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A PjBL-Based Student Worksheet on Integers to Support the Numeracy Skills of Grade VII Learners

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ABSTRACT

This research is about the development of a PjBL-based student worksheet that aims to support the numeracy skills of students, especially at the junior high school level, and to describe the development process as well as the validity and feasibility of PjBL-based student worksheet on the topic of integers to support the numeracy skills of seventh-grade students. This research uses the ADDIE development model (Analyze, Design, Development, Implementation, evaluation). The development stages in this research are preliminary studies, planning, worksheet development, worksheet validation, and worksheet feasibility testing. The subjects of this study were seventh-grade students of a private junior high school in Surakarta, Central Java, Indonesia, in the 2023/2024 academic year. The data obtained from this study were interviews and questionnaire assessments. The worksheet validation by two expert validators showed that the worksheet was declared very valid with an average score of 3.725. The feasibility test results based on a questionnaire from students showed an average score of 3.248 with a very valid category.
***Keywords**: students worksheet, project-based learning, numeracy, integers*

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INTRODUCTION

Numeracy is applying mathematical concepts and number operations in everyday life. This ability refers to a comprehensive understanding that can express information mathematically through graphs, charts, and table (Han et al., 2017)With numeracy skills, learners can interpret the results of the analysis for further consideration in making predictions and decisions (Mahmud & Pratiwi, 2019).

Minimum Competency Assessment (MCA) is an activity to measure the actual minimum competencies required to map regions and schools according to these required competencies (Martiyono et al., 2021). The three elements of the MCA for numeracy are content, cognitive process, and context. Numbers, measurement and geometry, algebra, and data and uncertainty are the four elements of numeracy content. The cognitive processes in numeracy are understanding, application, and reasoning. Furthermore, the context in numeracy is personal, socio-cultural, and scientific (Ministry of Education and Culture, 2020).

Numeracy skills are learned from primary to secondary school. This is to achieve the objectives of the independent curriculum, which mainly focuses on simplification efforts and its thematic-integrative nature. Therefore, mathematics teachers must have the skills to manage learning that can optimize students' numeracy skills.

Teachers, as educators, certainly have the expertise to create a learning environment that can actively involve students in learning by providing relevant media and learning resources. A student worksheet is one of the media that can support the involvement of students in learning. A student worksheet is an activity guide for students that can be electronic or physical, where there are problems that must be solved by students by the learning objectives (Noprinda & Soleh, 2019). Teachers use student worksheets for successful learning so that teachers and students can interact effectively (Umbaryati, 2016).

Some factors determine the learning diversity of students, among others: (1) teacher factors, teachers can be seen from teaching abilities, personal attitudes, and knowledge; (2) learner factors, because students certainly have their talents, interests and motivations, analytical abilities, personal attitudes, and learning styles; (3) interaction factors seen from interactions between teachers-students-environment and learning systems; (4) facility factors, not only teachers and students but facilities also support learning, such as learning media, learning instruments, a supportive learning environment and learning resources (Tae et al., 2019).

Student worksheets have the benefit of helping direct students to find the concept of subject matter through individual and group activities, develop process skills, foster students' interest in the surrounding environment and scientific attitudes, and make it easier for teachers to assess students' success in achieving learning targets (Kristyowati, 2018). According to (Prastowo, 2012), There are four functions of student worksheets, namely: (1) as teaching material for students to be more active and minimize the teacher being the center; (2) as teaching material to assist students in understanding the material presented; (3) as practical and concise teaching material; (4) as a medium to facilitate the actualization of learning for students.

The learning model is one of the essential elements of learning. *Project-*

based Learning (PjBL) is one of the innovative learning models because it uses a project as a means of learning, thus making students more active during the learning process. Not only that, but students can work together in groups and manage time optimally so that they can produce a product that has *value*. (Melinda & Zainil, 2020). The PjBL model was taken because it can make students behave freely when learning takes place, make decisions, and then present the results of their discussions, which can invite students to play a more active role (Tascı, 2015). PjBL can make students think critically and systematically to be *multiple intelligences* because it uses this intelligence in all activities in the surrounding environment.

The PjBL model involves students actively, personally and in groups, in achieving learning objectives by producing actual products or works. (Dinda & Sukma, 2021). The steps of PjBL are: (1) providing fundamental questions; (2) designing product planning; (3) preparing a manufacturing schedule; (4) monitoring project activeness and development; (5) testing results; (6) evaluating learning experiences. (Ariyana et al., 2018).

Several previous studies have developed student worksheets to optimize mathematics learning. Research conducted by Nilam and Rejeki (2021) developed a student worksheet on solid figures by integrating van Hiele's theory to support the improvement of visual-spatial abilities of junior high school students. Meanwhile, research conducted by Aprilianti and Astuti (2020) developed a student worksheet on solid figure material for grade VIII high school students using the STEM learning model. Miftah & Setyaningsih (2022) developed an AKM-based student worksheet on geometry material to improve students' numeracy literacy skills. In addition, there is a development of a PjBL-based student worksheet for junior high school students on the subject of valid and practical triangles. (Saputri et al., 2022). A valid and practical PjBL-based student worksheet was also developed for the statistics topic. (Durohman et al., 2018). Furthermore, research conducted by Ulfah & Rejeki (2022) designed or, in other words, developed student worksheets on realistic mathematics education-based set material to support online learning in the COVID-19 era.

Based on some of these studies, there has yet to be much research on developing a PjBL-based student worksheet that aims to support students' numeracy skills, especially at the junior high school level. Therefore, this study describes the development process and the validity and feasibility of the PjBL-based student worksheet on integers to support the numeracy skills of seventh-grade students.

METHOD

The type of *research* used is development and research (*research and development*) (Sugiyono, 2013). According to Sutama (2019), research and development are steps or procedures to develop or improve products to create new products, all of which must be accountable. This research uses the ADDIE development model (*Analyze, Design, Development, Implementation, evaluation*). The analysis stage analyzes the core and essential competencies and the characteristics of students against teachers. The design stage, namely designing a PjBL-based student worksheet on integers to support the numeracy skills of Grade VII students, includes preparation of product

manufacturing, preparation of the student worksheet's basic frameworks, and preparation of research instruments.

At the development stage, expert validation is carried out to know the strengths and weaknesses of the student worksheet and make revisions according to the suggestions given until the product is said to be valid for testing. At the implementation stage, the effectiveness of the student worksheet was also tested with students. Furthermore, at the evaluation stage, namely analyzing the quality of the student worksheet in terms of the suitability of the material content, the final revision of the student worksheet that has been developed is carried out.

The subjects of this study were Grade VII students in a private junior high school in Surakarta, Central Java, Indonesia, conducted in the odd semester of 2023/2024. Data collection techniques used interviews and questionnaires involving teacher and lecturer respondents. Interviews were conducted at the analysis stage to determine the characteristics of students, media, and materials. Questionnaires are used to assess the validity of the PjBL-based student worksheet on whole number material to support the numeracy skills being developed in grade VII students. Questionnaires are also used at the implementation stage for the feasibility of the student worksheet.

Likert scale is the most commonly applied scale in research, especially analysis. The Likert scale measures a person or group's opinions, attitudes, and perceptions about an event or activity. The words used in expressing opinions on the Likert scale can be written, among others: Strongly Disagree, Disagree, Agree, Strongly Agree. For quantitative analysis purposes, the answer is given a score of Strongly Disagree (Score 1), Disagree (Score 2), Agree (Score 3), and Strongly Agree (Score 4) (Budiaji, 2013).

The data analysis techniques used in this research are quantitative and qualitative descriptive analysis methods. In this study, quantitative descriptive analysis is used to process data obtained through a questionnaire in the form of a score (Likert scale), which is then calculated using a percentage of each subject to determine the results of the product's validity. Furthermore, calculating the average indicator using the formula quoted from (Arikunto, 2010).

$$x = \frac{\sum x}{N}$$

Description:

x = Average value
$\sum x$ = Number of values
N = Number of subjects

Interpret descriptively qualitative with Interpret descriptively qualitative with assessment criteria. If the score is less than 2.00, then it is classified as invalid/not feasible; a score of 2.50-2.00 is included in the classification of less valid/less feasible, 3.00-2.50 is included in the valid/feasible classification; if the score is more than 3.00, then it is classified as very valid/very feasible. Figure 1 shows the Research Procedure.

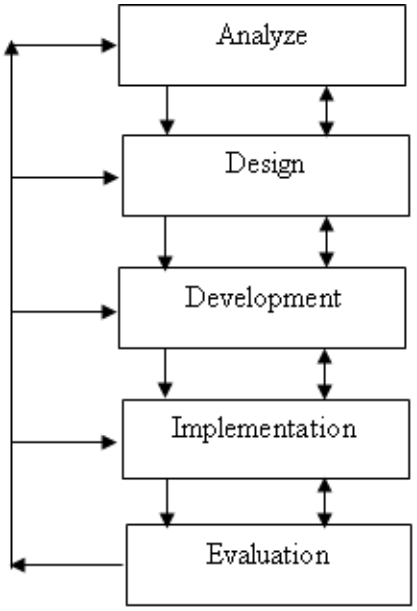


Figure 1. Research Procedure

RESULTS AND DISCUSSION

A PjBL-based student worksheet on integers to support numeracy skills in seventh-grade students was developed through research and *development* (R & D). The development model taken is *Analysis, Design, Development, Implementation, and Evaluation* (ADDIE). The stages of the method include analysis, design, development, implementation, and evaluation. However, this article only describes up to the implementation stage.

At the analysis stage, an analysis was carried out related to students' characteristics, the material's characteristics, and the media and teaching materials used in learning mathematics in grade VII. Based on the analysis results, students are active in the learning process because integer material is familiar, so students do not find it challenging to recall integer material. In addition, researchers developed two operations on integers, namely addition and subtraction. Students occasionally use student worksheets and listen to explanations from the teacher. The student worksheets used are from several book sources; the type of student worksheets given is *discovery learning* in the analysis of the material to be developed with Project-Based Learning-based student worksheets by researchers, namely integers in competencies 3.1 and 4.1.

In this design stage, the design of PjBL-based student worksheet components, which aim to produce a PjBL-based student worksheet product framework, is carried out. The composition of PjBL-based student worksheet products consists of a cover, the identity of the student worksheet compiler, a preface, a brief explanation of the student worksheet, a list of tables and a list of images, core competencies and essential competencies, instructions for using student worksheet, concept maps, indicators of competency achievement, the student worksheets content, and a bibliography.

The development stage begins with the process of preparing the content of the PjBL-based student worksheet followed by expert validation. The worksheet contains projects in accordance with PjBL syntax to support numeracy skills. PjBL syntax consists of: (1) providing fundamental questions; (2) designing product

planning; (3) preparing a manufacturing schedule; (4) monitoring the activity and development of the project; (5) testing the results; (6) evaluating the learning experience. Meanwhile, to support numeracy skills in number content needs to involve: (1) cognitive processes in numeracy, namely understanding, application, and reasoning and (2) context in numeracy, namely personal, socio-cultural, and scientific.

1. Fundamental Questions.

At this stage, the teacher asks fundamental questions about the topic to be learned. The question can be packaged in a case study in the real world, followed by a more in-depth search. The activity of providing basic questions in meeting one is presented in Figure 2.

Figure 2. Fundamental Questions for Meeting 1

2. Project Design.

At this stage, the teacher divides learners into groups and explains the project completion procedure. Furthermore, learners discuss to develop a project completion plan. The teacher also monitors the learners' group participation in completing the project. The project design activity in meeting one is presented in Figure 3.

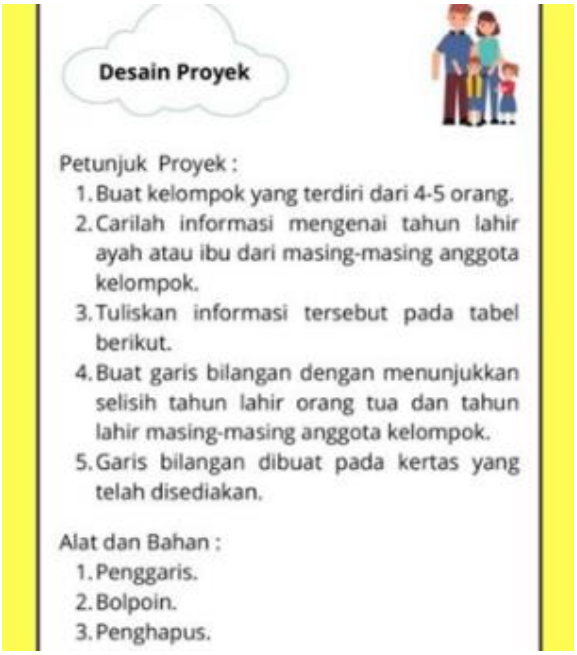


Figure 3. Project Design for Meeting 1

3. Testing Results.

At this stage, the project results are assessed when each group presents the results in front of the class. Furthermore, students and teachers make conclusions together. The results of the evaluation activity at meeting one are presented in Figure 4.

Figure 4. Testing Results for Meeting 1

4. Evaluation.

At this stage, the teacher and learners reflect on the project activities and results that have been carried out. This stage evaluates the activities as a reference for improvement for the next project assignment. Evaluation activities in meeting one are presented

in Figure 5.

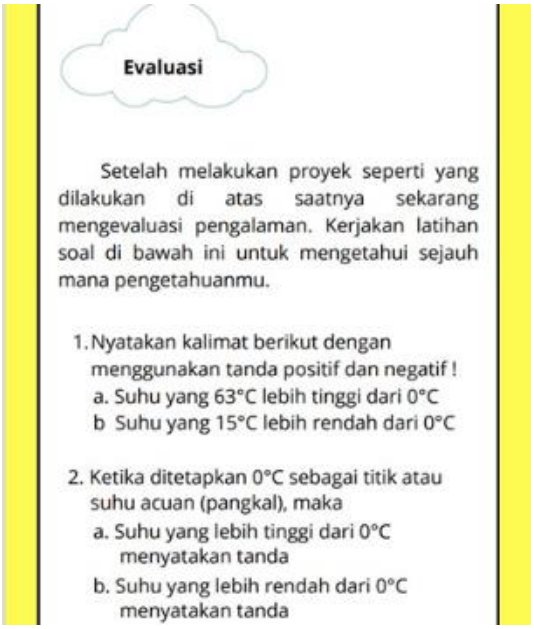


Figure 5. Evaluation for Meeting 1

Furthermore, the validation process is carried out to determine the validity of the PjBL-based student worksheet designed by researchers using open and closed questionnaires. Three aspects are content, linguistics, and presentation. Two experts in this study became validators: a mathematics education lecturer and a mathematics teacher. The validation results are described in Table 1.

Table 1. Expert Validation Results

No.	Aspects	Number of items	Average	Description
1.	Content	13	3.800	Very Valid
2.	Linguistics	3	3.500	Very Valid
3.	Presentation	4	3.875	Very Valid
Conclusion		20	3.725	Very Valid

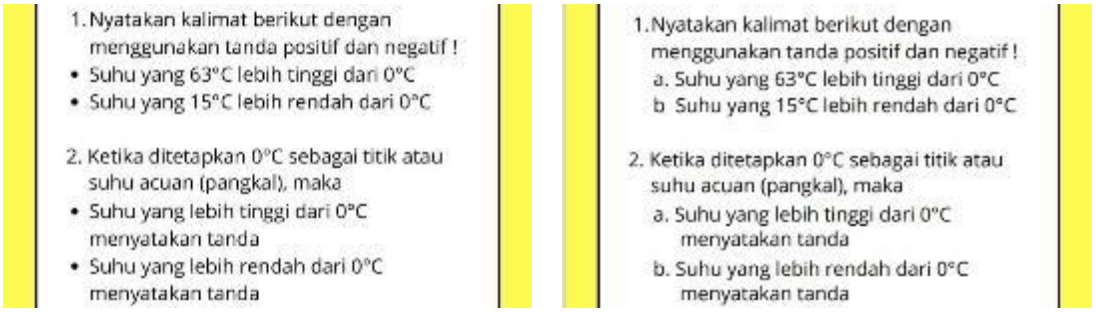
Table 1 shows that the developed student worksheet meets the highly valid category and can be implemented in mathematics learning. However, previously, there were some revision notes from both validators, including:

1. The learning objectives section of the first meeting needs to be rechecked for completeness and appropriateness.
2. In the project design section of the first meeting, there needed to be more information on where to answer the project.
3. In the evaluation section of the first meeting, the numbering rules need to be addressed.
4. The fundamental question section of the second meeting needs to be rechecked to make it easier to understand.
5. In the evaluation section of the second meeting, some sentences need to follow the correct language

rules.

6. In the project design section of the third meeting, there was an error in writing the project command.

Based on the suggestions and comments from the two validators, revisions were made to the student worksheet design. The figure below shows examples of the student worksheet displayed before and after improvement.

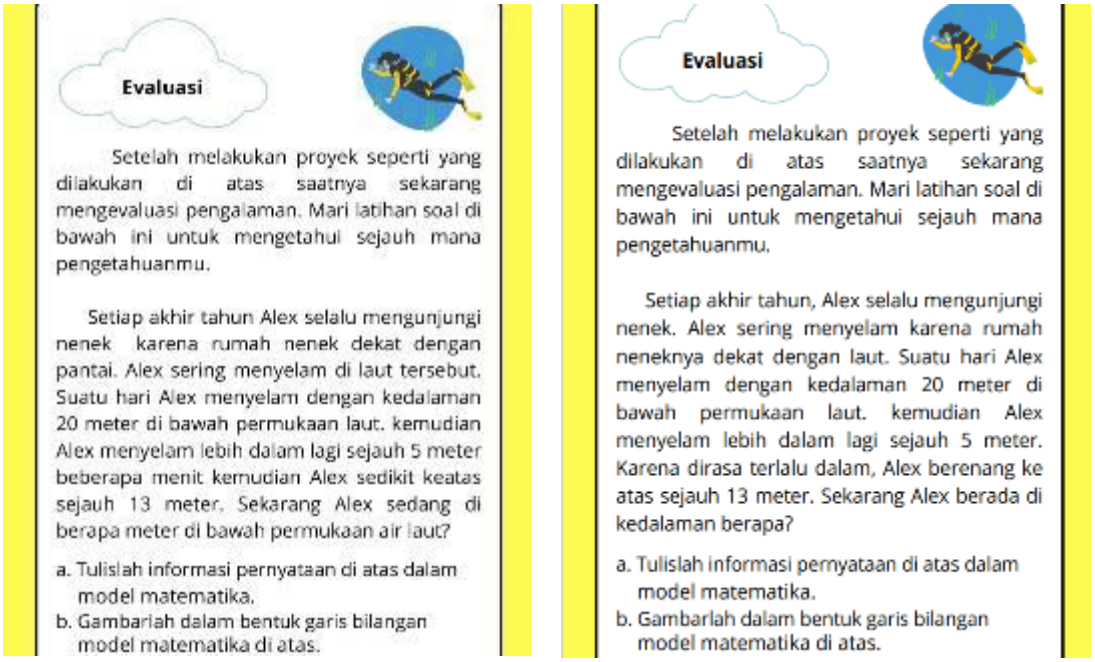


(a) (b)

Figure 6. Evaluation for Meeting 1 Before (a) and After (b) Revision

(a) (b)

Figure 7. Fundamental Question for Meeting 2 Before (a) and After (b) Revision



(a) (b)

Figure 8. Evaluation for Meeting 2 Before (a) and After (b) Revision

After the student worksheet is declared valid, the next stage is product testing or implementation. This student worksheet was tested on seventh-grade students at a private junior high school in Surakarta, Central Java, Indonesia. The pilot study was conducted involving 25 students. After implementing the student worksheet pilot, students were asked to fill out a questionnaire on the feasibility of the PjBL-based student worksheet that had been prepared. There are three aspects of the questionnaire, namely content, language, and presentation. The following are the results of filling out the questionnaire by 25 students.

Table 2. Students' Questionnaire Results

No.	Aspects	Number ofquestions	Average	Description
1.	Contents	7	3.183	Very valid
2.	Linguistics	2	3.260	Very valid
3.	Presentation	4	3.300	Very valid
Conclusion		13	3.248	Very valid

After analyzing the feasibility of the questionnaire filled in by students, an average score of 3.248 was obtained with a very feasible category. Therefore, the PjBL-based student worksheet on whole number material can be used as a medium for the learning process to support the numeracy skills of seventh-grade students. This research is in line with Nur'rohim & Somakim (2022), who state that student worksheets help learning so that students have better understanding skills. The research conducted by Khotimah and Sari (2020) showed that student worksheets guided students to grow their high-level thinking skills.

CONCLUSION

This development research has produced PjBL-based worksheets on whole number material to support the numeracy skills of seventh-grade students, which are very valid and feasible. This conclusion is based on the validation results of two experts with an average of 3.725, which can be categorized as very valid, and furthermore, based on the implementation results of an average of 3.248, which can be categorized as very valid.

The research and discussion results show that developing a PjBL-based student worksheet on whole number material significantly supports students' numeracy skills. This student worksheet was developed using the ADDIE development model, with the analysis, design, development, implementation, and evaluation stages. The PjBL-based student worksheet developed is focused on whole number material, which is part of the number content in the numeracy of Minimum Competency Assessment. Therefore, further research needs to develop PjBL-based student worksheets on other materials to support students' numeracy skills in algebra, geometry, and data and uncertainty content.

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