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Developing Student Worksheet for Learning Independence

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Abstract. One type of teaching material that can train students to find concepts from teaching materials is Student Worksheet. This study aims to develop a valid, practical and effective Student Worksheet to facilitate the independent learning of students in the Integer Number System Material Number Theory course. This study uses the ADDIE development model which consists of five stages, namely Analysis, Design, Development, Implementation and Evaluation. The instrument used was an assessment questionnaire from material experts and teaching material experts to measure the practicality of the Student Worksheet and as a measure of the validity of the Student Worksheet and the independent learning questionnaire used to measure the effectiveness of the Student Worksheet. The research was conducted on Student Worksheet users, namely lecturers and students in the Integer Number System lesson in the Mathematics Education Study Program of the PGRI Yogyakarta University by filling out practical and independent questionnaires. From the results of the research data analysis, it is known that the Student Worksheet in the Integer Number System lesson developed meets the criteria of validity, practicality and effectiveness of student learning independence.

1. Introduction

Many things can affect the success in producing graduates who can be religious, professional, innovative, national commitment and have a global perspective. These abilities can be achieved in the learning process. The model, method, strategy or learning approach used can be tailored to the learning objectives. One of them is the use of teaching materials in the learning process.

To meet the achievements of quality graduates, there are several abilities that must be developed, namely the ability independent learning. The independence of students affects learning outcomes. Independent learner will be able to dig up information or knowledge and solve their own problem [1]. Independent learning is needed so that we can adapt to the environment quickly and independently. Learning independence can be improved by being continuously trained in the learning process. Experience and interactions with the environment can affect a person's learning independence, so that a supportive environment will increase independence [2].

Learning independence is the ability of students to manage their own learning [3]. According to Suhendri and Mardalena, independent learning can affect learning outcomes so that in everyday life students are expected to be able to increase their knowledge independently and be able to solve daily problems without dependence on other people [4].

Independent learning is an independent learning system based on discipline in terms of time, energy and cost according to individual conditions [5]. Teachers or lecturers must be able to facilitate the learning process so that students' cognitive abilities and soft skills can develop properly. Lecturers must be able to design the learning process with a variety of learning models and use learning media to improve the quality of learning.

Currently students have been able to easily obtain learning materials easily on the market or via online both in Indonesian and in English. Most of the teaching materials on the market are in the form of books or instructional videos that only convey material. These textbooks or videos do not train students to independently discover concepts from the material being studied. Likewise, for the needs of the Number Theory course.

Most of the teaching materials available are still reference books that only contain descriptions of the material. Teaching material that can make it easier for students to learn which is very influential in the learning process is the Student Worksheet [6]. Student Worksheet is a sheet that contains activity steps that must be filled in and carried out by students. Student worksheet is type of teaching material that can train students to find concepts from a material. By using Student Worksheets students can develop their own material to be studied in accordance with the learning objectives [7].

The use of Student Worksheets in learning makes students practice active activities that can develop ways of thinking based on their knowledge and skills [8]. A good Student Worksheet can facilitate teachers and students in learning and is able to help students solve their problems independently [9]. Several studies that have succeeded in proving that Student Worksheets are effective on learning outcomes are research with the title "Effectiveness Of Collaborative Students Worksheet To Improve Student's Affective Scientific Collaborative And Science Process Skills (SPS)" [10] and research entitled "The Effect of STEM- Based Worksheet on Students' Science Literacy" [11]. This shows that the Student Worksheet can be used as an alternative to use teaching materials.

Student worksheets can be prepared by lecturers according to their needs in the learning process for student learning independence. Independent learning of students must be trained as early as possible. Until now, there have been many researchers who have succeeded in developing Student Worksheets including [12] in development research entitled "Development of Student Worksheet Teaching Materials with a Realistic Mathematical Approach" and [13] with the research title "Development of Student Worksheets to Improve the Ability. of Mathematical Problem Posing". From several Student Worksheets that have been developed, researchers are interested in developing Student Worksheets which can facilitate student learning independence.

Based on the description above, it is important to develop a Student Worksheet. With the aim that students can find the concept of a material and student learning independence in the Integer Number System lesson.

2. Methods

This study is a Research and Development (R & D) research using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) method [14]. The stages of developing Student Worksheet can be seen in the following chart:

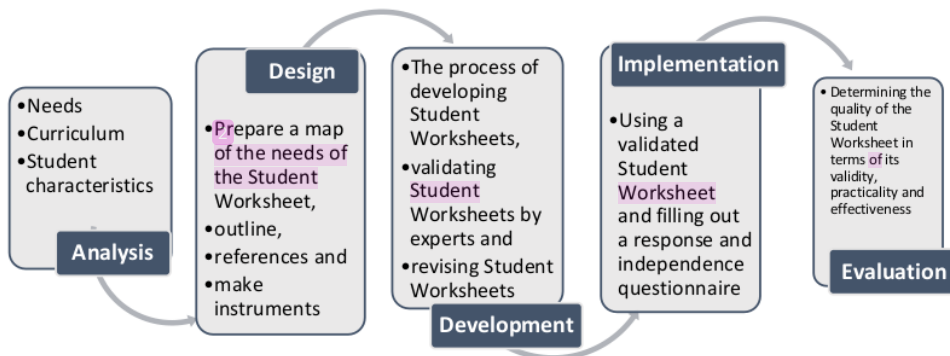


Figure 1: ADDIE Development Stages

The data in this study consisted of data on validity, practicality and data about independent learning. The validity of the Student worksheet that has been developed uses an assessment questionnaire filled out by material experts and teaching materials experts. The practicality of the

Student Worksheet is obtained from the response questionnaire filled out by users, namely students and lecturers. The questionnaire measurement scale uses a Likert scale model with 5 points, namely 1, 2, 3, 4, and 5. The aspects that are assessed to determine the validity of the Student Worksheet are aspects of the feasibility of content, language presentation and graphics. Meanwhile, the aspects used to assess practicality are aspects of ease and benefit. The average score obtained from both the validity and practicality data is then converted into a qualitative value according to the evaluation criteria of Eko Putro Widoyoko (2016) as follows:

Table 1. Expert Assessment Criteria

Score Interval	Criteria
$\bar{X} > \bar{X}_t + (1,8 \times sb_i)$	Very good
$\bar{X}_t + (0,6 \times sb_i) < \bar{X} \leq \bar{X}_t + (1,8 \times sb_i)$	Well
$\bar{X}_t - (0,6 \times sb_i) < \bar{X} \leq \bar{X}_t + (0,6 \times sb_i)$	Enough
$\bar{X}_t - (1,8 \times sb_i) < \bar{X} \leq \bar{X}_t - (0,6 \times sb_i)$	Less
$\bar{X} \leq \bar{X}_t - (1,8 \times sb_i)$	Very less

Information:

- \bar{X}_t = average ideal score = $\frac{1}{2}(\text{max score} + \text{min score})$
- sb_i = ideal standard deviation = $\frac{1}{2}(\text{max score} - \text{min score})$
- \bar{X} = actual average score

Table 2. Evaluation Criteria for Validity and Practicality

Score Interval	Criteria
$x > 4,20$	Sangat Baik
$3,4 < x < 4,2$	Baik
$2,6 < x < 3,4$	Cukup
$1,8 < x < 2,6$	Kurang
$x < 1,8$	Sangat Kurang

The effectiveness of student worksheets that was developed to facilitate student learning independence. Judging by the results of the learning independence questionnaire filled out by students after using the Student Worksheet. Indicators of independent learning in this study are discipline, initiative, responsibility, motivation, conducting learning evaluations. To test the effectiveness of the developed Student Worksheet, the T test was carried out.

3. Result

The results of the research are carried out in stages according to the stages of development carried out as follows:

3.1. Analysis

This stage aims to determine the objectives and problems as a benchmark in preparing the Student Worksheet. In this stage, a needs analysis is carried out to analyze the fundamental problems in the Number Theory course, students' English skills, concept analysis, analysis of student independence in learning, task analysis and learning objectives to be achieved as a basis for developing worksheets. The results of the analysis confirmed that a Student Worksheet was needed to help students learn the integer system material independently. The concept analysis carried out in the Number Theory course for the sub-topic of the Integer Number System is compiled the following concept map:

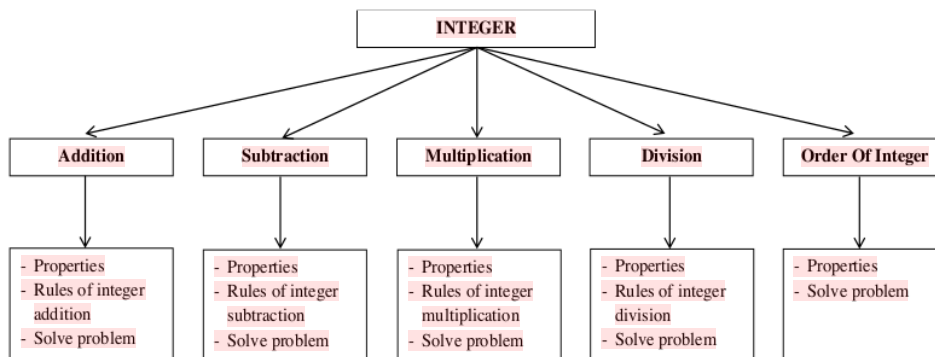


Figure 2: Concept Flow

3.2. Design

The purpose of this stage is to prepare a prototype Student Worksheet and evaluation tools. Based on the results of the analysis in the previous stage the Student Worksheet needs map that was developed was as follows:

Worksheet 1: Addition and Subtraction

Worksheet 2: Multiplication and Division

Worksheet 3: Integer sequences

The outline of the student worksheet developed can be seen in table 1 below:

Table 3. Outline Student Worksheet

Student Worksheet sections	Description
Cover Page	<ul style="list-style-type: none"> On the cover page there is information about the title of the student worksheet which describes the contents of the student worksheet. The cover page also contains the author's name and the author's university of origin.
Identity page	The identity page is entitled "Student Identity". On this page, students can write their identity as the owner of the student worksheet
table of contents	On this page a list of the contents of the entire student worksheet is displayed
Concept maps	On the concept map page, a concept map is displayed of the material discussed, namely the integer system.
Contents section	<ul style="list-style-type: none"> The contents of the Student Worksheet consist of 3 worksheets. Worksheet 1 on Addition and Subtraction, worksheet 2 on Multiplication and Division, worksheet 3 on the sequence of integers The contents of the student worksheet are prepared to facilitate student learning independence.
References	Contains a list of references used in developing student worksheets.

It's part of Student Worksheet:

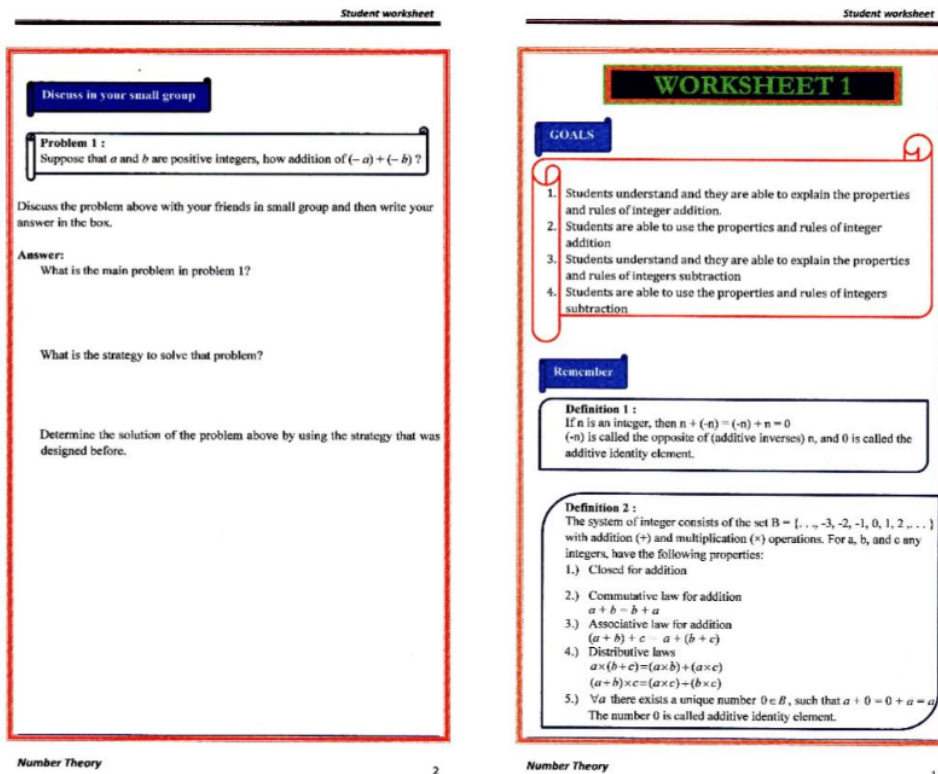


Figure 3: Student Worksheet

Student Worksheet begins with the delivery of learning objectives so that students know the objectives or competencies that must be possessed after using this Student worksheet. Students are also reminded of some basic definitions or axioms. Students are given several problems where the problem contains mathematical concepts that must be understood by each student in the material. To solve this problem students are given inducing questions that can direct students' thinking in determining solutions to the problems given.

3.3. Development

At this stage, Student Worksheet development is carried out to facilitate student learning independence based on the outline that has been prepared in the previous stage. Furthermore, the Student Worksheet that has been developed is consulted with material experts and teaching materials experts about the feasibility of the Student Worksheet. According to material experts, the material presented in the Student Worksheet does not require revision or revision. There are several things that are noted from teaching material experts related to the Student Worksheet being developed. Note that the Student Worksheet color is not valid and there are some writing errors.

The Student Worksheet is revised according to input provided by experts. The revised student worksheet was assessed by experts for its validity. The results of the student worksheet validity assessment by material experts and teaching material experts can be seen in tables 2 and 3 below:

Table 2. Result of Material Expert Assessment

Assessment Aspects	Average Score for Each Aspect	Category
Content eligibility	4.566	Very good
Serving eligibility	4.5	Very good
Average	4.53846	Very good

Tabel 3. Results of the Expert's Assessment of Teaching Materials

Assessment Aspects	Average Score for Each Aspect	Category
Language Eligibility	4.333	Very good
Graphic Worthiness	4.355	Very good
Average	4.344	Very good

From tables 2 and 3, it is clear that material and teaching materials experts state that the Student worksheet developed has met the feasibility aspect of a teaching material both in terms of material and in terms of its feasibility as teaching material. The assessment given meets the qualification "Very Good". This means that the Student Worksheet developed is valid for use in learning.

3.4. Implementation

Student Worksheets that have been declared suitable for use in learning by material experts and teaching material experts are implemented in Number Theory learning material for the Integer Number System material. And it is implemented in students who take Numbers theory courses in the even semester of the 2019/2020 academic year, namely students of the UPY Mathematics Education Study Program who are members of class IIA2. Learning is carried out online using the google classroom, google meet, zoom and WA Group applications. Students carry out learning by following the directions in the Student Worksheet. Learning is carried out independently by each student. Students also form small groups to discuss activities on the Student Worksheet. If there are not understood, they can be discussed in small groups or ask the Student Worksheet development team directly.

3.5. Evaluation

Evaluation of the Student Worksheet which has been used especially for its practicality and effectiveness to facilitate student learning independence.

3.5.1. Practicality of the Student Worksheet

Students and lecturers who have used the Student Worksheet filled out the practicality questionnaire that the researcher had compiled. The results of the practicality questionnaire that have been filled in by respondents (students and lecturers) can be seen in the following table:

Table 4. Analysis of Student Worksheet Practicality

Assessment Aspects	College student		Lecturer	
	Average score	Practicality Criteria	Average score	Practicality Criteria
Convenience	3.578	Good	1.18	Good
Benefits	3.540	Good	4.40	Very Good
Overall Average	3.559	Good	4.29	Very Good

From table 4 above, it can be seen, that from the student assessment, every practical aspect is in the good category. From the lecturer's assessment, the convenience aspect is in the good category, while the benefit aspect is in the very good category. This means that the Student Worksheet used in Number Theory learning, especially the Integer Number System material, is practical.

3.5.2. Student Worksheet Effectiveness

To test the effectiveness of the student worksheet, a hypothesis testing is carried out by:

- H_0 = Student Worksheet Integer is effective on student learning independence
- H_1 = Student Worksheet Integer is not effective on student learning independence.

Hypothesis testing is performed using the Wilcoxon test statistics assisted by the SPSS program.

The Wilcoxon Signed Ranks Test shows:

- Negative Rank for N, Mean Rank and Sum of Rank is 1, this value states that there is a decrease in the score of learning independence from pre-test to post-test by 1 respondent.
- Positive Rank on N is 24, it means that 24 respondents experienced an increase in their score from pre-test to post-test with an average increase of 13.5.
- Ties worth 2 states that there are 2 respondents who have fixed scores on the pretest and posttest.

Based on "Test Statistics" obtained Asymp.Sig. (2-tailed) is worth 0.000. Because the value of Asymp.Sig (2-tailed) < 0.05 , it is concluded that " H_1 " is accepted. This means that the Student Integer Worksheet is effective on student learning independence. The results of this study are consistent with the results of research conducted by Wahyuningsih who concluded that the use of worksheets students can increase student learning independence [15].

4. Conclusion

The Student Integer worksheet has met the requirements of being valid, practical and effective to facilitate student learning independence. So, the Student worksheet in the Number Theory course, especially on the Integer Number System material, has shown an impact on student independence. Especially during the Covid 19 pandemic, where students are required to be independent in online learning. To become the development of further research, it can be developed for other materials in Number Theory for Mathematics Education students.

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