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Development of Hypercontent-Based PMR-Based Mathematics Learning Devices to Improve Students' Mathematics Problem Solving Abilities and Learning Independence

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Abstract

This research aims to analyze the validity, practicality, and effectiveness of PMR-based mathematics learning tools assisted by hypercontent developed to improve class VIII students' mathematical problem-solving abilities and learning independence at SMP N 1 Jorlang Hataran.. This research method is a type of development research using ADDIE learning tools. The place and time of the research was carried out at SMP N 1 Jorlang Hataran in the even semester of the 2022/2023 academic year on the subject of the Pythagorean Theorem. The subjects in this research were students in class VIII-3 of SMP N 1 Jorlang Hataran for the 2022/2023 academic year with a total of 32 students, while the object of this research was a learning tool developed based on a realistic mathematics approach assisted by hypercontent to improve problem solving abilities and learning independence. students on Pythagorean theorem material. Research result; The PMR-based mathematics learning device assisted by hypercontent that was developed was declared valid, practical and effective; the increase in mathematical problem solving abilities and learning independence of class VIII students at SMP N 1 Jorlang Hataran through the PMR-based mathematics learning device assisted by hypercontent that was developed was stated to have increased. Research and development of devices using the ADDIE model can be used as an alternative for developing devices for mathematics subjects because the ADDIE model is very easy to implement and the steps for implementing the development are very clear and structured.

INTRODUCTION

Mathematics is the science or knowledge about learning or logical thinking that humans really need for life, which underlies the development of modern technology and has an important role in various scientific disciplines and advances human thinking mathematics is studied because it is useful both in everyday life and as a language or as a tool for developing science and technology [1].

One of the high-level abilities that researchers will examine is problem-solving ability. [2] stated that the heart of mathematics is problem solving. Problem solving ability is the main focus in mathematics learning. Mathematics is only useful to the extent that it can be applied to a

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particular situation, and the ability to apply mathematics to a variety of situations is called problem-solving ability. According to [3] problem solving is an interaction between knowledge and errors that uses the process of applying cognitive and affective factors in problem solving. Problem solving skills are very important in everyday life, because we will never be free from problems. The importance of problem solving abilities is in line with the opinion of [4] who stated that problem solving abilities are very important in mathematics, not only for those who will later study or study mathematics, but also for those who will apply it in other fields of study and in everyday life.

However, in reality students' problem solving abilities are still low. In [3] research, the factors that cause errors when viewed from students' learning difficulties and abilities are described as follows: 1) Students are not able to absorb information well, 2) Students' lack of experience in working on difficult questions, 3) Students not understanding the material thoroughly, 4) Weak ability of prerequisite concepts, 5) Student negligence or carelessness (during the work process). Initial research conducted by [5] showed that students were not able to understand the questions correctly, there were still students who did not fully write down what they knew in the questions. There are still students who make mistakes in planning solution strategies, so they experience errors in carrying out problem solving where students are unable to determine formulas and arrange solution steps and are less able to provide appropriate conclusions.

From the two initial studies conducted by previous researchers over a period of 8 years, it can be seen that students' problem-solving abilities are still low, where there are still students who do not understand how to plan and solve problems, so students only focus on the final answer, which causes students' answers to be often wrong.

Problem solving abilities are still low based on observations made by researchers on Wednesday-Thursday, 10-11 August 2022 in class VIII of SMP N 1 Jorlang Hataran. The low ability of students to solve mathematical problems can be seen from the results of diagnostic tests in the form of problem solving questions and are related to the Pythagorean theorem.

To see students' problem solving abilities, problem solving indicators according to Polya are used, namely understanding the problem, planning the problem, solving the problem, and checking again. Based on the results of the students' answers obtained from the 32 students who were given this question, if we look at the problem solving scoring guidelines in the aspect of understanding the problem with indicators of achievement in writing what was known and asked correctly and completely, there were only 3 people who wrote what was known and asked correctly. but 4 people were incomplete, 5 people made mistakes in writing what they knew and asked, 8 people didn't write down what they knew and asked, and 12 people didn't give an answer at all.

In planning problem solving, there were no students who used procedures that led to the correct answer, those who used strategies that led to the wrong answer or did not try other strategies. There were 3 students, who used less strategies so they could not continue. There were 7 people, who used strategies that did not There were 8 people relevant and there were 14 people who did not provide any answers at all. In the aspect of solving the problem, there were no students who wrote down the correct results and procedures, there were 6 who wrote partially

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wrong results, 8 people who wrote the final results of the calculation incorrectly and 18 people who did not give an answer at all.

In the aspect of checking again in interpreting answers, there were no students who carried out the examination completely, there were 3 people who carried out the examination but were incomplete, there were 8 people who carried out the examination but got it wrong, there were 21 people who did not carry out the examination and who did not give an answer at all. .From the description above, it can be seen that each step of students' problem solving activities is categorized as low ability, because most students get the lowest scores on each indicator in problem solving. The results of the problem solving ability test showed that there were no students with very high criteria, there was 1 student with high criteria, there were 5 students with medium criteria, there were 8 students with low criteria and there were 18 students with very low criteria. Overall, it can be concluded that students' problem solving abilities are still low.

Another thing that is considered important is students' attitudes in studying mathematics, one of which is students' learning independence. Independent learning is related to independent learning but not learning alone or separating students from other students. Learning independence is a learning skill that in the individual's learning process is encouraged, controlled and assessed by the individual himself [6].

The importance of independence in learning mathematics is because the curriculum demands that students be able to face increasingly complex problems in the classroom and outside the classroom and reduce students' dependence on other people in everyday life. The importance of learning independence in mathematics is also supported by the results of Pintrich's study [7] with findings including: individuals who have high learning independence tend to learn better, are able to monitor, evaluate and organize their learning effectively, saving time in completing assignments, managing studies and time efficiently. Learning independence must be a concern in the learning process, because based on the research results of Febriyanti & Imami (2021), it was found that student learning independence in mathematics subjects is still very low. The research results of [8] also show that independence in learning mathematics is still low. So it is necessary to make efforts to increase learning independence in order to achieve the desired learning goals and make students successful in their learning.

Likewise, the reality obtained from the results of the researcher's interview with Mr. D. Sitorus, S.Pd, one of the mathematics teachers at SMP N 1 Jorlang Hataran on Wednesday 10 August 2022, he said that there are still many students who cannot study independently. For example, (1) Students often do not do their homework even though if you look at the questions, they are relatively easy and in accordance with the examples studied at school, (2) Students do not make preparations before facing learning at school, and study the material only during tests or exams, (3) when working on questions that are applied to real problems or story problems, students experience difficulties if they are not previously given examples of questions with the same form, (4) and when asked to come to the front of the class to work on a problem, students just wait for their name to be called or wait another friend to do it. Based on this fact, it can be concluded that the level of independence in students' mathematics learning is still low.

Apart from the lack of problem solving and student learning independence, the learning approach used by teachers is still considered an ordinary learning approach. According to the results of the researcher's interview with one of the mathematics teachers at SMP N 1 Jorlang

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Hataran on Wednesday 10 August 2022, learning activities took place as usual, the teacher explained the material and students listened to the teacher's explanation, followed by giving practice questions in the student's book. Learning activities are not carried out in accordance with the existing RPP, the most important thing is that the material is explained to students and students are expected to be able to absorb the knowledge provided by the teacher.

In research, [9] stated that mathematics teaching and learning activities are still teacher-centered and conventional. Then [9] stated that teachers still teach with a traditional approach, where mathematics teaching in schools is introduced symbolically or abstractly, and forces students to memorize. This approach is contrary to students' cognitive development. In line with research by [10] that teachers do not involve students enough in the learning process. Teachers still use the usual form of learning, namely explaining with little interaction, giving example questions rather than giving exercises. This can make students unfamiliar with solving problems.

The conventional approach that teachers usually use can be quickly prepared, because they are already used to implementing it. The impact is that students cannot hone their thinking skills, and only use ordinary methods. This makes it difficult for students to develop their abilities in expressing creative ideas and tends to depend on the presence of the teacher to solve the mathematical problems they face. Students do not feel challenged to explore their thinking abilities more deeply.

To overcome problems that occur in the field in the mathematics learning process at school, especially regarding mathematical problem solving abilities and student learning independence which result in low mathematics learning outcomes, teachers must make efforts to improve these conditions. Efforts made include improving learning devices.

Learning devices are tools or equipment used by educators before carrying out learning, the contents of which are activities carried out by students and teachers in detail and regularly. The learning tools used by teachers in teaching according to Ibrahim [11] are: Syllabus, Learning Implementation Plan (RPP), Student Activity Sheets (LKS), Evaluation Instruments or Learning Outcome Tests (THB), learning media, and teaching books student. Learning tools are one of the things that influence the success of education, and are also factors that must be considered by a teacher and must be owned by every teacher without exception.

Based on statements and observations of researchers in the field, one of the causes of the low problem-solving abilities and learning independence of students in schools is the result of inadequate learning tools that teachers have for students to improve their abilities so that the learning carried out is not optimal. less efficient. This statement was revealed based on the researcher's interview with the mathematics teacher of SMP N 1 Jorlang Hataran on Wednesday 10 August 2022, revealing that: 1) Teachers use lesson plans that are ready to use and sometimes teachers also use lesson plans that are not suitable. with the learning process implemented, the RPP used also rarely changes every year unless there is an inspection from the local education office 2) teachers also pay less attention to the appropriate model or approach used to increase student interest and motivation in learning mathematics, because they only pay attention to accuracy in the length of hours lesson 3) there is no use of LKPD. This school only has teacher books and student books.

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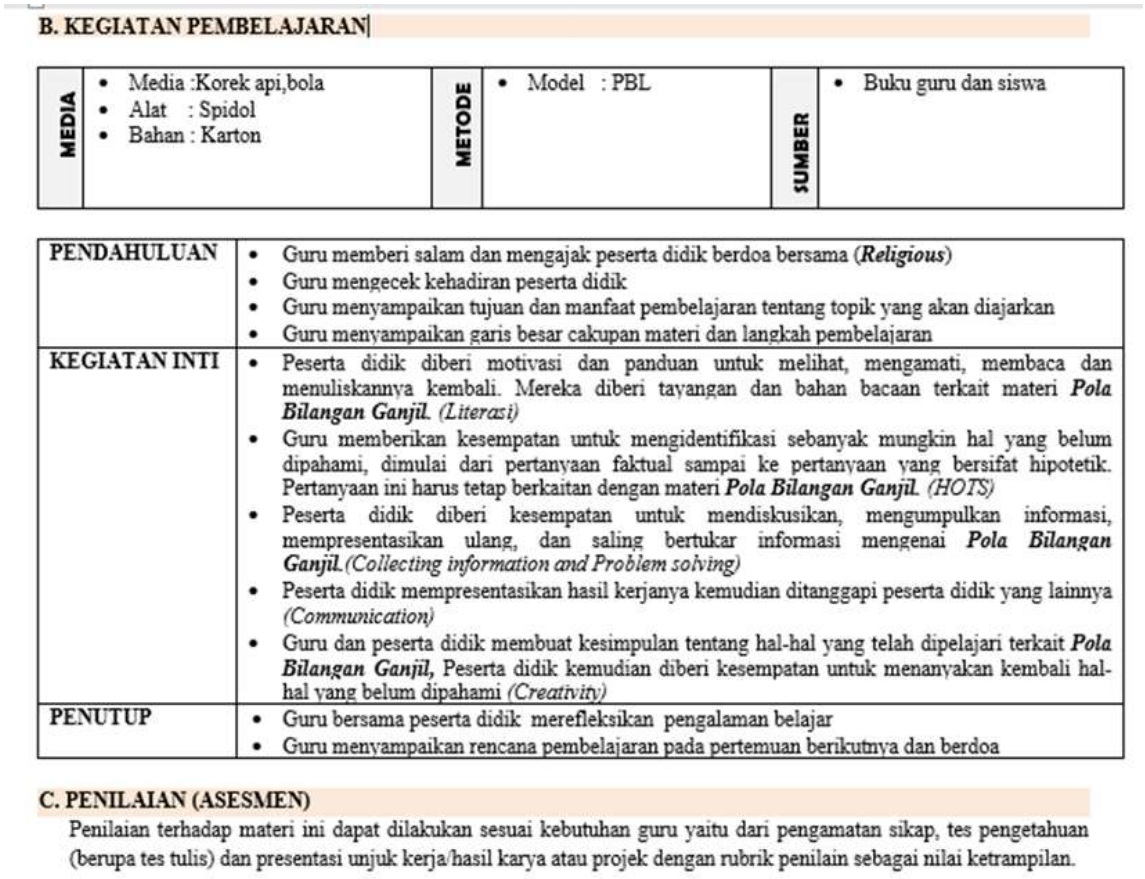

B. KEGIATAN PEMBELAJARAN

MEDIA	• Media :Korek api,bola • Alat : Spidol • Bahan : Karton	METODE	• Model : PBL	SUMBER	• Buku guru dan siswa

PENDAHULUAN	• Guru memberi salam dan mengajak peserta didik berdoa bersama (***Religious***) • Guru mengecek kehadiran peserta didik • Guru menyampaikan tujuan dan manfaat pembelajaran tentang topik yang akan diajarkan • Guru menyampaikan garis besar cakupan materi dan langkah pembelajaran
KEGIATAN INTI	• Peserta didik diberi motivasi dan panduan untuk melihat, mengamati, membaca dan menuliskannya kembali. Mereka diberi tayangan dan bahan bacaan terkait materi ***Pola Bilangan Ganjil.*** *(Literasi)* • Guru memberikan kesempatan untuk mengidentifikasi sebanyak mungkin hal yang belum dipahami, dimulai dari pertanyaan faktual sampai ke pertanyaan yang bersifat hipotetik. Pertanyaan ini harus tetap berkaitan dengan materi ***Pola Bilangan Ganjil.*** *(HOTS)* • Peserta didik diberi kesempatan untuk mendiskusikan, mengumpulkan informasi, mempresentasikan ulang, dan saling bertukar informasi mengenai ***Pola Bilangan Ganjil.*** *(Collecting information and Problem solving)* • Peserta didik mempresentasikan hasil kerjanya kemudian ditanggapi peserta didik yang lainnya *(Communication)* • Guru dan peserta didik membuat kesimpulan tentang hal-hal yang telah dipelajari terkait ***Pola Bilangan Ganjil,*** Peserta didik kemudian diberi kesempatan untuk menanyakan kembali hal-hal yang belum dipahami *(Creativity)*
PENUTUP	• Guru bersama peserta didik merefleksikan pengalaman belajar • Guru menyampaikan rencana pembelajaran pada pertemuan berikutnya dan berdoa

C. PENILAIAN (ASESMEN)

Penilaian terhadap materi ini dapat dilakukan sesuai kebutuhan guru yaitu dari pengamatan sikap, tes pengetahuan (berupa tes tulis) dan presentasi unjuk kerja/hasil karya atau projek dengan rubrik penilain sebagai nilai ketrampilan.

Figure 1. Weaknesses of the RPP SMP N 1 Jorlang Hataran

This introduction contains theory, research results and/or the latest news which provides the background for the importance of conducting research, formulates the problem being studied, and ends with the research objectives. The introduction is written in Garamond-12 upright, with 1.15 spacing. Each paragraph begins with a word that is indented with 5 digits, or about 1 cm from the left edge of each column. In literature reviews, it is permissible to use the latest literature (last 5 years).

Apart from that, SMP N 1 Jorlang Hataran still uses old student books and has several weaknesses, including: some of the material in the student books is not in accordance with the learning objectives to be achieved, namely solving contextual problems according to KD 4.6. So the learning tools used by teachers do not meet expectations as learning tools that enable students to solve contextual problems. Therefore, the learning tools used cause students to have difficulty solving contextual problems which have an impact on students' mathematical problem solving abilities and learning independence.

Teachers' lack of knowledge of learning tools causes low student interest and motivation to learn [12]. Seeing the reality in the field, it is appropriate for teachers to prepare complete equipment used in the learning process so that the learning carried out runs as expected, because apart from being required for their ability to process learning, teachers are also required to develop the learning tools that will be used.

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From the description above, it can be concluded that the use of learning devices provides good benefits in learning. The aim of developing learning tools is to improve and produce new materials. Apart from that, the selection of learning tools needs to be linked to the goals to be achieved in the learning process, especially in improving students' mathematical abilities, especially mathematical problem solving abilities and students' learning independence.

Addressing the problems that exist in mathematics learning as described above, especially relating to mathematical problem solving abilities, student learning independence, approaches to learning and learning tools. So it is necessary for teachers or researchers to choose models, approaches, strategies and learning methods. In line with research [13] states that developing learning media, strategies or learning models that are more appropriate to the learning material or the context faced by students is important for teachers to do. .

One mathematics strategy that is based on mathematizing everyday experiences and applying mathematics in everyday life is the Realistic Mathematics Learning (PMR) approach. Realistic Mathematics Education (RME) or Realistic Mathematics Learning (PMR) is a teaching and learning theory in mathematics education. RME theory was first introduced and developed in the Netherlands by Hans Freudenthal. RME was developed and tested in the Netherlands and was proven successful in stimulating students' reasoning and thinking activities [14]. Freudental [15] said that mathematics must be linked to reality and mathematics is a human activity. This means mathematics must be close to students and relevant to everyday life.

In the Realistic Mathematics Approach (PMR), mathematics is seen as something that must be constructed by students themselves. The Realistic Mathematics Approach (PMR) places students' reality and environment as the starting point for learning. Learning starts from characteristics, definitions, then theorems are expected to be discovered by students themselves. Thus, in realistic mathematics learning, students are encouraged or challenged to actively work and are even expected to be able to construct or build their own knowledge that will be obtained.

By considering the need for learning media for independent learning that can contain concept/theory material, detailed explanations, and other interesting content that can build imaginative thinking, the researcher chose learning media, namely student handbooks and student worksheets using hypercontent. [16] stated that hypercontent is a concept that interweaves material with one another simultaneously in a digital program, and hypercontent uses the concept of non-linear patterns or random reading. What characterizes hypercontent is material taken from cyberspace, so that the hypercontent module utilizes open source which is then used as a learning resource, which usually takes the form of using tools/icons to be used for the following things, namely: (1) Utilization various website pages, (2) Use of hypertext, (3) use of quick response codes (QR codes), (4) Use of YouTube video channels and cloud computing. Based on research conducted by Widyasari et al (Anisa, Nurdiyanti, Thahir, R, 2021) that learning based on QR codes can help teachers in the learning process because students can access lesson material anytime and anywhere and can improve learning outcomes.

This is in line with Prensky's opinion [16] explains that digital natives will learn if they really want to. They know what facilities (internet) are available and they can use them to achieve their desires. Through the internet, they will surf looking for as much information as possible. If they make a school assignment, it is possible that the information they obtain exceeds the demands of the assignment, because of the vast amount of information available in cyberspace. Students

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definitely prefer using QR & Barcode Scanners because this is easier than students searching for explanation on Google by typing in keywords that match the learning material, because students only need to open the QR & Barcode Scanner application then immediately scan the QR Code, the teaching material will appear. So students not only learn using textbooks, but can watch videos learning and reading material from cyberspace by entering links or scanning QR Codes that are already in textbooks and Student Worksheets (LKPD) using the internet network via their Smartphone.

Thus, using learning tools based on a realistic mathematics approach (PMR) assisted by hypercontent is expected to improve students' problem solving abilities and learning independence. This is what prompted researchers to conduct research with the title "Development of PMR-Based Mathematics Learning Tools Assisted by Hypercontent to Improve Mathematical Problem Solving Abilities and Learning Independence for Class VIII Students of SMP N 1 Jorlang Hataran".

METHODS

This research is development research using the ADDIE learning device development model which consists of 5 development stages, namely Analysis, Design, Develop and Implementation and Evaluation [17]. This model was chosen because it aims to produce a product that is developed and then tested for feasibility with validity and product trials to determine the extent to which students' mathematical problem solving abilities and student learning independence have increased with hypercontent-assisted PMR-based learning tools. The learning tools research instruments developed were learning implementation plans (RPP), student books (BS), student activity sheets (LKPD), problem solving ability tests (TKPM) and student learning independence questionnaires. This research was carried out at SMP N 1 Jorlang Hataran in the semester even the 2022/2023 academic year on the Pythagorean Theorem material. The subjects in this research were students in class VIII-3 of SMP N 1 Jorlang Hataran for the 2022/2023 academic year with a total of 32 students, while the object of this research was a learning tool developed based on a realistic mathematics approach assisted by hypercontent to improve problem solving abilities and learning independence. students on Pythagorean theorem material. The research procedure used in this research is the ADDIE model development research design which consists of 5 stages, namely Analyze, Design, Development, Implementation, and Evaluation [18]. The research procedures can be seen in the picture below in Figure 2:

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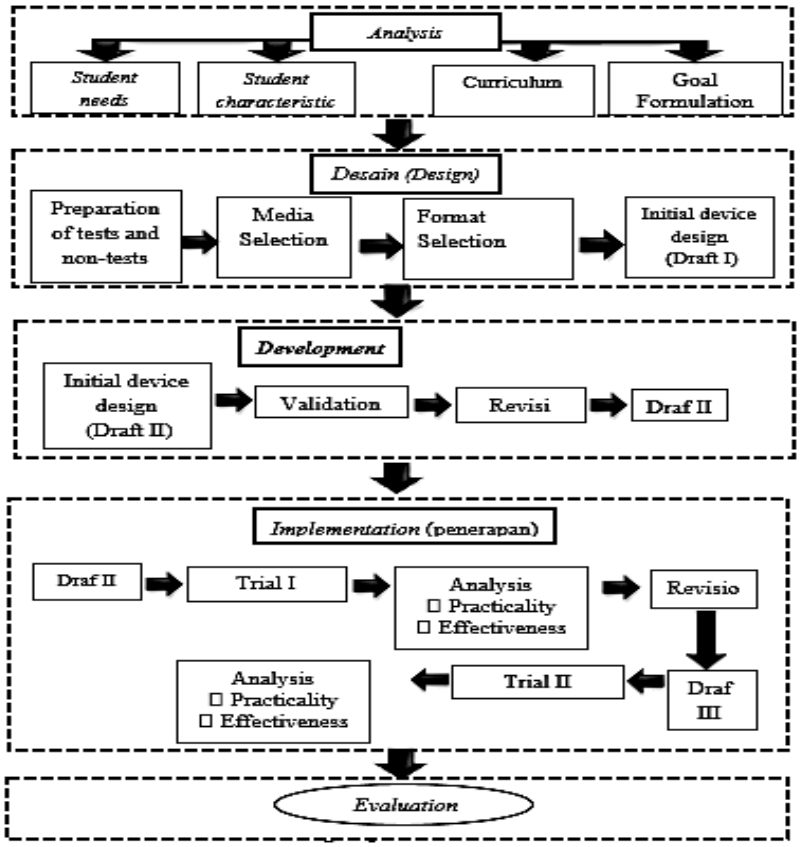

Figure 2. Research procedures for developing learning tools

RESULTS AND DISCUSSION

This research is development research, so the product of this research is a PMR-based learning tool assisted by hypercontent which meets the criteria of being valid, practical and effective with the aim of improving the mathematical problem solving abilities and learning independence of class VIII students at SMP N 1 Jorlang Hataran. The learning device development stage uses the ADDIE development model, which includes five stages, namely: the first stage starting from the analysis stage, the second stage design, the third stage development, the fourth stage implementation and the final stage evaluation. The results of each stage are described as follows.

Analysis

The analysis stage is the stage where researchers analyze the need for developing learning tools and analyze the feasibility and requirements for development. The analysis stages carried out in this research include three things, namely analysis of student needs, analysis of student character, and curriculum analysis.

Design

The aim of this stage is to design learning tools, so that a prototype (example of learning tools) is obtained for PMR-based PMR-based Pythagorean theorem material assisted by hypercontent. Activities at this stage are preparing tests and non-tests, selecting media, selecting formats and initial design of learning tools. At this stage, an initial design of learning tools is

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produced in the form of a Learning Implementation Plan (RPP), Student Book (BS), and Student Activity Sheet (LKPD) for four meetings, a problem solving ability test, and a learning independence questionnaire.

Lesson plan

The Learning Implementation Plan (RPP) consists of one set for four meetings. The RPP is prepared in accordance with the characteristics of RPP preparation in the K-13 curriculum which consists of: (1) Education Unit; (2) Subjects; (3) Class/Semester; (4) Time allocation; (5) KD and GPA; (6) Learning Materials; (7) Learning Objectives; (8) Learning Activities; (9) Approach; (10) Learning Methods (11) Learning Settings; (12) Products; (13) Description; (14) Tools, Materials, Media; (15) Assessment of Learning Outcomes.

Student Book

The Student Book (BS) is prepared so that students have guidance in understanding the subject matter in accordance with the set learning objectives. The student book developed contains contextual problems that must be solved in groups and independently. Next, in each subchapter problems are presented whose solutions lead to the process of students discovering each concept in the Pythagorean Theorem. Then, in each subchapter, examples of questions are given along with alternative solutions to increase students' understanding in solving problems and practice questions based on problem solving abilities are given at the end of the subchapter to train students' problem solving abilities. The student book resulting from this phase is referred to as draft I. The form of the student book product in this research is::

Figure 3. Display of Keywords and Concept Map of Pythagorean Theorem Material

Develop

The analysis and design stage produces an initial design of a learning tool called draft I. The first phase in the development stage is to validate draft I with experts. Expert validation focused on the format, content, illustrations and language of the hypercontent-assisted PMR-based mathematics learning tools developed. The results of expert validation in the form of validation scores, corrections, criticism and suggestions are used as a basis for revising and perfecting the learning tools developed. The revised learning tools are learning tools that meet the valid criteria and are hereinafter referred to as draft II. Validation is an important part in developing learning tools to correct errors and weaknesses in the design results (draft I). The validators chosen in this research consisted of three UNIMED lecturers and two junior high school teachers. The following are the results of the validation of the research instrument:

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Table 1. Summary of Learning Module Validation Results by Experts and Practitioners

No	Appraised Object	Mark Average Total Validity	Validation Level
1	Student Book	4,3	
2	Lesson plan	4,4	Valid
3	Student Worksheets	4,4	

Based on Table 1 above, the total average for each learning device is in the interval $4 \leq Va < 5$ with the valid category. Based on the validity criteria, it can be said that the learning tools developed meet the valid criteria.

Trial Description I (Implementation)

The student's mathematical solving ability test is carried out once at the beginning before the learning activity begins, which is called the pretest, and once at the end of the lesson after carrying out four teaching and learning activity meetings, which is called the posttest. The aim of giving the pretest and posttest is to determine the increase in mathematical problem solving abilities obtained by students after being given learning treatment using PMR-based devices assisted by hypercontent on the Pythagorean Theorem material. To see the effectiveness of learning, data on the achievement of learning objectives is needed. The achievement of learning objectives in trial I can be seen in table 2.

Table 2. Description of Results of Mathematical Problem Solving Ability Test I

Score Max	*Pretest*			*Posttest*		
	Xlowest	Xhighest	$\bar{x}$	Xlowest	Xhighest	$\bar{x}$
100	33,75	76,25	56,41	52,50	91,25	74,61

Based on Table 2, it shows that the average students' mathematical problem solving ability in the pretest results was 56.41. and the average mathematical problem solving ability of students in the posttest results was 74.61. If categorized based on the level of mathematical problem solving ability in table 3.14 Chapter III, then the level of students' mathematical problem solving ability in the pretest results of trial I can be seen in Table 3 below.

Table 3. Level of Students' Mathematical Problem Solving Ability Result of Pretest Trial I

No	Value Interval	Mathematical Problem Solving Ability		Information
		Number Of Students	Percentage (%)	
1	$90 < x \leq 100$	0	0,00	Very high
2	$80 < x \leq 90$	0	0,00	High
3	$70 < x \leq 80$	6	18,75	Currently
4	$60 < x \leq 70$	8	25,00	Low
5	$x \leq 60$	18	56,25	Very low

Based on Table 3, the pretest results of students' mathematical problem solving abilities were obtained, namely, there were no students whose level of mathematical problem solving ability was in the "very high" and "high" (0%) categories, 6 students (18.75%) obtained the medium category. ,

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8 students (25%) received the low category and 18 students (56.25%) received the very low category.

Furthermore, the posttest results are categorized based on the level of students' mathematical problem solving abilities which can be seen in table 4.

Table 4. Level of Students' Mathematical Problem Solving Ability Result of Posttest Trial I.

No	Value Interval	Mathematical Problem Solving Ability		Information
		Number Of Students	Persentase (%)	
1	$90 < x \leq 100$	1	3,13	Very high
2	$80 < x \leq 90$	10	31,25	High
3	$70 < x \leq 80$	12	37,50	Currently
4	$60 < x \leq 70$	3	9,38	Low
5	$x \leq 60$	6	18,75	Very low

Based on Table 4 above, in the posttest 6 students (18.75%) got the very low category, 3 students (9.38%) got the low category, 12 students (37.50%) got the medium category. 10 students (31.25%) received the high category and 1 student (3.13%) received the very high category. Furthermore, the results of classical completion of students' mathematical problem solving abilities in the pretest and posttest in trial I can be seen in Table 5 below.:

Table 5. Pretest and Posttest Completeness Levels of Students' Mathematical Problem Solving Ability in Trial I

Category	*Pretest*		*Posttest*	
	The number of students	Classical Completion Percentage (%)	The number of students	Classical Completion Percentage (%)
Complete	3	9,38	21	65,63
Not Completed	29	90,63	11	34,38
Amount	1805,00		2387,50	
Class Average	56,41		74,61	

Based on table 5, it was found that the number of students who completed the pretest of trial I was 3 students (9.38%) and those who did not complete were 29 students (90.63%) while in the posttest of trial I, the students who completed were 21 students (65.63%) and those who did not complete were 11 students (34.38%).

Description of Trial Student Learning Independence Questionnaire I

In this research, student learning independence questionnaire data was obtained from pretest and posttest data. A description of the results of student learning independence in trial I is shown in the following table.

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Table 6. Description of Pretest and Posttest Data for Student Learning Independence Questionnaire in Trial I

Category	*Pretest*		*Posttest*	
	Amount Student	Percentage	Amount Student	Percentage
High	3	9,38%	14	43,75%
Currently	20	62,50%	18	56,25%
Low	9	28,13%	0	0,00%
Amount	32	100 %	32	100 %
Average	53,27 %		73,69 %	

Trial Description II (Implementation)

Based on the results of trial II data analysis, it is known that the learning tools developed are effective, the posttest results of mathematical problem solving abilities in trial II have met the criteria for achieving classical completeness and students' responses to PMR-based mathematics learning tools assisted by hypercontent have been positive.

Table 7. Description of Results of Students' Mathematical Problem Solving Ability in Trial II

Score Max	*Pretest*			*Posttest*		
	X_{lowest}	$X_{highest}$	$\bar{x}$	X_{lowest}	$X_{highest}$	$\bar{x}$
100	36,25	77,50	57,97	70,00	93,75	80,86

Based on Table 7, it shows that the average students' mathematical problem solving ability in the pretest results was 57.97. and the average problem solving ability of students in the posttest results was 80.86. If categorized based on the level of problem solving ability in table 3.13 Chapter III, then the level of students' problem solving ability in the pretest results of trial II can be seen in Table 8 below.

Table 8. Level of Students' Mathematical Problem Solving Ability Result of Pretest Trial II

No	Value Interval	Mathematical Problem Solving Ability		Information
		Number Of Students	Persentase (%)	
1	$90 < x \leq 100$	0	0,00	Very high
2	$80 < x \leq 90$	0	0,00	High
3	$70 < x \leq 80$	5	15,63	Currently
4	$60 < x \leq 70$	8	25,00	Low
5	$x \leq 60$	19	59,38	Very low

Based on Table 8, the pretest results of students' problem solving abilities were obtained, namely, there were no students whose problem solving ability levels were in the "very high" and "high" (0%) categories, 5 students (15.63%) got the medium category. 8 students (25%) received the low category and 19 students (59.38%) received the very low category. Furthermore, if the posttest results are categorized based on the level of students' problem solving abilities, they can be seen in table 9.

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Table 9. Level of Students' Mathematical Problem Solving Ability Result of Posttest Trial II.

No	Value Interval	Mathematical Problem Solving Ability		Information
		Number Of Students	Persentase (%)	
1	$90 < x \leq 100$	4	12,50	Very high
2	$80 < x \leq 90$	12	37,50	High
3	$70 < x \leq 80$	15	46,88	Currently
4	$60 < x \leq 70$	1	3,13	Low
5	$x \leq 60$	0	0,00	Very low

Based on Table 9, there were no students who got the very low category (0%), who got the low category as many as 1 student (3.13%), who got the medium category as many as 15 students (46.88%), who got the high category as many as 12 students (37.50%) and 4 students (12.50%) received the very high category. Furthermore, the results of classical completion of students' mathematical problem solving abilities in the pretest and posttest in trial II can be seen in Table 10 below.:

Table 10. Pretest and Posttest Classical Completeness Levels of Students' Mathematical Problem Solving Ability in Trial II

Category	*Pretest*		*Posttest*	
	Amount Student	Classical Completion Percentage (%)	Amount Student	Classical Completion Percentage (%)
Complete	4	12,50	29	90,63
Not Completed	28	87,50	3	9,38
Amount	1855		2587,5	
Class Average	57,97		80,86	

Based on table 10, the number of students who completed the second trial pretest was 4 students (12.50%) and those who did not complete were 28 students (87.50%) while in the second trial posttest, the students who completed were 29 students (90 .63%) and those who did not complete were 3 students (9.38%).

Description of Trial Student Learning Independence Questionnaire II

A description of the results of student learning independence in trial II is shown in the following table.

Table 11. Description of Pretest and Posttest Data for Student Learning Independence Questionnaire in Trial II

Category	*Pretest*	Average *pretest*	*Posttest*	Average *posttest*
	Amount Student		Amount Student	
High	5	15,63%	28	87,50%
Currently	19	59,38%	4	12,50%
Low	8	25,00%	0	0,00%
Amount	32	100 %	32	100 %
Average	58,06%		82,25%	

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Average From the table above it can be seen that the average student learning independence in the Pretest II trial was 58.06%, while the average student learning independence in the Posttest II trial was 82.25%. To see the percentage of student learning independence, below is a bar chart of the percentage of student learning independence results in trial II.

Improving Problem Solving Ability Trial II

The increase in mathematical problem solving abilities in trial II will be seen through the N-Gain from the results of the pretest and posttest mathematical problem solving abilities in trial II. The results of the N-Gain calculation are presented in appendix 25. The N-Gain summary results of the mathematical problem solving ability of trial II can be seen in table 12 below.:

Table. 12. Summary of N-Gain Results of Trial II Students' Mathematical Problem Solving Ability

Score *N-Gain*	N-Gain Criterion	Amount Student
$0{,}00 < N - Gain \leq 0{,}30$	Low	0
$0{,}30 < N - Gain \leq 0{,}70$	Currently	31
$N - Gain > 0{,}70$	High	1

The average value of N-Gain is 0.55 if interpreted into the classification described in Chapter III, then the total increase in mathematical problem solving ability in trial 1 obtained is in the "medium" category or with an N-Gain percentage of 55%.

Evaluation

The developed Hypercontent-assisted PMR-based mathematics learning device is valid with an average RPP validity of 4.40, an average student book (BS) validity of 4.39, and an average student worksheet (LKPD) validity of 4.49. After the second trial, the implementation of learning with the Hypercontent-assisted PMR-based mathematics learning device was in the category of "Well implemented" with a score of 3.38. This score has met the success criteria. Furthermore, the results of classical completeness of problem-solving ability in the trial were 90.63%. In the second trial, students' positive responses to the Hypercontent-assisted PMR-based mathematics learning device were developed with an overall average of 97.44. Learning independence in the second trial obtained was in the "moderate" category or with an N-Gain percentage of 58%. So it can be concluded that the development of the Hypercontent-assisted PMR-based mathematics learning device is valid, effective, and practical.

DISCUSSION

The validity test was carried out to see the shortcomings of the initial draft of the learning tools which were designed by taking into account problems in Class VIII of SMP N 1 Jorlanghataran related to basic competencies, material, sample questions and practice questions. The expert team (validators) involved in developing this tool consists of five experts. The validation results from the five validators stated that they were valid with a total average RPP of 4.40; Student Books 4.39; LKPD 4.49, Mathematical solving ability test and student learning independence questionnaire valid.

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Learning tools are said to be valid due to several factors, including: first, the learning tools developed have met content validity. This means that the development of learning tools is in accordance with the demands of the existing curriculum. These curriculum demands relate to core competencies (KI) and basic competencies (KD) that students must achieve in learning activities that are adapted to the material or content of the lessons provided. The above is in line with the opinion of [19] that content validity is the accuracy of a test in terms of the content of the test (measuring instrument). A measuring instrument is said to have content validity if the content or material of the measuring instrument is truly representative material for the learning material provided. This means that the contents of the measuring instrument are estimated to be in accordance with what has been taught based on the curriculum., [20] also stated that good content validity is if a learning tool can measure certain specific objectives that are parallel to the material or lesson content provided. This content validity is also often called curriculum validity.

Second, the learning tools have met construct validity. This means that the development of this learning tool is in accordance with the concepts and indicators of mathematical problem solving abilities. The learning tools developed are designed to complement the Learning Implementation Plan (RPP), Student Books and LKPD (Students' Worksheets) which are adapted to measure students' mathematical problem solving abilities and learning independence. Fulfillment of good validity aspects as stated above is in line with the opinions of [21] stated that the validity aspect refers to the extent to which the design of the tool being developed is based on content validity and construct validity.

Based on the results and opinions above, and supported by research conducted by Zakiamani. A, [22] a learning device is said to be valid, if the expert assessment shows that the development of the device is based on a strong theory and has internal consistency, namely that there is an interrelationship between the components in the device developed by Mustarni in [23]. Furthermore, the same thing was also revealed through the research results of [24] that the learning tools developed had met valid qualifications because they had reached the minimum good criteria. Thus it can be concluded that the learning tools developed have met the valid criteria.

CONCLUSION

Based on the results of the analysis and discussion in this research, several conclusions are put forward as follows: The hypercontent-assisted PMR-based mathematics learning tool developed was declared valid for use to improve mathematical problem solving abilities and learning independence for class VIII students at SMP N 1 Jorlang Hataran. The average validity of the lesson plans is 4.40, the average validity of student books (BS) is 4.39, and the average validity of student worksheets (LKPD) is 4.49. Increasing the ability to solve mathematical problems and independent learning of class VIII students of SMP N 1 Jorlang Hataran through the PMR-based mathematics learning tool assisted by hypercontent which was developed was stated to have increased from trial I to trial II as seen from N-Gain. In trial I, the increase in students' mathematical problem solving abilities and learning independence had the same N-ga¬in, namely 0.44 "medium". In trial II, the increase in mathematical problem solving abilities was 0.55 and the student's learning independence increased by 0.58. The hypercontent-assisted PMR-based mathematics learning tool that was developed was stated to be practically used to

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improve mathematical problem-solving abilities and learning independence for class VIII students at SMP N 1 Jorlang Hataran. Practicality is seen from the level of learning implementation (Ok), namely the criteria for being well implemented with a score of Ok = 3.38. The hypercontent-assisted PMR-based mathematics learning tool that was developed was declared to have been effectively used to improve the mathematical problem-solving abilities and learning independence of class VIII students at SMP N 1 Jorlang Hataran. Effectiveness is viewed from 1) Classical completeness reached 90.63%, having met the completeness criteria. 2) Student responses to learning were very positive with a score of 97.44%.

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