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DEVELOPMENT OF WORKSHEET RELATIONS AND FUNCTIONS PROBLEM-BASED LEARNING (PBL) FOR SUPPORTING PROBLEM SOLVING ABILITY

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Abstract

This is a design research study with the goal of developing worksheets based on relations and functions for valid, useful problem-based learning (PBL). to assist students in their problem-solving abilities. Examine The relevance of material relations and functions as material precondition material next, as well as the low background ability solving problem students have. subject of his research, eighth-grade SMP Palembang students. There are multiple phases to this study: 1) preliminary; 2) formative evaluation, which includes field testing, expert review, self-evaluation, and prototyping (one-on-one and small-group). Outcomes that were collected as work sheets. PBL stands for valid, practical problem-based learning based on student relations and functions. to assist students in their problem-solving abilities.

Keywords: PBL, relations and functions, student's worksheet

Abstrak

Penelitian ini merupakan penelitian d*esign research* tipe *development study* yang bertujuan untuk menghasilkan Lembar Kerja Siswa (LKS) relasi dan fungsi berbasis *Problem-Based Learning* (PBL) yang valid, dan praktis untuk mendukung kemampuan pemecahan masalah siswa. Penelitian ini dilatarbelakangi oleh rendahnya kemampuan pemecahan masalah siswa dan pentingnya materi relasi dan fungsi sebagai materi prasyarat materi selanjutnya. Subjek penelitiannya siswa kelas VIII SMP Palembang. Ada beberapa tahapan untuk penelitian ini diantaranya 1) *preliminary*, 2) *formative evaluation*, yang terdiri dari *self evaluation, prototyping (expert riview, one-to-one dan small group)* serta *field test*. Hasil yang didapatkan berupa Lembar Kerja Siswa relasi dan fungsi berbasis *Problem-Based Learning* (PBL) yang valid, dan praktis untuk mendukung kemampuan pemecahan masalah siswa.

Kata kunci: PBL, relasi dan fungsi

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The following are the goals of teaching mathematics: (1) educating students to appreciate math; (2) teaching students to be self-assured in their ability to solve math problems; (3) developing students' ability to connect mathematics; and (5) teaching students to reason with math (NCTM, 2000). Based on the subject, students need to be capable of handling problem-solving. Relations and functions are one subject that requires math skills to solve problems. Eight graders of junior highschool were taught material relations and functions in addition to significance matters. This is being researched since the material in question is a straight line and also a prerequisite for the material (Ancient & Warmi, 2022). Relations and functions material has strong connections to daily life (Denbel, 2015). The issues that are provided typically form important information for comprehending the issues that are raised.

Problem solving is an activity that involves finding a way out of a situation that needs to be resolved; nonetheless, however, we need to have some frequent practices to train the problem solving ability (Lambertus & Sudica, 2017). Capacity to solve problems involves the student's capacity to

observe internal processes in mathematical settlement problems and come up with solutions based on steps. Examples of problem-solving techniques include understanding the problem, planning the solution, solving the problem, and checking the return (Havill, n.d.). Comprehending how to solve a problem can be summarised as a process of looking for answers that link to the essential issue and involve combining ideas or regulations. This abilty was relevant to daily life, thus the student required to develop the ability. This ability aids students in information analysis, design, and alternative solution compilation.

According to the study, Subaidah indicated that the ability to digest information and arrange alternative solutions is useful in achieving the target destination (Subaidah, 2020). The significance of the student's skill lies in his capacity to find alternative solutions to problems and his true ability to play a crucial part in life by solving problems and finding necessary solutions through problem-solving. Being capable of problem solving ability can be seen if student is able to comprehend, select an appropriate approach, and use it to solve the problem (Mita et al., 2019).

Nonetheless, students' capacity to solve required problems is not consistent with the field's current findings, despite the fact that students' ability to solve problems is demonstrated by All students possess this number. According to Purba & Warmi (2022); Dwi Putra et al. (2018); Julianti et al. (2021), problem-solving skills are also in the low category. Students who are not accustomed to being given difficult, non-routine problems to think about are less capable of solving challenges. According to research by Mulyati (2016), teachers frequently place more emphasis on material learning and algorithm settlement than they do on assignment-solving skills and ability. When faced with challenging, non-routine problems, students learn to apply prior knowledge to come up with a solution (Mulyati, 2016).

The primary issue that needs to be solved for capability of solving problem is, as evidenced by the low ability of solving problem. According to Zulfah (2018), device learning is one factor that determines the effectiveness of the learning process and math accomplishment aim. In the learning process, a variety of tools and components are employed, including lesson plans, instructional materials, exams, and syllabuses. Worksheet is one of the teaching resources used in schools. Worksheets are one type of instructional resource that teachers utilise in their study sessions. Effective and engaging lesson plans facilitate students' attainment of learning objectives and align with the curriculum (Idka Putri, 2022). A new worksheet designed to build students' knowledge and help them reach the goal of learning mathematics—namely, the capacity to solve mathematics problems—can help overcoming cases when they lack the necessary skills. A model is used as the foundation for worksheet development, which is one of the innovations produced in worksheets. The best worksheet could be created if it was suitable for both solving problems and relevant learning models.

Sumartini (2016) states that in order to improve a student's ability for problem-solving, proper learning is necessary. An approach to improve students' capacity for problem-solving that is problem-

based learning approach (Sumartini, 2016). Students who are challenged with real-world problems or who begin with real-world problems are said to be learning through problem-based learning (PBL) (Tan, 2003; Wee, LKN, & Kek, 2002; Tan, 2021). According to Hudojo (1988), PBL is a person's process for looking for a solution from an issue they encounter till it is resolved (Hudojo, 1988). Problem-Based Learning (PBL) can be concluded as an existent learning approach that involves students in solving or finishing real-world problems based on the description. Students are exposed to high-level skills and critical thinking through the PBL paradigm. Aulia, L. & Budiarti, Y. (2022) conducted a study that was previously related to PBL and shown the impact of the problem-based learning (PBL) model on ability solving based problems. Research by Hidayati (2022) shows that using the PBL learning approach can improve students' understanding of maths.

Correlated research using worksheet evidence like in Anggraini et al.'s research based on matter logarithm for senior high school students to provides a practical worksheet derived on observations and one-on-one interviews. The worksheet's impact on students' perceptions is demonstrated by its own potential (Anggraeini, 2022). With an average percentage of 80.74%, the Osin et al. (2019) worksheet, which is based on discovery learning on material arithmetic social, fulfils the valid category. The practical category is employed in learning and satisfying the effective category. The validity of the assessment worksheets used in seventh grade students is derived from the validator using the facet content, construct, and language (Osin et al., 2019). Study of Apertha and Yusup; creation of a worksheet based on rectangular, open-ended material classified as legitimate, practicable, and feasible used in mathematics for seventh grade students; evaluation of facet content, construct, and language validity rated validator; practicality obtained from small group trials; and efficacy evident from outcomes. This demonstrates how the worksheet that was created can support students in comprehending the exercises and topics that they have studied (Khairul Putri Apertha & Yusup, 2018).

METHODS

Numerous qualitative studies using design research methods and development study types were used in this investigation. Primary research is to create worksheets on relations and functions based on problem-based learning (PBL) to support students' problem-solving skills. This study's use technique Tessmer (1993) states that the stages completed by design research are the kind of development study that is employed in the research. According to Tessmer (1993), there are two stages involved in this process: the preliminary stage and the prototype stage (Formative Evaluation), which involves self-evaluation, expert reviews, one-on-one, small-group, and field tests.

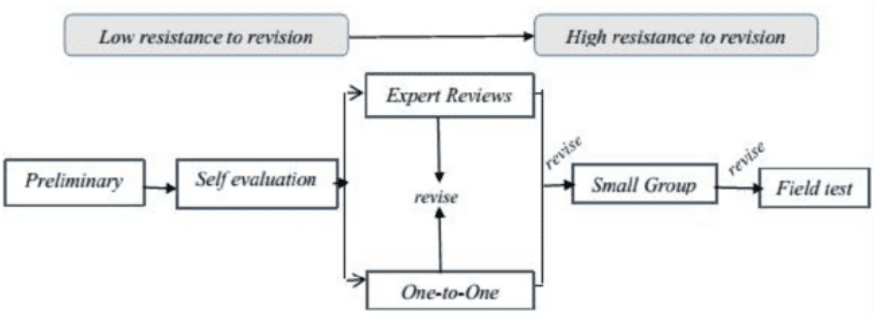


Figure 1. Formative Evaluation Design Flow (Tessmer, 1993)

The first stage is preparation, which includes choosing the research location and subject (in this case, Junior High School 8 Palembang) and the research topic (Eight grade students). Next, handle the research and procedures related to letter permission. collaboration amongst educators; Second the analysis stage, which includes examining students, the curriculum in use, and the examination of the material; Third, the design stage, problem designing in worksheet relations and functions that assist PBL-based problem solving for students. Prototyping (expert review, one-to-one, small group) and field testing are the components of the formative evaluation stage.

The collection and analysis data and examination of research including the walkthroughs, tests, interviews, and surveys. The purpose of the walkthrough was to gather professional reviewers' recommendations and comments regarding the validity of the worksheet's structure, content, and language. Review of the findings by experts. The experts were two math education lecturers from Sriwijaya University and a math teacher from Junior High School 8 Palembang. Test administered during the field test phase with the intention of gathering information regarding students' aptitude for solving issues and their completion of worksheets that have been produced.

Interview is done one-on-one and small groups. To learn about student comments and ideas and to understand the practicality of worksheets. Worksheet revisions were made based on feedback and recommendations. The closed questionnaire was employed, and its goals were to find out how students responded to the created worksheet and whether the worksheet was useful. The small group stage will make use of the questionnaire. Student responses to the questionnaire were quantitatively analysed, and the average percentage based on the criteria used to classify the results was calculated. Use the likert scale, which has a score range of 1 to 4, for scoring.

The average on the questionnaire sheet is calculated by:

$$Na = \frac{Number\ of\ scores\ obtained}{total\ scores} \times 100$$

Table 1. Categories Percentage Practicality

Achievement rate (%)	*description*
$84 \leq Na < 100$	Very practical
$68 \leq Na < 84$	Practical
$52 \leq Na < 68$	Practical enough
$36 \leq Na < 52$	Not practical
$20 \leq Na < 36$	Very impractical

(Sugiyono, 2013)

RESULTS AND DISCUSSION

The preliminary step of the study involved the investigation of the students, the curriculum, and the materials. Additionally, stage design has been completed for the PBL-based worksheet created to help students' problem-solving abilities. Researchers also prepare instruments to be used in learning, such as lesson plan and question tests to assess students' abilities to solve mathematical problems. During the formative assessment phase The first step is to evaluate oneself. A worksheet is created, reviewed, and completed.

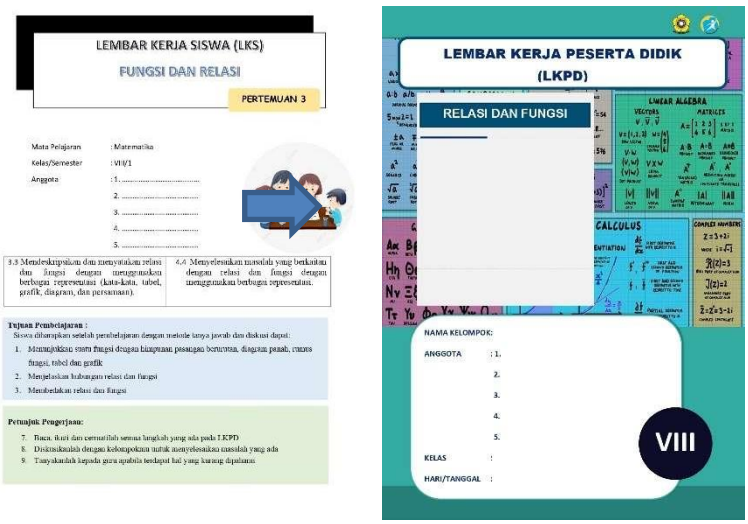


Figure 2. Initial prototype be prototype 1

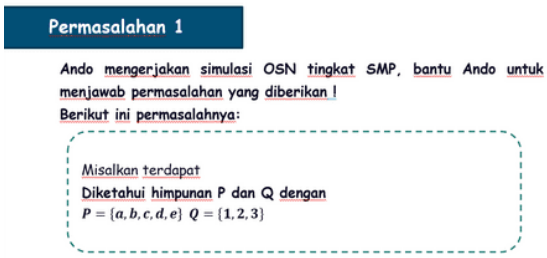
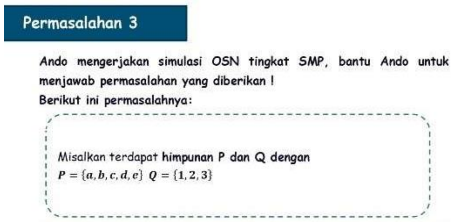
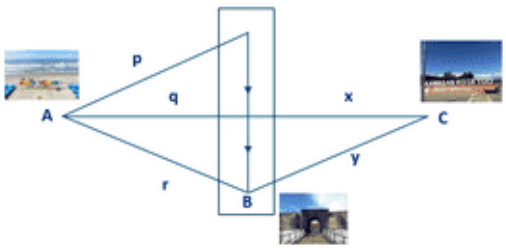
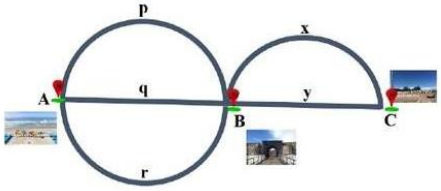
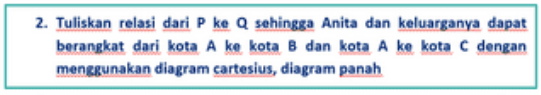
Figure 1 displays the findings of the stage self-evaluation revision. The researcher altered the worksheet cover to make it more interesting because the previous cover design was not enough intriguing. Expert Evaluations, phases in which experts review the designs, content, and language validated of this prototype. According to the aspect construct, the worksheet tasks with problem-solving skills, writing and picture layout, and suitability for PBL characteristics are all present. Regarding the aspect content, appropriateness with relevant curriculum, appropriateness with KI and KD in curriculum 2013. Regarding linguistic fit for EYD, the sentence is simple, doesn't create any questions about

interpretation, and doesn't touch on personal feelings. The researcher established the validity criteria and used them to construct a worksheet with appropriate and valid categories.

Subsequent feedback and recommendations provided by the validator on the sheet verification will be modified with the one-to-one findings. Conducted one-on-one trials in accordance with the validation provided by expert reviews. Expert validation accompanying one-on-one trials (Tessmer, 1993). The expert reviews' validation results have been confirmed by the one-to-one stage's outcomes (Syahbana, 2012). Three eight grade students of junior high school 8 Palembang participated in a one-on-one. Trial completed to assess student difficulties with the settlement problem in LKS and the clarity of the language used in the worksheet.

Student comments and suggestions as well as difficulty understanding in use of the word when student complete the worksheet later used for improve the developed worksheet. Validation results at the expert Prototype 2 has been formed fulfil valid criteria reviews and one-to-one stages can be seen in Table 1.

Table 1. Comments and Revision Decision

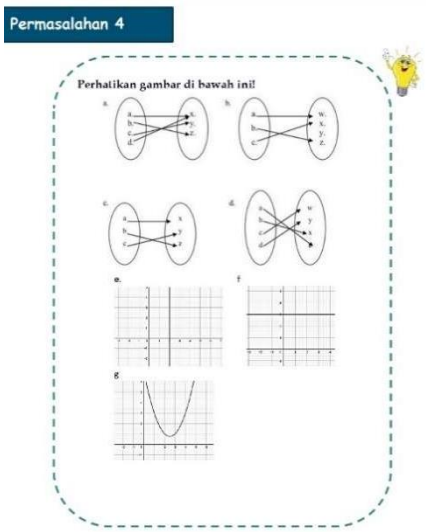
No.	*Comments/ Suggestions*	*Revision Decision*
1.	Problem 1 Remove known words The order of the problems is adjusted to the learning objectives 	Problem 3 Delete known words Order of problems from 1 changed to 3 
	Problem 2 Look again at the image used 	Problem 2 Replace image 
	Problem 2 The sentences used are ambiguous and ineffective 	Problem 2 Removing unnecessary words and replacing sentences so that they become effective

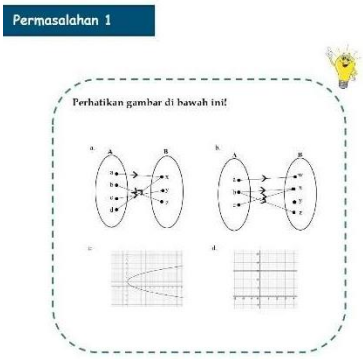
Problem 3
Pay attention to many issues and time allocations

Removing problem 3

Problem 4
For arrow diagram images, dots or dots are given
Pay attention to the order of the problems and adjust them to the learning objectives
Pay attention to many issues and time allocations

Problem 4 becomes problem 1
Add dots or dots to arrow diagrams
Change the order of problem 4 to problem 1
Remove some arrow diagrams and graphs and then replace them with appropriate arrow diagrams and graphs so that the learning objectives are achieved "students are expected after learning with the question and answer method and discussion to be able to distinguish between relations and functions".





Problem 4
Pay attention to many issues and time allocations

Problem 4
The question was deleted because it adjusted the time allocation and the types of functions were not
studied

Problem 4
Adding problems to problem 4 becomes a question that makes students analyze

Problem 4 becomes problem 1
Adding problems

Pay attention to time allocation

2. Ciri-ciri apakah yang dapat kamu amati agar sebuah kurva merupakan grafik fungsi dan sebuah diagram panah merupakan sebuah fungsi?

3. Jenis fungsi apakah yang terdapat pada gambar? Berikan pendapatmu!

2. Jika grafik pada gambar c bukan merupakan sebuah fungsi. Bagaimana cara membuat grafik pada gambar c tersebut menjadi sebuah fungsi?

Removing questions 2 and 3 in problem 4

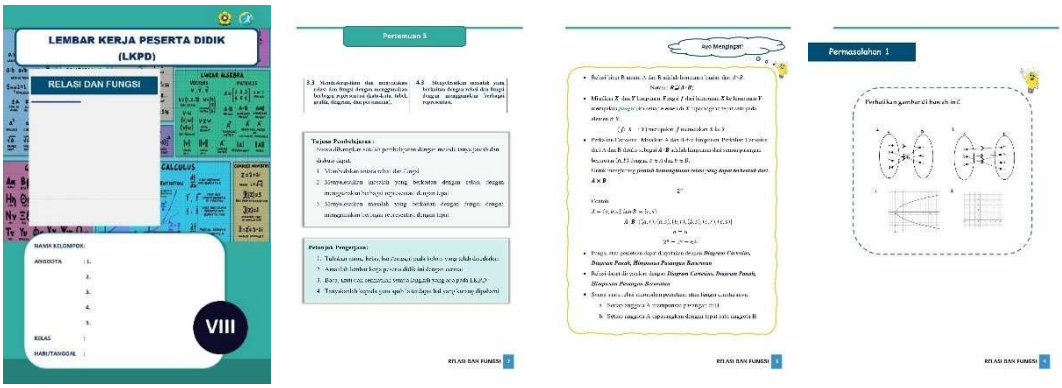
The procedure of reviewing through every aspect of the worksheet's content, organization, and design. The worksheet was reviewed with the expert once more after the prototype was revised in order to ensure that it met all relevant requirements to meet valid criteria. The next step involved putting prototype 2 worksheets to the test in two student groups of four and five members each. Currently, the goal is to see if the prepared worksheet can be completed practically through group discussion. The worksheet's effectiveness, efficiency, attractiveness, and usability demonstrate the usefulness of the design. The implementation was done offline with nine students of eight grade from junior school 8 Palembang. Students are given a student response form and a remark and suggestion sheet to complete after working on the LKS. Apart from completing the questionnaire, interviews were also held. The challenges and shortcomings found from the completed questionnaires and interviews were then incorporated into the worksheet's revision. Worksheet prototype 3 was derived from the revision outcomes.

2. Fungsi dari P ke Q disebut fungsi **menarik** jika memenuhi tiga syarat berikut.
a. Untuk setiap ncQ terdapat mcP sehingga $f(m) = n$.
b. Huruf vocal hanya dipetakan ke bilangan ganjil
c. Huruf konsonan hanya dipetakan ke bilangan genap
Nyatakanlah setiap kemungkinan fungsi **menarik** kedalam diagram cartesius, diagram panah dan pasangan berurutan!

2. Fungsi dari P ke Q disebut fungsi menarik jika memenuhi tiga syarat berikut.
- Untuk setiap anggota P memiliki satu pasangan pada anggota Q
- Huruf vocal hanya dipetakan ke bilangan ganjil
- Huruf konsonan hanya dipetakan ke bilangan genap

Nyatakanlah fungsi menarik kedalam diagram cartesius, diagram panah dan pasangan berurutan!

Figure 3. Prototype 2 Becomes Prototype 3



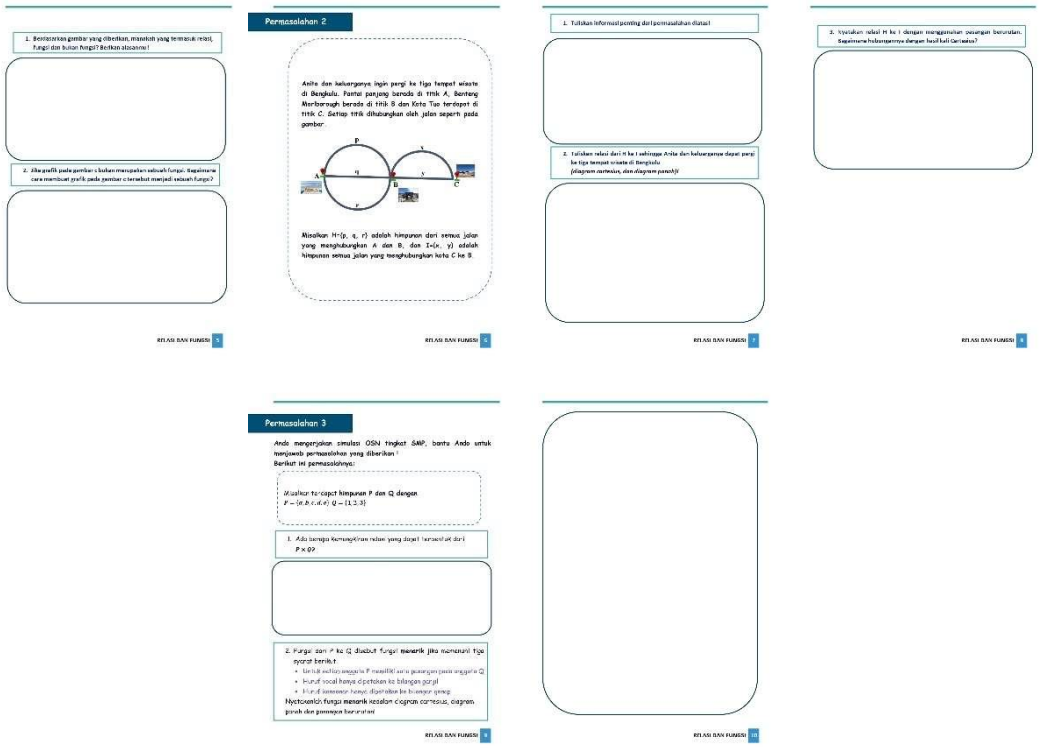


Figure 3. Valid and Practical LKS

The results of the revision at the small group stage are depicted in Figure 2, where the researcher decided to use simpler language to improve one of the criterion for becoming an intriguing function that was still difficult to grasp. Prototype 3 worksheets also satisfy practical requirements. Aspects of practicality include worksheet clarity, user-friendliness, and aesthetic appeal (Rahmadona et al., 2021). According to the practicality standards outlined by Akker (1999), it can be applied, as stated by experts and practitioners. Regarding the matter Opinion specialists (lecturers and teachers) who stated that the worksheet is possible indicated as much.

Second finding demonstrates the applicability of what was developed in small-group trials. The average is derived from results charging questionnaire response categorically 81.1% students practical in line with category based on questionnaire data analysis practicality from the worksheet small group data (Sugiyono, 2013). The already-developed worksheet has undergone testing for practicality and validation. The created worksheet was also tested in the validation test to ensure that it met PBL stages and supported students' ability to solve problems. According to Polya, students go through four stages: understanding the problem, planning the solution, solving the problem, and checking the result (Sudia & Lambertus, 2017).

CONCLUSION

It is concluded from the research and discussion that the relationship and function worksheet developed in this study supports students' problem-solving skills by providing a reliable and useful framework for Problem-Based Learning (PBL). The findings and discussion of expert reviews and one-on-one data demonstrated the worksheet's validity, and the results and discussion of student response questionnaire data in small groups demonstrated the worksheet's practicality and led to its classification as such. The third prototype worksheet has been considered valid and practical.

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