square, rectangular and triangular sequence patterns, 7) Determining Pascal and Fibonacci's triangular sequence patterns, and 8) Solving problems related to Pascal and Fibonacci's triangular sequence patterns.

The selection of media developed based on the results of the previous analysis, namely developing a printed teaching module for grade VIII SMP/MTs students with number pattern content with algebraic elements. The selection of media developed is also based on the facilities owned by the school.

The teaching module is arranged in the form of printed media or books, namely A4 format with a width of 21 cm and a length of 29.7 cm. The types of fonts used are Calibri, Cooper Black, and Times New Roman. The teaching module is

arranged into three parts, namely general information, core components, and appendices. The activities carried out at the format selection stage are guided by (Anggreana et al., 2022).

Initial Design

General information on the teaching module includes the following components: (1) module identity; (2) initial competencies; (3) Pancasila student profile; (4) facilities and infrastructure; (5) target students; (6) number of students; (7) learning modes and models and (8) general description of the module as shown in the Figure 1.

MODUL AJAR	
Pola Bilangan	
FASE D	
KELAS 8 (DELAPAN)	SEKOLAH MENENGAH PERTAMA (SMP) MATEMATIKA PERTEMUAN 1 (2JP x 40 MENIT) DOMAIN ALJABAR
	TAHUN 2023 KODE: MAT.D.8.1
Nama Penyusun	Sub Topik
Yolanda Tesalonika Sudiro Dr. Putri Yuanita, M.Ed Drs. Sakur, M.Ed	Mengenal dan menemukan pola selanjutnya dari susunan benda atau bilangan Kata Kunci: pola dan bilangan
KOMPETENSI AWAL	
Memahami operasi hitung aljabar (sifat-sifat operasi seperti komutatif, asosiatif, distributif, perpangkatan, desimal dan pecahan).	
PROFIL PELAJAR PANCASILA	
<p>1. Beriman dan Bertakwa Kepada Tuhan YME dan Berakhlak Mulia Peserta didik dapat melaksanakan ritual ibadah sebelum memulai pembelajaran, menghargai perbedaan pendapat sesama dan berempati kepada orang lain dalam mengenal dan menemukan pola selanjutnya dari susunan benda atau bilangan</p> <p>2. Gotong royong Peserta didik berkolaborasi (kerja sama memahami informasi, gagasan, dan keterampilan, mendemonstrasikan kegiatan kelompok, dan membagi peran dan menyelaraskan tindakan dalam kelompok) dalam mengenal dan menemukan pola selanjutnya dari susunan benda atau bilangan</p> <p>3. Mandiri Peserta didik dapat mengenali kualitas dan minat diri serta tantangan yang dihadapi, mengembangkan refleksi diri dan memonitor kemajuan belajar yang dicapai dalam mengenal dan menemukan pola selanjutnya dari susunan benda atau bilangan</p> <p>4. Bernalar Kritis Berdasarkan pemahaman dan keterampilan peserta didik dapat menganalisis dan mengevaluasi penalaran dan prosedurnya serta menalar dengan berbagai argumen dalam mengambil suatu kesimpulan dalam mengenal dan menemukan pola selanjutnya dari susunan benda atau bilangan</p>	
SARANA DAN PRASARANA	
1. LKPD 2. LCD Proyektor 3. Komputer/Laptop 4. Alat tulis	
TARGET PESERTA DIDIK	JUMLAH PESERTA DIDIK
Reguler/tipikal	30 siswa
MODA DAN MODEL PEMBELAJARAN	
1. Moda pembelajaran yang digunakan untuk moda tatap muka 2. Model pembelajaran menggunakan <i>problem based learning</i> (PBL)	

GAMBARAN UMUM MODUL	
Rasionalisasi	Penyusunan modul ini akan dilakukan dengan cara menyesuaikan alokasi waktu dengan topik dan tujuan pembelajaran. Untuk mencapai tujuan pembelajaran, alokasi waktu dibagi menjadi 2 JP x 3 pertemuan. Untuk setiap pertemuan disusun rencana kegiatan pembelajaran yang memuat aktivitas siswa beserta asesmennya dengan menggunakan model pembelajaran <i>problem based learning</i> dan moda pembelajaran tatap muka. Model pembelajaran <i>problem based learning</i> dan moda pembelajaran secara tatap muka dipilih berdasarkan materi, tujuan pembelajaran dan rencana aktivitas siswa dalam pembelajaran.
Urutan Materi Pembelajaran	1. Mengenal pola bilangan 2. Menemukan pola selanjutnya 3. Ragam pola bilangan
Rencana Asesmen	Asesmen dibagi menjadi tiga yaitu asesmen diagnostik yang akan dilakukan di awal pembelajaran sebagai tes awal, asesmen formatif yang dilakukan pada saat pengerjaan LKPD

Figure 1. Initial Design of General Information

The core components of the developed teaching module consist of (1) learning objectives, (2) assessment, (3) meaningful understanding, (4) trigger questions, (5) learning activities, and (6) teacher and student reflections, as can be seen in the Figure 2.

2 KOMPONEN INTI	
Tujuan Pembelajaran	Dengan menggunakan model pembelajaran PBL peserta didik diharapkan dapat: 1. Menjelaskan pengertian pola bilangan 2. Mengenal unsur-unsur pola bilangan 3. Mengenal contoh pola bilangan di kehidupan sehari-hari 4. Menemukan pola selanjutnya dari suatu susunan benda dan bilangan
Asesmen	1. Asesmen diagnostik : Tes tertulis (<i>terlampir</i>) 2. Asesmen formatif : LKPD (<i>terlampir</i>) 3. Asesmen sumatif : Tes tertulis (<i>terlampir</i>)
Pemahaman Bermakna	Peserta didik dapat mengenal, menjelaskan dan menemukan pola bilangan pada soal yang diberikan untuk membantu kehidupan sehari-hari
Pertanyaan Pemantik	1. Apakah kamu tau dengan pola bilangan? 2. Apakah 2,4,6,8,... termasuk pola bilangan? 3. Dapatkah kamu menyebutkan pola bilangan yang lain?
LANGKAH-LANGKAH PEMBELAJARAN	
♦ Kegiatan Pendahuluan (±5 menit) — Peserta didik menyiapkan diri secara fisik dan psikis untuk mengikuti proses pembelajaran melalui kegiatan berikut: a. Peserta didik memberi salam dan berdoa sesuai kepercayaan masing-masing b. Pendidik mengecek kehadiran siswa c. Peserta didik mempersiapkan perlengkapan dan peralatan yang diperlukan untuk pembelajaran — Peserta didik dimotivasi dengan <i>cara</i> mengaitkan materi dengan masalah yang terdapat dalam kehidupan sehari-hari dengan menggunakan konsep pola bilangan sehingga dapat menjelaskan manfaat pola bilangan yang ditampilkan dalam PPT.	

Figure 2. Initial Design of Core Component

The attachment components in the teaching module are as follows: (1) LKPD; (2) enrichment and remedial; (3) reading materials for educators and students; (4) glossary; (5) bibliography, as can be seen in the Figure 3.

3 LAMPIRAN	
LEMBAR KERJA PESERTA DIDIK	PENGAYAAN DAN REMEDIAL
❖ Lembar Kerja Peserta Didik (<i>lembar terlampir</i>)	❖ Remedial untuk siswa berpencapaian rendah : Ya / Tidak (<i>lembar terlampir</i>) ❖ Pengayaan untuk siswa berpencapaian tinggi : Ya / Tidak (<i>lembar terlampir</i>)
BAHAN BACAAN PESERTA DIDIK	
❖ Kemendikbud. 2017. Matematika SMP/MTs Kelas VIII: Buku Siswa. Jakarta: Pusat Kurikulum dan Perbukuan	
BAHAN BACAAN PENDIDIK	
❖ Kemendikbud. 2017. Matematika SMP/MTs Kelas VIII: Buku Guru. Jakarta: Pusat Kurikulum dan Perbukuan ❖ Adinawan, M. Cholik. 2017. Matematika Untuk SMP/MTs Kelas VIII Semester 1: Buku Siswa. Jakarta: Erlangga ❖ Modul Pembelajaran Matematika Madrasah Tsanawiyah Pola Bilangan, Barisan dan Deret dari Direktorat Guru dan Tenaga Kependidikan Madrasah Kementerian Agama RI 2020	
GLOSARIUM	DAFTAR PUSTAKA
<i>Barisan</i> ...daftar urutan bilangan yang mempunyai karakteristik atau pola tertentu <i>Deret</i> ...jumlah dari elemen-elemen yang berurutan <i>Aritmatika</i> ...teori bilangan <i>Suku (bilangan)</i> ...bilangan yang menjadi bagian dari suatu barisan bilangan	Kemendikbud. 2017. Matematika SMP/MTs Kelas VIII: Buku Siswa. Jakarta: Pusat Kurikulum dan Perbukuan Kemendikbud. 2017. Matematika SMP/MTs Kelas VIII: Buku Guru. Jakarta: Pusat Kurikulum dan Perbukuan Adinawan, M. Cholik. 2017. Matematika Untuk SMP/MTs Kelas VIII Semester 1: Buku Siswa. Jakarta: Erlangga Modul Pembelajaran Matematika Madrasah Tsanawiyah

Figure 3. Initial Design of Attachment Component

Designing a validation sheet

In the development of this teaching module, the validity testing used is construct validity testing (validity testing in terms of learning activities that are adjusted to the learning model used and student characteristics) and content validity (testing by comparing the contents of the instrument with the content of the lessons that have been taught). The validity assessment aspect is divided into 4 parts, namely 1) validity of the contents of the teaching module, 2) identity and general information, 3) core components and 4) attachments.

Designing a response questionnaire

The evaluation of practicality in this study was conducted by analyzing students' responses to the LKPD made through a questionnaire. The assessment components of the student response questionnaire were categorized into three parts, including 1) LKPD appearance, 2) LKPD content/material and 3) language.

Development Stage

The development stage consists of two activities, namely expert assessment and product testing.

Expert assessment

The resulting teaching module is then validated. The findings of the validation of the teaching module for number pattern content for grade VIII are presented in the Table 1, Table 2, Table 3, and Table 4.

Table 1. Validation Results of Teaching Module Content Components

Assessment Aspects	Validator Score Average		
	V1	V2	V3
Compliance of material with CP and ATP	4,00	3,50	3,50
Accuracy of material	4,00	3,00	3,00
Learning support materials	4,00	3,00	3,33
Average	4,00	3,16	3,27

Source: Researcher data processing

Table 2. Validation Results of Teaching Module General Information Components and Identity

Assessment Aspects	Validator Score Average		
	V1	V2	V3
Teaching module components	4,00	4,00	4,00
Teaching module information	4,00	4,00	4,00
Initial competencies	4,00	3,00	4,00
Pancasila student profile	4,00	3,00	4,00
Learning model	4,00	3,00	4,00
Average	4,00	3,40	4,00

Source: Researcher data processing

Table 3. Validation Results of Teaching Module Core Activity Components

Assessment Aspects	Validator Score Average		
	V ₁	V ₂	V ₃
Learning objectives	4,00	3,00	3,00
Meaningful understanding	4,00	3,00	4,00
Initiator questions	4,00	3,00	3,00
Learning activities	4,00	4,00	4,00
Introductory activities	4,00	4,00	4,00
Suitability of learning activities with PBL phases	4,00	4,00	4,00
Suitability of learning activities with KPMM indicators	4,00	3,00	4,00
Suitability of learning activities with scientific approaches	4,00	3,00	4,00
Closing activities	4,00	4,00	4,00
Average	4,00	3,44	3,77

Source: Researcher data processing

Table 4. Validation Results of Teaching Module Attachment Components

Assessment Aspects	Validator Score Average		
	V ₁	V ₂	V ₃
Assessment of learning outcomes	4,00	3,00	3,33
Compilation of LKPD	4,00	3,33	4,00
Compilation of reading materials	4,00	3,00	4,00
Assessment	4,00	3,00	3,00
Average	4,00	3,08	3,58

Source: Researcher data processing

One-to-one evaluation trial

One-to-one trial was conducted to assess the readability of the LKPD created. The trial was conducted on three heterogeneous students in class XI₄ of one of the junior high schools in

Tambang. After that, the LKPD was given to be read and understood by the students. Furthermore, the researcher revised the LKPD according to the students' suggestions and comments, such as the narrative being too long.

*Implementation Stage**Small group test*

After conducting a one-to-one evaluation trial to measure the readability of the LKPD, a small group test was then conducted. The small group test was conducted on a group of 6 heterogeneous students in class IX₂ at one of the junior high schools in Tambang. Table 5 shows the results of the practicality of the LKPD in learning number pattern material for class VIII in the small group test.

Table 5. Small Group Student Response Questionnaire Results

Assessment Aspects	Average score of LKPD			$\overline{R_p}$
	1	2	3	
LKPD display	3,51	3,69	3,75	3,65
Content/material in LKPD	3,30	3,66	3,63	3,53
Linguistics	3,41	3,58	3,70	3,56
Average	3,40	3,64	3,69	3,58

Source: Researcher data processing

Large group test

The large group test was conducted on a group of 30 students of class IX₁₀ at one of the junior high schools in Tambang. The results of the practicality of the LKPD for the number pattern material for class VIII in the large group test are presented in the Table 6.

Table 6. Large Group Student Response Questionnaire Results

Assessment Aspects	Average score of LKPD			$\overline{R_p}$
	1	2	3	
LKPD display	3,44	3,44	3,39	3,42
Content/material in LKPD	3,12	3,32	3,26	3,23
Linguistics	3,38	3,44	3,39	3,40
Average	3,31	3,40	3,35	3,35

Source: Researcher data processing

Student engagement increases when formative tests are given during learning activities. By doing these activities, learning deficiencies are reduced so that the learning process becomes better. In the indicator of understanding the problem, the percentage obtained was 86.67-93.33% who achieved the maximum score. In this range, there were 26-28 students who got the maximum score. An increase also occurred in the indicator of planning problem-solving, namely 53.33-63.33% with the number of students who achieved the maximum score of 16-19 students. The indicator of implementing the problem-solving plan obtained a percentage of 76.67-83.33% with the number of students who achieved the maximum score of 23-25 students. In the indicator of interpreting the results obtained, there was a significant increase, namely 96.67-100% with the number of students who achieved the maximum score of 29-30 students.

Discussion

Detailed data processing results on pre-test and post-test data show a significant increase in the average scores of students. This increase indicates that the PBL model contributes significantly to increasing students' MPSA.

In addition, unexpected findings emerged from the analysis of the

questionnaire data showing that students not only experienced improvements in MPSA, but also showed significant improvements in positive attitudes towards mathematics and confidence in solving mathematical problems. This indicates that the PBL model not only affects the cognitive aspect of mathematics learning, but also the affective aspect of students. This increase in confidence may be due to the structure of the PBL model which allows students to be actively involved in the learning process and gain a deeper understanding through direct practice in solving problems (Hidayatati et al., 2022). These findings suggest that the implementation of the PBL model can have a broader impact on students' learning experiences, including increasing motivation and positive attitudes towards mathematics, which are important aspects in mathematics learning.

Based on the statistical analysis carried out, it can be concluded that students' MPSA increased after the implementation of the problem-based learning method, compared to before the method was implemented. The interpretation of the results of this study shows that the PBL model significantly improves students' MPSA. The increase in the average score from pre-test to post-test indicates that students gained a better understanding of mathematical concepts and were able to apply them in solving real problems. This is in line with the constructivist theory that supports problem-based learning, which states that knowledge is built through direct experience and interaction with the environment. This increase not only reflects the positive influence of problem-based learning on the cognitive aspect of learning, but also shows the potential of this approach to make students more visible and motivated in learning

mathematics.

Furthermore, the findings on the increase in students' positive and self-confidence towards mathematics provide additional evidence of the affective benefits of problem-based learning. This suggests that the PBL model is not only effective in improving students' academic abilities but also strengthens emotional and motivational factors that contribute to learning success. The active involvement of students in the learning process seems to help students overcome psychological barriers to mathematics, such as anxiety or fear, and build a more positive attitude towards this subject. This is in line with research that also shows that the PBL model has a positive impact on students' MPSA. This finding is in line with the results of research (Yunita *et al.*, 2024) which shows that the application of problem-based learning can improve students' mathematical problem-solving abilities and increase positive attitudes and self-confidence in solving mathematical problems.

This study contributes to answering the main questions raised in the introduction by providing empirical evidence that the application of the PBL model has a positive influence not only on improving students' MPSA, but also on increasing their positive attitudes and self-confidence towards mathematics. This finding reaffirms the importance of adopting a more interactive and learner-centric learning model in mathematics education, which not only focuses on cognitive learning outcomes but also pays attention to students' affective development. The results of the study (Setiawati & Agoestanto, 2023) strengthening the findings of this study where in addition to a significant increase in MPSA, students also showed positive attitudes and self-confidence in solving mathematical problems.

At the stage of student orientation to the problem, students have the opportunity to understand the challenges given in the LKPD. In this indicator, students are able to understand the problem or identify known elements. Phases 1 and 2 in the PBL model facilitate students very well in this indicator.

At the stage of organizing students to learn, students are encouraged to ask questions about things that are not understood in the questions given and are asked to identify what is known and asked in the questions in the LKPD. Phase 3 in the PBL model facilitates quite well in this indicator. In this third indicator, some students still have difficulty in making problem-solving plans, estimating the strategies to be used and solving problems through the knowledge they have. So the results of the post-test are not too significant.

Furthermore, in the third stage, namely conducting individual and group investigations, students are instructed to collect data in order to answer the difficulties in the LKPD through group discussions. Students then link the data that has been collected to solve the problems in the LKPD. Phase 3 in the PBL model can facilitate well for this indicator.

Finally, students are asked to interpret the results obtained about the problem-solving process. Next, the teacher invites students to report the results of their group work in front of the class, either orally or in writing, on the topic being studied. This stage is known as the development and presentation of work results. In the last stage, the instructor facilitates students' collaborative reactions to the findings of other groups' presentations. The teacher conducts questions and answers to confirm, provide additional information, or complete student information. Phases 4 and 5 in the PBL model facilitate very

well for indicator 4 in the MPSA.

All of these PBL procedures facilitate the responsibilities of instructors and students and encourage active participation of students to build mathematical problem-solving skills. This is in accordance with the statement (Kodariyati et al., 2016) that PBL can facilitate better problem-solving, group work, and interpersonal skills.

Learning with the PBL model trains students to create designs and processes that lead to problem-solving, thereby building their own knowledge through real experiences (Pertiwi et al., 2021) Then students identify problems by looking for things that are known, asked, and looking for appropriate problem-solving methods to solve the problem. In investigating and solving problems, in the process students use many skills so that they are motivated to solve problems, and teachers appreciate student activities so that students enjoy working together (Zahira et al., 2020).

In large group trial classes, the PBL model can optimize the active participation of students by discussing in groups to solve the problems given. By optimizing this participation, student activity in learning increases and requires higher thinking skills so that students can feel the benefits of learning mathematics because the problems solved are everyday problems. In addition, by implementing the PBL model which presents problems as the focus of learning, students can be trained to solve problems. The stages of the PBL model greatly help students in improving their mathematical problem-solving abilities, so that they can improve their mathematical problem-solving abilities related to the subject matter they are studying. The results of this study in large group trials are in line with the results of research (Maharani et al., 2024; Yanti et

al., 2024) which obtained a very practical category in the results of their large group trials.

The results of this study are in line with other studies (Sumartini, 2016) which state that students taught with the PBL model show a greater increase in MPSA compared to students taught with conventional learning methods. The results of the study (Yusri et al., 2018) also revealed that the PBL model has a positive effect on students' MPSA because by using the PBL model, students better understand difficulties, plan problems, solve problems according to plan, and interpret solutions.

Considering the very low results of the students' MPSA test at the pre-test stage. In the problem-solving process, students must write answers carefully and accurately. Based on the answer sheet according to the data, there are several students who have not written the answers correctly and completely. Students are not fully able to determine the answers to the questions given. In addition to the ability to execute problem-solving strategies, the level of understanding of the results obtained is also still relatively low. Many students do not write conclusions at the end of the problem-solving exercise, while some students write conclusions that are not perfect because the solutions are not quite right.

These results indicate that the use of PBL-based teaching modules contributes significantly to improving students' problem-solving abilities. This is in line with research (Heleni et al., 2022) dan (Sawilda et al., 2022) which emphasize that the problem-based learning model can improve high-level thinking skills and students' learning independence so that they can solve problems.

This study aims to develop a PBL-

based teaching module for Number Pattern content to facilitate MPSA for grade VII students that is in line with the Merdeka Curriculum. The teaching module was evaluated for its validity and practicality through a rigorous validation and testing process involving validator experts in the field of mathematics education and practitioners. The findings from this evaluation provide important insights into the quality, usefulness, and potential educational impact of the developed learning module.

The results of this study indicate that this teaching module meets important design criteria. Including clarity of learning objectives, content correlation, suitability with the PBL model and structural completeness. According to (Nieven et al, 2019) a teaching module is considered valid if it adheres to theoretical foundations, maintains logical consistency and is supported by learning principles. In this case, the validator confirmed that these criteria were successfully met which further strengthened the credibility and potential effectiveness of the teaching module.

The most important thing is that the validation process also involves qualitative feedback from the validators. The validators provide constructive suggestions for improvement, especially those related to the clarity of instructions, contextual problem statements that are too long and convoluted and the sequence of learning tasks. These suggestions were then refined and incorporated into a revised version of the module, demonstrating a commitment to continuous improvement based on expert feedback—an approach supported by the design-based research paradigm in education (Anderson & Shattuck, 2012).

Furthermore, feedback from students highlighted several shortcomings of the module, such as

student-friendly language and overly long narratives. This is in line with what was stated (Kemendikbudristek, 2022) that the teaching module has the potential to facilitate students' MPSA with the main objective of the Merdeka Curriculum, which emphasizes student-centered learning and competency development. The feedback not only validates the quality of the teaching module but also reflects its alignment with national education reforms that prioritize inquiry-based and problem-based learning strategies.

From a broader perspective, this study contributes to the growing body of research supporting the use of PBL approaches in mathematics education. Several recent studies have shown that PBL promotes deeper understanding, critical thinking, and collaborative problem-solving among students (Hung et al., 2022; Mergendoller et al., 2006). By embedding these pedagogical principles into the structure of the teaching module, this study not only validates the validity and practicality of the teaching module itself but also supports the integration of PBL into mainstream curriculum practices, especially in a competency-based framework such as Merdeka.

The results of this study are in line with the results of research (Putri et al., 2025) which showed that the teaching module developed on linear equations and inequalities using the PBL model was highly valid and highly practical. Expert validators confirmed the module's alignment with pedagogical standards, while teachers affirmed its usefulness and relevance for classroom teaching. The incorporation of feedback and subsequent revisions further improved the quality and effectiveness of the module. These findings support the integration of innovative problem-based teaching materials into the Merdeka

Curriculum and provide a foundation for future research and development in this area.

Implication of Research

The implications of this study indicate that the development of PBL-based teaching modules not only improves the quality of mathematics learning but also helps students develop a Pancasila student profile. This teaching module supports students to become independent, creative, critical thinkers, and able to collaborate and communicate effectively. Therefore, teachers are advised to integrate PBL-based modules in daily learning to achieve the learning outcomes of the Merdeka Curriculum (Fajri et al., 2021).

Limitation

However, this study also has several limitations. First, the long-term effectiveness test of the teaching module on student learning outcomes has not been carried out widely. Second, this study is still limited to one school context so that generalization of the results needs to be done carefully. Third, external factors such as teacher readiness in implementing the PBL approach have not been evaluated comprehensively. Further research is recommended to examine the effectiveness of the module in a broader context and scale.

With a problem-based approach applied systematically through this teaching module, students are expected to be able to improve their critical and creative thinking skills, and be better prepared to face challenges in the real world. The results of this study are an important contribution in efforts to develop innovative learning tools based on the Merdeka Curriculum.

CONCLUSION

The learning and development of teaching modules in this study have produced high-quality products in the content of number patterns for grade VIII junior high school students. The developed teaching module has proven effective in improving students' mathematical problem-solving abilities. The results of validation by experts showed an average score of 3.65 which is included in the very valid category. Likewise, the practicality of the Student Worksheet (LKPD) obtained an average score of 3.35, which is classified as very practical.

The findings of this study also strengthen the validity and practicality of the PBL model teaching module in facilitating mathematical problem-solving abilities. Based on the test results, the average MPSA score of students increased significantly from 22.49% in the initial test to 81.66% in the formative test after the implementation of the teaching module. In this finding, students showed that the application of PBL in mathematics learning was able to provide a significant positive impact on the development of problem-solving abilities and showed a positive attitude and self-confidence in solving mathematical problems, especially in grades VIII-10 at one of the junior high schools in Tambang. Through this approach, students are expected to not only master mathematical concepts, but also be able to apply them in various life situations.

RECOMMENDATION

Based on the research results, the researcher recommends that educators and academics develop teaching modules that are tailored to the specific needs of each institution. In addition, teachers and other researchers are advised to adapt

various innovative learning models in compiling modules, according to the characteristics of students and the learning context. The researcher also recommends that further research be conducted to test the effectiveness of this teaching module on a wider scale, as well as assess the long-term impact on improving students' mathematical problem-solving abilities.

The researcher also recommends that teachers start getting students used to solving contextual problems that can facilitate students' MPSA. For other researchers who are interested in developing teaching modules, they can develop them on the topic of mathematics and facilitate other mathematical skills.

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