



## Development of Problem Based Learning Model Learning Tools to Facilitate the Mathematical Problem Solving Abilities of Grade VII Students at Junior High School

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### ABSTRACT

This research is development research (R&D) motivated by students' mathematical problem solving abilities (MPSA) and the limited learning facilities capable of facilitating students' MPSA. The research aims to produce a mathematics learning tool based on problem based learning with fulfillment of validation conditions which is also practical in order to support the MPSA of class VII at junior high school students in discussing social arithmetic. The development model is a 4D model developed by Tiagarajan and Semmel through four stages, namely define, design, develop, disseminate. The instruments for compiling research data are instruments were students daily test scores, test on students problem solving abilities, interview sheets, observation sheets, validation sheets and student response questionnaires. The study technique used is descriptive analysis. The learning tools were validated by three validators and also revised according to validator input, and tested in small groups for six students in class VII.2 at junior high school students and tested in large groups with 30 students in class VII.1 at junior high school students to see the practicality of the teaching materials in the form of student worksheets made with steps and questions on problem solving. Validation findings for syllabus, lesson plan, student worksheet are 3.52, 3.48, 3.48 in the very valid category. The findings of small group testing for student worksheet showed that student worksheet had been developed in line with practicality requirements with an average score of 3.31. The findings of large group testing for student worksheet obtained an average score of 3.50 and met the practicality requirements.

Keywords: learning media; problem based learning; problem solving skill

### INTRODUCTION

In the minister of education and culture number 58 of 2014 the 2013 curriculum, one of the objectives of learning mathematics is for students to understand mathematical problem solving abilities (MPSA). In line with this statement, Rezi Ariawan in (Frengki, Kartini & Nahor 2021), stated that MPSA is an essential skill related to the main focus for students to develop and possess through learning mathematics at school. Ayu Yarmayani (2016) KPM is an important ability that students must have, the ability to find solutions to problems to achieve knowledge learning, readiness, creativity in contextual application.

The previous statement shows that MPSA is important as an actualization of other mathematical abilities. However, in reality, students' MPSA has not yet met expectations. Rizky Restiani Fatmala (2020) emphasized that students' MPSA is relatively low because students are not used to working on solving mathematical problems. In addition, according to Dini Farera, Lies & Irma (2020), of the total number of students who answered, 67% did not fully understand the problem, 70% could not find a solution, 87% could not apply the

solution, and 85% could not look back at the answer. On the other hand, one of the causes of low MPSA is the implementation of learning that is not appropriate, and the role of students in knowledge construction is not yet optimal. In reality, learning activities are still teacher-centered. Garcia et al (2019) stated that mathematical problem solving is a difficult activity that involves solving many problems. Arjudin et al (2016) said that MPSA must be the center of attention so that research can continue.

Based on these facts, it is necessary to optimize the learning process to encourage better MPSA for students. In terms of facilitating MPSA, teachers need to make appropriate preparations and use learning models as a starting point for efforts to improve learning. Teachers need a learning method that can achieve learning goals. Problem Based Learning or abbreviated as PBL is one of the learning models in the 2013 curriculum which is in line with the scientific method and can support teachers in facilitating students' MPSA.

Lestari & Yudhanegara (2015) PBL is a strategic learning program that involves students analyzing problems through the scientific method stage so that students can learn knowledge related to problems while also having the skills to solve them. M. Fathurrohman (2017) PBL is a learning model that stimulates students' high-level thinking regarding situational problems in learning activities. Desi Anti Rahayu (2020) syntax in PBL includes orienting students to problems, organizing students to learn, guiding individual or group experiences, developing and presenting work results, and analyzing and evaluating progress in solving problems.

To implement PBL, learning tools are needed. Trianto (2015) said that learning tools are devices used in the learning process. Ibrahim in (Jumananta Hamdayani, 2016) learning tools are plan learning that includes activities to formulate goals to be achieved during learning activities. Learning tools such as student worksheet, lesson plan and syllabus. So that the tools created can support students' MPSA, the learning tools must be valid and practical. Nieveen (Frengki, Kartini & Nahor, 2021) Learning tools are considered good quality if they are valid and practical.

Based on the results of a literature study on mathematics learning tools for Social Arithmetic material (sales, purchases, discounts, profits, losses, single interest, percentages, gross, net, tare), obtained information that the syllabus was prepared without containing a learning model. Then the facts are taken from the lesson plan, the learning material in the lesson plan does not yet contain facts, concepts, principles and procedures, and there are no indicators of basic abilities and competency achievement; the learning model used is not written. Teachers conduct one-way learning, and students do not actively participate in learning. Students only focus on the problem solving steps taught by the teacher, resulting in students' problem solving ideas and creativity not developing. The teacher gradually, using the lecture method, presents the lesson material and presents examples in the textbook. To examine insights, the teacher also provides feedback and gives practice questions in the textbook to students. This of course has an impact on students' ability to solve problems by requiring an understanding of the concepts being applied.

Starting from various previous findings, the author believes that there is a need for research with the aim of producing a device learning in the form of a PBL-based

mathematics syllabus, lesson plans and student worksheet which also meet the validation requirements most practical to facilitate MPSA student in class VII at junior high school social arithmetic material. Researchers conducted research into the development of a learning tool based on problem based learning to facilitate students' mathematical problem solving abilities. The learning tool developed in this research involves contextual narrative questions in everyday life with the aim of getting to know and understanding the role of mathematics learning in everyday life and improving students problem solving abilities. This research as conducted on class VII social arithmetic material at junior high school.

## RESEARCH METHODS

The research aims to produce mathematics learning tools that can facilitate students' MPSA. The development model used is the 4-D Model which is a development model consisting of four stages, namely defining, designing, developing and disseminating.

The subjects in the research were seventh grade students at junior high school 1 Peranap. Six students participated in the small group trial, and thirty students participated in the large group trial. Research data was collected through surveys that assessed practicality and validity. To determine whether a learning tool is valid or not, the formula is used:

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

Information:

$\underline{M}_v$  = average total validity

$\bar{V}_i$  = average validation of the *i*th validator

*n* = number of validators

The distribution of validity is shown in Table 1.

Table 1. Validity Categories

Intervals	Category
$3,25 \leq \underline{M}_v < 4$	Very Valid
$2,50 \leq \underline{M}_v < 3,25$	Valid
$1,75 \leq \underline{M}_v < 2,50$	Less Valid
$1,00 \leq \underline{M}_v < 1,75$	Invalid

Suharsimi Arikunto, 2012 (in Ami Habibah et al., 2017)

Analysis of the practicality of student worksheet is calculated using the formula:

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

Information :

$\underline{T}_p$  = average value of total practicality

$\bar{P}_i$  = average practicality of the *i*th practitioner

*n* = number of practitioners

The response questionnaire criteria student The practicality of the student worksheet applied can be seen in Table 2, namely.

Table 2. Practicality Categories

Intervals	Category
$3,25 \leq T_p < 4$	Very Practical
$2,50 \leq T_p < 3,25$	Practical
$1,75 \leq T_p < 2,50$	Less Practical
$1,00 \leq T_p < 1,75$	Impractical

Suharsimi Arikunto, 2012 (in Ami Habibah et al., 2017)

## RESULTS AND DISCUSSION

This development research produced a PBL-based mathematics learning device product to facilitate MPSA for class VII at junior high school students in discussing social arithmetic. Learning findings in various stages are presented, among others

### 1. Definition Stage

The definition stage is composed of initial-finish analysis, student analysis, and concept analysis:

#### a. Initial Final Analysis

At this stage, information was obtained that the teacher had not created his own learning tools and the learning plan did not include facts, concepts, principles, procedures. There is still an emphasis on teachers in a direct learning style. Schools use ready-made textbooks containing summaries of material and a series of questions that do not help students directly in defining concepts.

#### b. Analysis of student characteristics

Learning ability, prior knowledge, and cognitive capacity are factors that must be considered when analyzing student characteristics. Based on characteristic analysis, class VII at junior high school students are able to think abstractly, reason logically, and draw conclusions.

#### c. Concept Analysis

The explanation of the discussion regarding learning tools sourced from the 2013 Curriculum for class VII at junior high school, with basic competencies for social arithmetic material is:

3.9 Introduce and analyze various situations related to social arithmetic (sales, purchases, discounts, profits, losses, single interest, percentages, gross, net, tare)

4.9 Resolve problems related to social arithmetic (sales, purchases, discounts, profits, losses, single interest, percentage, gross, net, tare)

By referring to these two basic competencies, the researcher created a concept map which can be seen in Figure 1, namely.

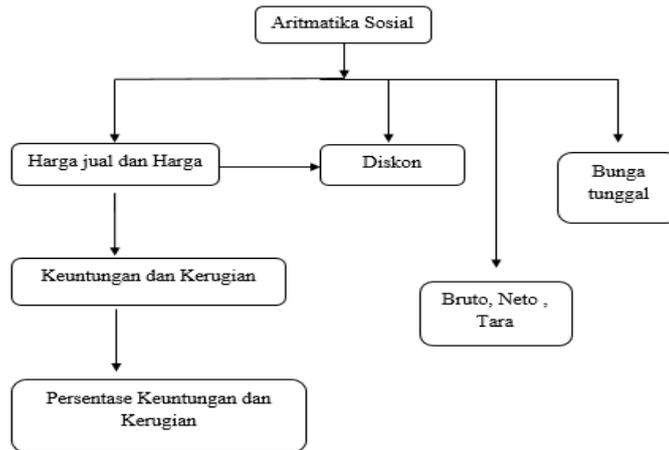


Figure 1. Concept Map

## 2. Design Stage

The next step after carrying out concept analysis is to create an initial design of learning tools. The learning tool consists of five meetings covering material: (1) Purchase price, selling price, profit and loss; (2) Profit percentage and loss percentage; (3) Discounts; (4) Single flower; and (5) Gross, net, and tare. Researchers also designed learning tool validation sheets for validators, and questionnaires for students to fill out. The following are the results of the design of learning tools and created by researchers

Kompetensi Dasar	Materi Pembelajaran	Indikator Pencapaian Kompetensi	Kegiatan Pembelajaran	Penilaian	Alokasi Waktu	Media/Alat/Bahan dan Sumber Belajar
3.9 Mengenal dan menganalisis berbagai situasi terkait aritmetika sosial (penjualan, pembelian, potongan, keuntungan, kerugian, bunga tunggal, persentase, bruto, neto, tara) 4.9 Menyelesaikan masalah berkaitan dengan aritmetika sosial (penjual, pembelian, potongan, keuntungan, kerugian, bunga tunggal, persentase, bruto, neto, tara)	1. Harga jual, Harga beli, Keuntungan dan Kerugian	3.9.1 Menentukan harga jual dan harga beli dari suatu kegiatan jual beli 3.9.2 Menentukan besar keuntungan dan kerugian dari suatu kegiatan jual beli 4.9.1 Menyelesaikan masalah kontekstual yang berkaitan dengan harga jual, harga beli, keuntungan dan kerugian dari suatu kegiatan jual beli	Melalui penerapan model <i>Problem Based Learning</i> (PBL) dengan pendekatan <i>scientific</i> , peserta didik melakukan aktivitas pada setiap fase berikut : <b>Fase 1 : Orientasi peserta didik pada masalah</b> • Peserta didik difasilitasi oleh guru untuk memahami suatu permasalahan kontekstual yang ditampilkan melalui <i>slide powerpoint</i> • Peserta didik memperoleh informasi logistik dan diberikan motivasi untuk terlibat aktif dalam aktivitas penyelesaian masalah <b>Fase 2 : Mengorganisasikan peserta didik untuk belajar</b> Peserta didik di dorong untuk mengamati permasalahan yang diberikan dalam LKPD-1, sehingga peserta didik dapat mengidentifikasi hal-hal yang diketahui dan ditanya. ( <b>Mengamati</b> ) Peserta didik diminta untuk menuliskan hal-hal terkait dengan permasalahan yang diberikan dalam LKPD-1 ( <b>Menanya</b> ) <b>Fase 3 :Membimbing penyelidikan individual dan kelompok</b> Guru mendorong peserta didik untuk mengumpulkan informasi terkait dengan penyelesaian masalah yang diberikan melalui LKPD-1 ( <b>Mengumpulkan Informasi</b> ) Guru mendorong peserta didik untuk menyelesaikan masalah yang diberikan dengan memanfaatkan informasi yang diperoleh peserta didik ( <b>Menalar</b> ) <b>Fase 4 : Mengembangkan dan menyajikan hasil karya</b> Peserta didik mempresentasikan hasil diskusi kelompok didepan kelas ( <b>Mengkomunikasikan</b> ) <b>Fase 5: Menganalisis dan mengevaluasi proses pemecahan masalah</b> Peserta didik difasilitasi oleh guru untuk memberikan tanggapan terhadap hasil presentasi.	<b>Pengetahuan</b> • Tes tertulis Berupa uraian • Penugasan berupa tugas individu/ kelompok <b>Keterampilan</b> • Tes tertulis Berupa uraian	3 x 40 menit	• Buku Matematika Siwa SMP/MTs Kelas VII Semester 2 Kurikulum 2013 Edisi Revisi Tahun 2017 Kementerian Pendidikan dan Kebudayaan • Lembar Kegiatan Peserta didik (LKPD-1)

Figure 2. Syllabus

**RENCANA PELAKSANAAN PEMBELAJARAN (RPP -1)**

Nama Sekolah : SMPN 1 Peranap  
 Mata Pelajaran : Matematika  
 Kelas/Semestr : VII/Genap  
 Materi Pokok : Aritmetika Sosial  
 Materi Pembelajaran : Harga Jual, Harga Beli, Keuntungan dan Kerugian  
 Alokasi waktu : 3 x 40 Menit

**A. KOMPETENSI INTI**

KI 3 :Memahami, menerapkan, menganalisis dan mengevaluasi pengetahuan faktual, konseptual, prosedural, dan metakognitif berdasarkan rasa ingintahunya tentang ilmu pengetahuan, teknologi, seni, budaya, dan humaniora dengan wawasan kemanusiaan, kebangsaan, kenegaraan, dan peradaban terkait penyebab fenomena dan kejadian, serta menerapkan pengetahuan prosedural pada bidang kajian yang spesifik sesuai dengan bakat dan minatnya untuk memecahkan masalah

KI 4 : Mengolah, menalar, menyaji dan mencipta dalam ranah konkret dan ranah abstrak terkait dengan pengembangan dari yang dipelajarinya di sekolah secara mandiri serta bertindak secara efektif dan kreatif, dan mampu menggunakan metoda sesuai kaidah keilmuan

**B. KOMPETENSI DASAR DAN INDIKATOR PENCAPAIAN KOMPETENSI**

Kompetensi Dasar	Indikator Pencapaian Kompetensi
3.9 Mengenal dan menganalisis berbagai situasi terkait aritmetika sosial (penjualan, pembelian, potongan, keuntungan, kerugian, bunga tunggal, persentase, bruto, neto, tara)	3.9.1 Menentukan harga jual dan harga beli dari suatu kegiatan jual beli 3.9.2 Menentukan besar keuntungan dan besar kerugian dari suatu kegiatan jual beli
4.9 Menyelesaikan masalah berkaitan dengan aritmetika sosial (penjual, pembelian, potongan, keuntungan, kerugian, bunga tunggal, persentase, bruto, neto, tara)	4.9.1 Menyelesaikan masalah kontekstual yang berkaitan dengan harga jual, harga beli, keuntungan dan kerugian dari suatu kegiatan jual beli.

Figure 3. Lesson Plan

**LEMBAR KERJA PESERTA DIDIK - 1**  
(LKPD - 1)

**Harga jual, Harga beli, Keuntungan dan Kerugian**

Untuk SMP/MTs Kelas VII

**Nama** : .....

**Kelas** : .....

**Kelompok** : .....

**Hari/ tanggal** : .....

**Tujuan Pembelajaran**

Setelah mengikuti pembelajaran ini, kamu diharapkan dapat :

1. Menentukan harga jual dan harga beli dari suatu kegiatan jual beli
2. Menentukan besar keuntungan dan kerugian dari suatu kegiatan jual beli
3. Menyelesaikan masalah kontekstual yang berkaitan dengan harga jual, harga beli, keuntungan dan kerugian

**Petunjuk Pengerjaan**

- 1 Bacalah LKPD-1 berikut dengan cermat kemudian pahami masalah yang diberikan bersama teman sekelompokmu
- 2 Diskusikan LKPD-1 ini bersama teman sekelompokmu
- 3 Btuti langkah-langkah kerja yang diajikan dalam LKPD-1
- 4 Jika ada yang kurang jelas, bertanyalah pada guru
- 5 Waktu yang disediakan untuk mengerjakan LKPD-1 ini adalah 30 menit
- 6 Setelah selesai mengerjakan LKPD-1, salah satu perwakilan kelompok akan mempresentasikan hasil diskusi kelompoknya di depan kelas

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Figure 4. Student Worksheet

### 3. Development Stage

In the development stage, the author develops the device learning of the harmony of the initial design. The development tool was developed and then validated through three validators. The validation results for the syllabus are very valid without validator suggestions and revisions. The results of the syllabus validation can be seen in Table 3.

Table 3. Syllabus Validation Results

Rated aspect	Average Rating of the Three Validators			Average	Category
	V1	V2	V3		
Complete syllabus identity	3.00	4.00	4.00	3.67	Very Valid
Core Competencies and Basic Competencies	4.00	4.00	4.00	4.00	Very Valid
Indicators of Competence Achievement	4.00	3.67	3.00	3.55	Very Valid
Time Allocation	4.00	4.00	3.00	3.67	Very Valid
Learning materials	4.00	4.00	3.00	3.67	Very Valid
Suitability of learning steps with the problem based learning model	4.00	4.00	3.00	3.67	Very Valid
Evaluation	2.00	3.00	3.00	2.67	Valid
Learning Resources	3.00	4.00	3.00	3.33	Very Valid
Average	3.50	3.83	3.25	3.52	Very Valid

The validation results show that the resulting device is very valid. Researchers ensure that the syllabus created is in line with the requirements of Minister of Education and Culture Regulation No. 22 of 2016 by obtaining an average validity score of 3.52 from three different validators, which places it in the very valid. The average rating is 3.67 on the

indicator that measures the completeness of the identity of the resulting syllabus. A perfect score of 4.00 was achieved by KI and KD in terms of usability. A value of 3.55 was obtained for the GPA suitability element. A score of 3.67 was given for the learning material element. The very valid category value is 3.67. The PBL model is considered suitable for use for learning activities. Nscore 2.67 for assessment of learning outcomes and 3.33 for learning resource elements.

The results of the validation of the PBL model lesson plan in discussing social arithmetic for class VII SMP/MTs can be seen in Table 4. Results of the RPP validation, namely:

Table 4. Lesson Plan Validation Results

Rated aspect	Average Rating of the Three Validators			Average	Category
	V1	V2	V3		
Completeness of RP components	3.50	4.00	4.00	3.83	Very Valid
Clarity of indicators of competency achievement	3.00	3.67	3.00	3.22	Valid
Clarity of learning objectives	3.00	3.67	3.00	3.22	Valid
Learning materials	3.80	4.00	3.00	3.60	Very Valid
Selection of approaches, models and learning methods	4.00	4.00	3.00	3.60	Very Valid
Tools, media and learning resources	3.00	4.00	3.00	3.30	Very Valid
Learning Activities	4.00	4.00	3.00	3.60	Very Valid
Conformity of learning activities with KPMM indicators	3.50	4.00	3.00	3.50	Very Valid
Assessment of learning outcomes	3.41	3.71	3.00	3.37	Very Valid
Average	3.46	3.89	3.10	3.48	Very Valid

Based on table 4, the total average of the three validators in the 5 lesson plans developed by researchers is 3.48, including the very valid category. The lesson plan is worth testing after apply input from the validator.

The validation results of the PBL model Student Worksheet with social arithmetic material for class VII at junior high school can be seen in Table 5.

Table 5. Student Worksheet Validation Results

Rated aspect	Average Rating of the Three Validators			Average	Category
	V1	V2	V3		
Student Worksheet cover display	4.00	4.00	3.00	3.67	Very Valid
Fill in the Student Worksheet	3.33	3.88	3.00	3.53	Very Valid
Suitability of Student Worksheet with the Problem Based Learning model	4.00	4.00	3.00	3.67	Very Valid
Conformity of activities in Student Worksheet with MPSA Indicators	3.00	4.00	3.00	3.33	Very Valid
Compliance with Didactical Requirements	3.20	4.00	3.40	3.40	Very Valid
Compliance with construction requirements	3.50	3.83	3.00	3.44	Very Valid
Compliance with technical requirements	3.62	3.75	3.00	3.45	Very Valid
Average	3.52	3.92	3.00	3.48	Very Valid

Table 5 shows that the five student worksheet developed by researchers have an average of 3.48 from three validators, which fall into the category very valid. After modifications are made according to the validator's suggestions, the student worksheet is ready to be tested.

Referring to the results of syllabus validation, lesson plan, and student worksheet, learning tools the author agrees that the fulfillment of the valid criteria is very valid and worthy of being applied through the suggested improvements. After the device was revised, class VII students at junior high school 1 Peranap participated in product testing in small and large groups. This test tests the feasibility of the student worksheet. The average student worksheet assessment for junior high school students is 3.31 in the very valid category. Students said that this worksheet was good, colorful, encouraged learning, and helped them understand the topic.

Product updates are based on student feedback in small group testing. Large group testing using product modifications. This test was carried out to examine whether the developed student worksheet could be used. After completing the student worksheet, students are asked to fill out a questionnaire. Based on student response questionnaires in large group trials, mathematics learning tools to encourage junior high school students' mathematical problem solving skills obtained an average of 3.50 in the very valid category. Small and large group testing of mathematics learning tools using the Problem Based Learning model to help class VII junior high school students in solving mathematics

problems has met the validation requirements. This research is limited to a valid and practical stage, so future research can be carried out to evaluate mathematics learning tools.

## CONCLUSION

Research development has resulted in a product in the form of a mathematics learning tool composed of syllabus, lesson plans and worksheet, also referring to the 2013 curriculum through the application of the Problem Based Learning model to facilitate the mathematical problem solving abilities of class VII SMP/MTs students who have met the valid and practical requirements after being validated by 3 people validator and testing expert for class VII junior high school students.

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