Development of Learning Tools Based on Realistic Mathematics Approach Using Hypercontent for Improving Student's Problem Solving Ability and Learning Independence at VII Grade

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Abstract. The purposes of the research 1) analyze the validity, practicality and effectiveness of learning tools based on realistic mathematics approach using hypercontent to improve problem solving skills and learning independence; 2) analyze the improvement of mathematical problem solving ability and learning independence using learning tools based on realistic mathematics approach using hypercontent. This study used the ADDIE development model. The results of the study 1) Learning tools based on realistic mathematics approach use hypercontent to improve problem-solving ability and learning independence has fulfilled the criteria, valid, practical and effective; 2) Student's problem solving ability using learning tools based on realistic mathematics approach using hypercontent increased from trial I 0.42 to 0.62 in trial II and student's learning independence using learning tools based on realistic mathematics approach using hypercontent increased from trial I 0.492 to 0.556 in trial II.

Keywords: Realistic Mathematic Appoach, Hypercontent, Problem Solving Ability, Independent Learning

1. Introduction

However, the facts on the ground show that students' mathematical abilities are not satisfactory enough. Thus, it is very important to develop students' abilities, one of which is problem solving skills.

Problem solving is the basis of mathematical activities, so the curriculum should focus on problem solving. The importance of problem solving is because in the learning stage or solving it allows students to gain experience by utilizing their knowledge and skills to be practiced in non-routine problem solving. (Kesumawati, 2010:4) Problem solving is a process of students getting a combination of various previously studied rules for solving the next problem.

The explanation above shows that problem solving ability is a very important aspect for students' cognitive development. Problem solving is an element of a mathematics program because in studying or solving it, students are allowed to gain experience by utilizing their knowledge and skills to be applied to non-routine problem solving.

The mathematical problems that exist in schools such as low mathematical problem solving abilities cause low mathematics learning outcomes, requiring educators to apply

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various efforts to improve such conditions. Educators can improve learning tools and strategies.

Freudental (Ningsih: 2014) Mathematics is a human activity and must be associated with reality. Mathematics is a science that must be constructed by students themselves, not a ready-made result. The Realistic Mathematics Approach (PMR) positions reality and the learner's environment as a learning reference. Learning does not begin with definitions, theorems, or properties accompanied by various examples, but the definitions, theorems, and properties are expected to be sought by students independently.

Realistic mathematics education has three main principles, including (Gravemeijer: 1994), guided reinvention through progressive mathematizing (Guided Reinvention Through Progressive Mathematizing); didactic phenomena (Didactical Phenomenology); self-developed model development. And five characteristics including (Treffers, 1897) 1) use of context; (2) the use of approaches to progressive mathematization; (3) the use of student constructs; (4) interactive activities; (5) continuity.

By considering the need for alternative learning for independent study that can using hypercontent in learning include being able to make lessons more interesting because of the access to QR Codes that make it easier to understand theory through modules that are connected to videos and images.

The digital generation will learn more easily by utilizing Hypercontent-based learning. In simple terms, hypercontent can be considered as an idea that combines a material with different materials at once in a certain computerized innovation program. Another definition of hypercontent is a link (link) in a virtual word (virtual space), namely through the merging of two spaces such as virtual space with reality. Thus knowledge does not only come from books, but by watching learning videos and reading modules in digital form by accessing links or scanning QR Codes listed in books and Student Worksheets (LKPD) by accessing the internet through their smartphones.

This is what prompted researchers to conduct research with the title "Development of Mathematics Learning Devices Based on Realistic Mathematics Approach (PMR) Using Hypercontent to Improve Problem Solving Ability and Learning Independence of Class VII Students".

2. Theoretical Study

2.1 Problem Solving Ability

In studying mathematics, students are expected to have mathematical abilities, one of which is problem solving skills. Problem solving is a person's potential in utilizing his thoughts to solve problems by collecting facts, analyzing information, designing alternative solutions, and determining the most effective problem solving to do.

Next Activities that can be grouped as mathematical problem solving include problem solving in the form of story problems in textbooks, solving non-routine problems or puzzles, practicing mathematics for concrete problems, and making or testing conjectures that can help find fields of study.

Ruseffendi (1991) That giving various problem-solving questions for students had reasons including: 1) it could arouse curiosity, provide motivation, support creativity in thinking; 2) in addition to having knowledge and skills (counting and so on), they are required

to have reading skills and produce correct statements; 3) can make original answers unique, and varied, and knowledge is increasing; 4) the application of knowledge gained is increasing; 5) provide benefits for students because it covers various fields of study.

So that the point of learning problem solving is students' efforts to get used to solving various problems using good memory, experience and knowledge. Then students explore concrete objects and learn various mathematical ideas from informal to formal.

So problem solving ability is the ability of students to solve math problems to find answers by referring to the stages of problem solving, (1) understanding the problem (2) planning problem solving (3) solving problems (4) check again.

2.2 Realistic Mathematics Appoarch

The main idea of realistic mathematics is to provide opportunities for students to rediscover various mathematical ideas with guidance from educators (guide reinvention). With informal knowledge the teacher directs students to acquire various mathematical theories for their formal knowledge. With contestual problems that are understood, students use this informal knowledge to find various mathematical materials. The procedure can support students to learn interactively. The existence of contextual problems in realistic mathematics is very important in building students' mathematical concepts from informal to formal.

Streefland (Rini dan Ely 2003 : 3) Learning design with a realistic approach can be made through three key principles including (1) Guided reinvention and progressive mathematizing, (2) Didactical Phnenonology, and (3) Self Developed models. The characteristics of learning with a realistic approach include (Wijaya, 2012):

1) Involves logical problems as opportunities for application and references for the development of ideal mathematical ideas.
2) Utilizing models or extensions with vertical instruments through coordinated considerations on the presentation of schematics, models, and symbolization rather than transferring formulas or formal mathematics directly.
3) Utilizing the dominant student participation in the educational experience comes from the students themselves which are expected from informal to formal ways.
4) The occurrence of interactive activities in the course of lessons with explicit offers, cooperative interventions, and evaluations between students and educators is an important element in the productive educational experience by involving informal strategies to achieve formal.
5) Utilize ideas that are relevant, interrelated, and in accordance with other learning materials. Unify topics within and outside of mathematics.

2.3 Hypercontent

Hypercontent is an idea that links one material with other materials together in digital form. Almost the same as hypertext, which is a text that is connected to various other texts. Its real form is the various icons that appear on the website page, by clicking it will direct the user to various materials. Or a text contains and relates various other texts (hyper).

Hypercontent is an idea used to describe the location of a content (content) with other content that is connected simultaneously. Means all content that is interrelated in one linked is called hypercontent. The use of hypercontent in learning is growing along with the rapid development of information technology, especially online learning. The design of systematic learning materials using hypercontent is expressed as hypercontent-designed instruction.

Another definition according to Amin, et al hypercontent is linked (link) that combines two dimensions, namely the virtual world with the real world in virtual words (virtual world), namely hypercontent modules that can access various links such as cloud computing such as data centers or Google. drive, youtube, wikipedia and so on, which are accessed via online Qr-Code, Amin, dkk (2020:230)

It can be concluded that hypercontent is a link (link) to learning resources that become a concept in learning that links one material to other materials simultaneously in a certain digital program.

2.4 Learning Tools

Learning tools are various alternatives and guidelines that will be used in the learning process. Furthermore, Usman (2001) said that learning tools are a very important prerequisite for ideal collaboration of teaching and learning. Uno (2007) In the learning procedure describes the entire component of a set of learning materials and growing learning materials in a general sense must be based on the quality of students. Because the teaching materials grown basically should help students get accommodation in learning. In this review the learning tools in question are a collection of learning resources designed in a certain way to support the learning process, in the form of a lesson plan (RPP), student books (BS), student activity sheets (LKPD) and problem-solving ability tests.

3. Research Methods

This research is developmental research using the ADDIE model. This research focuses on developing mathematics learning tools based on realistic mathematics approach using hypercontent.

The research do in MTs S Hajijah Amalia Sari for Class VIII students. The object of this study was a learning device based on a realistic mathematical approach using hypercontent.

The scheme of the development model in this study is shown in Figure 1.

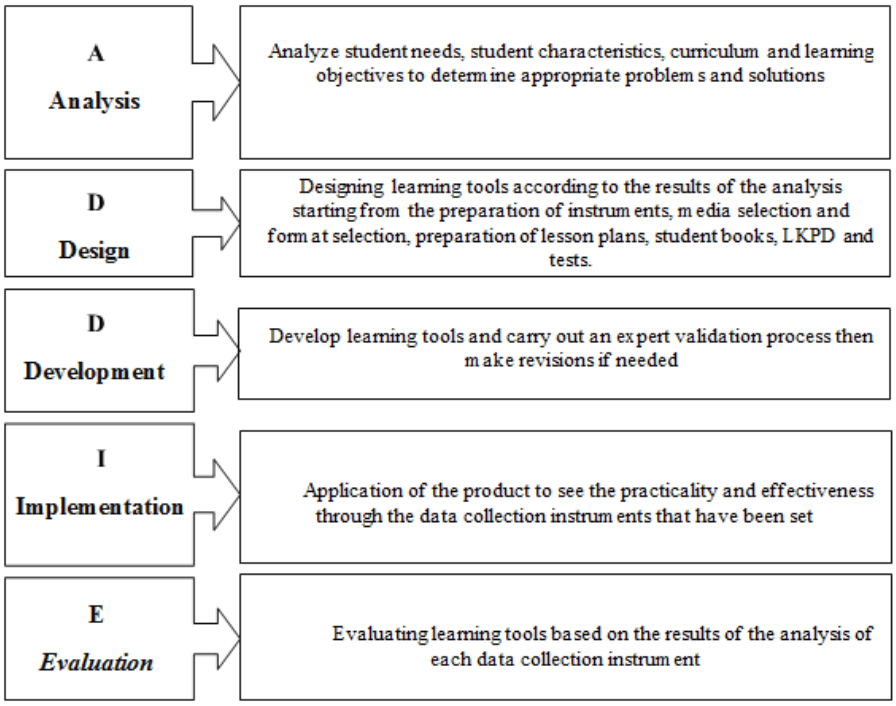

Fig. 1. scheme of the development model

4. Research Result

4.1 Description of Learning Device Development Stage

The results of this development research are learning tools based on a realistic mathematical approach using hypercontent. This development research has the objectives of (1) analyzing the effectiveness, practicality, and effectiveness of the developed learning tools and (2) improving students' problem solving abilities. In order to achieve this goal, the ADDIE Model is used to initiate the development research.

4.1.1 Analysis of the Results of the Validation of the Learning Implementation Plan

There are several indicators in the Learning Implementation Plan (RPP) which are included in the validator's assessment including: format, language, and content of the developed RPP which is presented in the table below:

Table 1. Results of Validation of Learning Implementation Plans

No	Aspect	Average of each Aspect	Average Total	Criteria
1	Format	4,25		Valid
2	Contents	4,2	4,2	Valid
3	Language	4,15		Valid

4.1.2 Analysis of Student Book Validation Results (BS)

The indicators in the student books included in the assessment of the validator include: format, language, illustrations, and contents of the developed student book (BS) as shown in the following table:

Table 2. Results of Student Book Validation (BS)

No	Aspect	Average of each Aspect	Average Total	Criteria
1	Format	4,171	4,139	Valid
2	Language	4,1		Valid
3	Illustration	4,2		Valid
4	Contents	4,085		Valid

4.1.3 Analysis of Student Worksheet Validation Results

The indicators in the LKPD included in the validator assessment include: the format, language, and content of the developed student worksheets as shown in the following table:

Table 3. Results of Validation of Student Worksheets

No	Aspect	Average of each Aspect	Average Total	Criteria
1	Format	4,166		Valid
2	Language	4,114	4,122	Valid
3	Contents	4,085		Valid

4.1.4 Research Instrument Validation Results

There are several indicators included in the validator's assessment including content validity, language and clarity. The results of expert validation for students' problem-solving ability tests are described as follows.

4.1.4.1 Problem Solving Ability Test (Pre Test).

The results of expert validation of the research instrument are contained in the following table:

Table 4. Validation Results of Problem Solving Ability Test (Pre Test).

No	Validator	Validator assessment on each item				Recommendation
		1	2	3	4	
1	Vdr 1	CV	CV	CV	CV	RK
2	Vdr 2	V	V	V	V	TR
3	Vdr 3	V	V	V	V	TR
4	Vdr 4	V	V	V	V	TR
5	Vdr 5	V	V	V	V	TR

Information:
Vdr = Validator
V = Valid
CV = Quite valid
RK = Usable with minor repairs
TR = Can be used without repair

4.1.4.2 Problem Solving Ability Test (Post Test).

The results of expert validation of the research instrument are contained in the following table:

Table 5. Validation Results of Problem Solving Ability Test (Post Test).

No	Validator	Validator assessment on each item				Recommendation
		1	2	3	4	
1	Vdr 1	CV	CV	CV	CV	RK
2	Vdr 2	V	V	V	V	TR
3	Vdr 3	V	V	V	V	TR
4	Vdr 4	V	V	V	V	TR
5	Vdr 5	V	V	V	V	TR

Information:
Vdr = Validator
V = Valid
CV = Quite valid
RK = Usable with minor repairs
TR = Can be used without repair

4.1.5 Test Results of Research Instruments

4.1.5.1 Trial 1

The implementation is seen from 3 aspects, namely: a) learning stages, b) social system, and c) the implementation of the management reaction principle with the prepared support system. A review of the results for the first test is shown in the following table:

Table 6. Observation Results of the Implementation of Trial Learning Devices 1

Information	Value
Average Trial Score 1	2,93
Information	low

Learning tools with a Realistic Mathematics Approach using hypercontent that were developed are appropriate to use if they can have a positive influence on learning. Effective learning tools can be seen from: (1) the achievement of learning mastery (if it has a minimum absorption capacity of 75%, while classical mastery is realized if the minimum student mastery is 80%) (2) student responses to learning are positive.

a. Mastery of Trial 1

The results of problem solving abilities on the pretest and posttest for trial 1 are listed in the following table:

Table 7. Completeness Level in Trial 1

Category	Pre test Total students	Classical Completeness Percentage	Post test Total students	Classical Completeness Percentage
Complete	12	37,5 %	22	68,75 %
Not Complete	20	62,5 %	10	31,25 %
Amount	32	100 %	32	100 %
Class Average	60,98		79,88	

The results of for each aspect are listed in table 8 below:

Table 8. Problem Solving Ability Test Results for Each Aspect in Trial I

Aspects of Problem Solving Ability	Mean	
	Pre test	*Post test*
Understanding the Problem	13,156	13,656
Planning Problem Solving	8,968	12,875
Solve the problem	8,593	12,5
Check again	8,312	12,093
Overall Aspect	39,029	51,124

The summary results of the n-gain mathematical problem solving ability test 1 are contained in table 9 below:

Table 9. Summary Problem Solving in Trial I

N-Gain	Interpretasi	Ttal Students
$n > 0,7$	Tall	2
$0,3 < n \leq 0,7$	Currently	24
$n \leq 0,3$	Low	6

The average value of N-Gain is 0.44 "medium" level or 44% with the Gain percentage.

b. Student Response Trial 1

The results of the questionnaire responses from 32 students after attending learning with a realistic mathematics approach using hypercontent are shown in the following table:

Table 10. Data Result of Student Response Questionnaire Recapitulation

No	Statment	Total Score
1	Students who stated that they were happy with the components of the learning media	91.25 %
2	states that the components and learning activities are still new	89.38 %
3	Students who express interest in participating in mathematics learning on other materials such as learning carried out	100 %
4	Students who state the language in student books, worksheets and tests are clear and understandable	90.63 %
5	Students who expressed interest in the appearance of student books and LKPD	95.31 %
Overall Average		93.31 %

Based on the category of effectiveness of student responses, the percentage of student responses is positive if they get more than or equal to 80% of students who give positive responses to the elements of the learning tools developed.

c. Students' Learning Independence in Classical Trial 1

The results of classical completeness of students' learning independence solving abilities before and after learning using the device developed for trial 1 are listed in the following table:

Table 11. Completeness in Trial 1

Categori	*Pre test* Total Students	Classical Completeness Percentage	*Post test* Total Students	Classical Completeness Percentage
Tall	2	6,25% %	27	84,375%
Currently	27	84,375%	5	15,63%
Low	3	9,375%	0	0%
Total	32	100%	32	100%
Average	50,573		70,708	

Table 12. Summary Results of n-gain values

N-Gain	Interpretasi	Total Students
$g > 0{,}7$	Tall	3
$0{,}3 < g \leq 0{,}7$	Currently	26
$g \leq 0{,}3$	Low	3

The average value of N-Gain is 0.42, "medium" level or 42% with the Gain percentage.

4.1.5.2 Trial 2

In this study, the implementation was seen from 3 aspects of observation, namely: a) learning stages, b) social system, and c) management reaction principle with the prepared support system. The description for the first test is shown in the following table:

Table 13. Results Trial Learning Tools 2

Information	Value
Average trial score 2	4,054
Information	tall

Learning tools with a Realistic Mathematics Approach using hypercontent that were developed are appropriate to use if they can have a positive influence on learning. Effective learning tools are seen from: (1) the achievement of learning mastery (if it has a minimum absorption capacity of 75%, while classical mastery is achieved if the minimum student mastery is 80%) (2) student responses related to learning are positive.

a. Mastery of Student Learning Classical Trial 2

The results of classical completeness of students' problem solving abilities in the pretest and posttest for trial 2 are listed in the table below:

Table 14. Completeness Level in Trial 2

Categori	*Pre test* Total Students	Classical Completeness Percentage	*Post test* Total Students	Classical Completeness Percentage
Complete	17	53,125%	27	84,375%
Not Complete	15	46,875%	5	15,625%
Amount	32	100 %	32	100 %
Class Average	63,818		86,230	

Table 15. Results for Each Aspect in Trial 2

Aspects	Rata-Rata (Mean)	
	Pretest	*Postest*
Understanding the Problem	13,718	15,062
Planning Problem Solving	9,593	14,125
Solve the problem	8,906	14,062
Check again	8,625	11,937
Overall Aspect	40,842	55,186

The increase in mathematical problem solving ability for test 1 is seen in the N-Gain The summary of trial 2 are contained in the following table:

Table 16. Summary in Trial II

N-Gain	Interpretasi	Total Students
$n > 0{,}7$	Tinggi	14
$0{,}3 < n \leq 0{,}7$	Sedang	14
$n \leq 0{,}3$	Rendah	4

The average N-Gain value of 0.62 "medium" level or 62% in the Gain percentage.

b. Student Response Trial 2

The results of the questionnaire responses from 32 students after attending learning with a realistic mathematics approach using hypercontent are shown in the following table:

Table 17. Data Result of Student Response Questionnaire Recapitulation

No	Statment	Total Score
1	Students who stated that they were happy with the components of the learning media	98,71 %
2	states that the components and learning activities are still new	89.68 %
3	Students who express interest in participating in mathematics learning on other materials such as learning carried out	100 %

4	Students who state the language in student books, worksheets and tests are clear and understandable	97.79 %
5	Students who expressed interest in the appearance of student books and LKPD	93,55 %
	Overall Average	95,95 %

c. Students' Learning Independence in Classical Trial 2

The results of classical completeness of students' learning independence solving abilities before and after learning using the device developed for trial 1 are listed in the following table:

Table 18. Completeness Level of Student Learning Independence before and after Learning in Trial 2

Categori	*Pre test*		*Post test*	
	Students	Classical Percentage	Students	Classical Percentage
Tall	2	6,25% %	27	84,375%
Currently	27	84,375%	5	15,63%
Low	3	9,375%	0	0%
Total	32	100%	32	100%
Average	50,573		70,708	

The increase in learning independence for trial 2 is seen in the N-Gain The summary results of the n-gain student learning independence test 2 are contained in table 19 below:

Table 19. Summary Results of n-gain values

N-Gain	Interpretasi	Total Students
$g > 0,7$	Tall	3
$0,3 < g \leq 0,7$	Currently	26
$g \leq 0,3$	Low	3

The average value of N-Gain is 0.55, "medium" level or 55% with the Gain percentage.

5. Discussion

This study focuses on the results of data analysis sourced from trials 1 and 2.

5.1 Validity of Developed Learning Tools

Based on the results of the validation, the elements contained in the Learning Implementation Plan (RPP), Student Books (BS), Student Activity Sheets (LKPD) and valid problem solving ability tests.

5.2 Practicality of Developed Learning Tools

The implementation that is applied to learning tools, the learning tools are called practical, their practicality is shown in the score of observing the implementation of learning for trial 1 with a moderate level, while for trial 2 obtained a score with a high level. Thus the learning tools developed are practical for use by educators and students.

5.3 Effectiveness of Developed Learning Tools

The results of trials 1 and 2, have been developed have reached an effective level in terms of: (1) classical student learning completeness; (2) a positive respon

5.4 Improved Problem-Solving Ability Developed

From trial 1 and 2, it shows that there is an increase in students' problem solving abilities. This increase can be seen from the average problem-solving ability test results obtained by students. Improvements are also seen in each of the indicators, namely there is an increase in the indicators of understanding the problem, planning a solution, implementing the solution and reinterpreting it.

5.5 Improved Learning Independence Developed

for trials 1 and 2 show that there is an increase in student learning independence. This increase can be seen from the average results of the learning independence questionnaire obtained by students. Improvements are also seen in each of the indicators.

6. Conclusion

The conclusions in this study obtained from the results of the analysis and discussion are as follows:

1. Learning tools is valid
2. Learning tools is practical
3. Learning tools is effective
4. Improving the problem solving ability has increased from trial 1 to trial 2.
5. Increasing student learning independence has increased from trial 1 to trial 2.

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