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Development of Digital-Worksheet on Social-Arithmetic Based on Problem Based Learning for Grade 7th

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ABSTRACT
There are many aspects of everyday life that apply mathematics concepts at some level, one of them is social arithmetic. However, many students have difficulty learning this subject. Many students have difficulty determining the appropriate arithmetic concept to apply in solving problems. As a result, students are ultimately unable to solve the problems they face. Furthermore, the majority of students are not accustomed to solving contextual problems that apply mathematical concepts to solve real-life problems. Students generally focus on calculation skills without understanding the concept or which concept is appropriate to apply. Therefore, social arithmetic learning should be designed as a real-life problem-solving activity. Therefore, in this study, problem-based learning media was developed for social arithmetic material. The learning media developed is digital, in accordance with the demands and needs of the current educational world. This study uses the Research and Development method with the ADDIE model. The product trial on material validation obtained 82.85% on valid criteria, 83.16% on aspects of media development, and 88.16% on practical criteria. The use of this learning media supports students' understanding of the use of mathematical concepts in solving real-life problems. Furthermore, Problem-Based Learning (PBL) supports students' ability to identify and apply appropriate mathematical concepts to solve given problems. This is demonstrated by the average student learning outcome of 89.8.

***Keywords**: Digital-worksheet; Social-arithmetic; Problem-based-learning*

INTRODUCTION
Mathematics plays a dominant role in human life, and it is widely applied as an essential element in personal achievements (Primi, Bacherini, Beccari, Donati, 2020). In the 21st century, mathematics plays a significant skill in individual satisfaction and involvement in society, school, and the labor market, and appears to be a key academic filter for students' educational trajectories (Pitsia, Biggart, & Karakolidis, 2017). Mathematics plays an essential role in supporting people to think, to reason and problem-solving skills. By taking a positive attitude towards mathematics, students will think that mathematics is fundamental, so they try to improve their performance in mathematics.

One of the mathematical concepts widely used in everyday life is social arithmetic. Ramadhany & Prihatnani (2020) stated that social arithmetic is learning material that presents things about selling and buying prices, profit, losses, tare, gross, interest, and even tax. Although the concept of social arithmetic is often encountered and applied in solving problems in the context of everyday life, several previous studies show that many students experience difficulties in understanding the concept of social arithmetic, especially in applying the concept to solve real-life problems (Rahayu & Istikomah, 2020; Dila & Zanthy, 2020; Kurni, Marzal, & Zurweni, 2022). Many students find it difficult to understand mathematical problems in the form of story problems. Dila & Zanthy (2020) explained two main difficulties faced by students in social arithmetic, they are (1) students are unable to interpret questions, difficulty in identifying what is known and what problems must be solved; (2) students have difficulty in determining the appropriate mathematical formula or formula to be applied to solve the given problem. This is because the student's learning pattern begins with an introduction to theoretical concepts, then continues with routine practice questions that emphasize calculation skills and do not support students in developing reasoning and applying mathematical concepts in solving problems (Dila & Zanthy, 2020; Lestary, Zulfah, & Astuti, 2023; Satiti, Hidayati, & Zuhriawan, 2023).

The problems in arithmetic learning as revealed in several previous studies above are consistent

with the results of observations and interviews conducted by the researcher. The researcher conducted observations of mathematics classes at SMPI Ar-Rahman Perak Jombang, and interviews with teachers and students. The results of the interviews and observations indicated that students experienced difficulties when asked to solve real-life problems. This included students being unable to determine the appropriate concept or formula for the given problem. Students were accustomed to simply performing calculations using formulas, without understanding whether the formulas and concepts used were appropriate. As a result, students were unable to determine the correct solution to the given problem.

Interviews and observations show that students' learning patterns begin with an introduction to concepts and theories, followed by practice problems. The problems presented are routine math problems, emphasizing arithmetic skills without providing students with the opportunity to develop reasoning and apply concepts to solve contextual problems. This pattern of activity leads students to perceive mathematics as a matter of calculation, without developing their understanding and thinking skills. This makes it difficult for students to be confronted with math problems presented in real-life contexts. Yet, many aspects of real life require mathematical skills to solve various problems. Therefore, learning is needed that provides problem-solving activities that encourage students to think and build conceptual understanding so that students can apply these mathematical concepts in problem-solving.

One learning method that supports students in improving their mathematical skills and knowledge, especially in solving problems from everyday life, is Problem-Based Learning (PBL) (Bosica, Pyper & MacGregor, 2021; Supriatna, Siregar, & Nurrahma, 2022; Lestary, Zulfah & Astuti, 2023). Uygun & Tertemiz (2016) explained that Problem-Based Learning is based on problem-solving and "contextual learning" which is used to investigate and solve complicated real-life difficulties. Therefore, PBL is suitable for learning social arithmetic because it emphasizes solving real-life problems.

Problem-Based Learning (PBL) is student-centered and supports students' understanding of the concepts being studied and supports students' ability to apply mathematical concepts to solve daily life problems (Jayahartwan & Sudirman, 2022). PBL-based learning consists of the following steps: (1) presenting a problem; (2) discussing the problem; (3) solving the problem; (4) sharing information; (5) presenting solutions; and (6) reflecting on the problem (Rosmala, 2021). PBL-based learning also encourages students to be more actively involved in learning because students learn through problem solving and discussions with groups or their peers (Kurni, Marzal & Zurweni, 2022).

In line with current technological developments, learning media should be technology-based, especially digital technology (Jenanda, 2021). This also presents a challenge for educators, who must provide learning media with active and engaging learning concepts in presenting material (Indarta, etc., 2022). One technology-based learning medium that can be used in learning is a digital worksheet. A digital worksheet is a digital tool that can be used to assist and facilitate understanding of material that must meet at least one criterion related to learning outcomes (Wijayanti & Ernawati, 2020).

The use of digital worksheets in 21st-century learning can make learning more effective and efficient (Suharnita, etc., 2021). Some advantages of using digital worksheets include the ability to combine them with various features such as videos and learning links, and the ability to present various types of questions, including descriptive, multiple-choice, short answer, and drop-down lists. The features in digital worksheets can be utilized to visualize translation, rotation, and reflection processes through animated videos. Furthermore, several other features, such as essays, are commonly used to train students' mathematical thinking skills (Lestari, etc., 2022).

METHOD

The method used in this study is Research & Development (R&D). R&D is a method to produce new products or improvements to existing products with new innovations and the application of certain theoretical foundations. The method applies the ADDIE model, namely Analysis, Design, Development, Implementation, and Evaluation. The purpose of this study is to produce a digital worksheet based on Problem Based Learning (PBL) on Social Arithmetic for junior high school/Islamic junior high school students that is valid, practical, and effective. Validity shows that the developed learning media contains the content of Social Arithmetic material according to the applicable curriculum, while practicality shows whether the developed media is feasible and easy to use. Effectiveness shows that the developed media can support students in understanding Social Arithmetic, developing mathematical knowledge and abilities, and supporting students' abilities in applying mathematical concepts to solve real-world problems.

To obtain valid results, expert validation was used for both content and media aspects. Practicality

was assessed by users, namely teachers and students. Effectiveness was tested using the N-Gain pretest and posttest. Techniques used in data analysis are as follows:

1. Expert assessment (expert validation)

$$x_i = \frac{\sum S}{S_{max}} \times 100\%$$

Annotation:

S_{max} = Maximum score
$\sum S$ = Total score
x_i = validity results

Table 1. Validity Criteria

Percentage (%)	Validity Level
81% – 100%	very valid
61% - 80%	Valid
41% - 60%	quite valid
21% - 40%	invalid
0% - 20%	very invalid

(Damayanti, etc., 2018)

2. Practicality assessment

$$x_i = \frac{\sum S}{S_{max}} \times 100\%$$

Annotation:

S_{max} = Maximum score
$\sum S$ = Total score
x_i = validity results

Table 2. Practicality Criteria

Percentage (%)	Level of Practicality
81% – 100%	very practical
61% - 80%	practical
41% - 60%	quite practical
21% - 40%	impractical
0% - 20%	very impractical

(Damayanti, etc., 2018)

3. N-Gain pretest and posttest

$$N - Gain = \frac{Skor\ Post\ test - Skor\ Pre\ test}{Skor\ Ideal - Skor\ Pre\ test}$$

pretest score : scores from pretest results
Posttest score : score from post test results
Ideal score : 100-the pretest score

Table 3. N-Gain Effectiveness Category

N-Gain Effectiveness Category	
Percentage (%)	**Category**
< 40	Ineffective
40-55	Less Effective
56-75	Quite Effective
> 76	Effective

RESULT AND DISCUSSION

The process of developing a digital worksheet based on Problem-Based Learning (PBL) consists of several steps. The following describes the study results according to the ADDIE model stages.

Result

1. Analysis
   Based on the results of the needs analysis, it was found that student learning was low, which was caused by a lack of understanding of the concepts and a lack of student activity. These results are consistent with the findings of several previous studies that showed that many students were less active in learning and their ability to understand the material was still low (Kurni, Marzal & Zurweni, 2022). Through interviews with students, the researchers also revealed that the material was not applied to everyday life. This is one of the factors causing students to lack understanding of the material concepts in classroom learning. In line with Ramadhany & Prihatnani (2020), mathematical concepts are often encountered in everyday life, but many students experience difficulty in understanding them.
2. Design
   In the design stage, researchers created a content framework and compiled digital worksheet materials. The developed digital worksheets contained five subtopics of social arithmetic: sales, purchases, profit, and loss, discounts, gross net, and simple interest. Once the product was designed, the digital worksheets could be used offline, and they could be printed. Furthermore, the digital worksheets were designed for online use through the Live Worksheets website and the Flipbook website.
3. Development
   Digital worksheets are developed based on the following development stages.
   a. In this stage the learning media was developed and enhance before before being assessed by experts. Therefore in this stage it was also developed expert validation questionnaire.
   b. Expert validation was conducted to determine the feasibility of the learning media before being implemented in real mathematics classroom. Expert validation contains two aspects; aspect of content material and aspect of media. In term of content, this learning media was reviewed by a mathematics lecture and a mathemtics teacher for junior high school. In term of media aspect, this learning media was reviewed by a mathematics lecturer that is expert ini developing learning media. The developed digital worksheet was declared feasible and could proceed to the implementation stage if the digital worksheet received a minimum rating of "Quite Valid" and had been revised according to the suggestions/comments from the experts.

   Based on the expert validation results, the average score for content was 82.85%, which meets the "Very Valid" criteria. Meanwhile, the average score for aspect media was 83.16%, which meets the "Very Valid" criteria. Therefore, it can be concluded that the learning media developed is suitable for the next stage, that is Implementation.
4. Implementation
   Implementation was carried out on a limited basis, which was carried out in one mathematics classroom. Implementation was carried out at SMPI Ar-Rahman Perak Jombang. There were 27 students at junior high school SMPI Ar-Rahman Perak Jombang as test subjects in this implementation.
   Based on the results of a study of student understanding after learning social arithmetic using the developed digital worksheet, the average class score was 89.8, and the Minimum Completion Score (KKM) for mathematics at SMPI Ar-Rahman Perak, Jombang, was 70. All students achieved a good understanding of the social arithmetic material.
   In addition to piloting the learning process using the digital worksheet, researchers also asked students to complete a pre-test given before the lesson and a post-test given after the lesson. The pre-test results showed that 27 students scored an average of 28.70. Only two students scored above 70 (the Minimum Completion Score), representing a 7% completion rate. Twenty-five students scored below the Minimum Completion Score (KKM), which is 93% incomplete. The post-test results showed that 27 students scored an average of 80.58. Students who obtained scores above the KKM were 22 students who fulfilled the mathematics learning completion category with scores above 70 (KKM score), where the percentage of student completion was 80.57%.
   Based on the pre-test and post-test results, it was used the N-Gain to analyze the effectiveness. The

average N-Gain result was 73.04%, which qualifies as quite effective. Therefore, the conclusion is that the Problem-Based Learning (PBL) digital worksheet on social arithmetic can be used as a learning media for mathematics in junior high school.

After the implementation was completed, it was carried out practicality assessment by user, they were students and mathematics teacher. Based on the practicality assessment, the average score was 88.16%, which meets “Very Practical" criterion. It indicates that the learning media developed, Digital worksheet on social-arithmetic based on Problem Based Learning can be used in mathematics classrooms.

5. Evaluation

   In the evaluation stage, it was reviewed the result obtained at each previous stages. Acording to practicality assessment result it shows that the learning media practical to be used in social arithmetic classrrom. Therefore this provides an opportunity to expand the implementation of the digital worksheet on social-arithmetic based on Problem Based Learning. It gives opportunity to disseminate this digital worksheet.

Discussion

1. Expert assessment (expert validation)
   Based on expert validation results, the material aspect scored 82.85% and the media aspect 83.16%, resulting in a "Very Valid" assessment.
2. Practicality assessment
   The results of the practicality assessment showed a result of 88.16%, which meets the criteria of "Very Practical".
3. N-Gain pretest and posttest
   The effectiveness test showed a result of 73.04%, which is in the fairly effective category.

Based on the results above, the developed learning media is valid and practical. Thus, this learning media is suitable for widespread use in Social Arithmetic learning at the junior high school/Islamic junior high school level. In addition, the evaluation results show that this Problem Based Learning-based learning media is effective. This shows that the developed media supports students in understanding the material, developing mathematical knowledge and skills in Social Arithmetic material, and supporting students in applying mathematical concepts to solve real-world problems. These results are in accordance with the results of several previous studies that show that digital-based learning media are practically used in mathematics learning (Khairunnisa & Ilmi, 2020; Marthani & Ratu, 2022; Azkia, Muin, & Dimyati, 2023) and PBL-based learning media supports students' abilities in solving real-world problems by applying the mathematical concepts they have learned (Widayanti & Nur’aini, 2020; Husnidar, & Hayati, 2021; Khikmiyah, 2021)

CONCLUSION

This study is aimed to develop a digital worsheet based on Problem Based Learning (PBL) approach for social arithmetic at junior high school. This study used ADDIE model as stages in developing the learning media. Based on expert validation results, the material aspect scored 82.85% and the media aspect 83.16%, resulting in a "Very Valid" assessment. The results of the practicality assessment showed a result of 88.16%, which meets the criteria of "Very Practical". Practicality assessment result shows that the learning media practical to be used in social arithmetic classrrom. Therefore this provides an opportunity to expand the dissemination of the digital worksheet. N-Gain pretest and posttest showed a result of 73.04%, which is in the fairly effective category. Therefore the learning media supports the students' abilities in solving real-world problems mathematics problems related to real life activities.

Suggestions for further study that is to expand the dissemination. Therefore it will expand the use of this learning media for mathematics classrooms. Moreover, the development of this media can be enhanced by varying the features of the digital aspect. So that it will improve the performance of the learning media.

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