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## **Development of Mathematics Module Based on Creative Problem Solving in Elementary Students**

**Jusmawati**

Universitas Megarezky, Makassar, Indonesia

**Satriawati**

Universitas Megarezky, Makassar, Indonesia

**Irman R.**

Universitas Megarezky, Makassar, Indonesia

**Abdul Rahman**

Universitas Negeri Makassar, Makassar, Indonesia

**Nurdin Arsyad**

Universitas Negeri Makassar, Makassar, Indonesia

**Abstract**--Teaching materials in the form of modules are very important to be used in the learning process, especially in mathematics subjects at elementary schools. This study aimed to develop creative problem solving (CPS) based on mathematics learning materials. Method used Research & Development (R&D) with Four-D consisted of 4 stages of development, namely: Define, Design, Develop and Disseminate. The number of participants in this study consisted of 30 students from grade V elementary school consisted of 19 female students and 11 male students. Based on the results of the limited trial analysis, it was found that the module used was valid and reliable with a note that it could be used with revisions. The results of the analysis on the module teaching materials product test were valid and reliable category and used without any revision. The results of the development of the module device that is applied to the creative problem solving model in students improve problem solving abilities by 85%, this shows that students' problem solving abilities are classically complete.

**Keywords**--creative problem solving, elementary students, mathematics module.

## Introduction

There are some modern tools that can be overcome human problems. It is time an era of science and technology. The most stored corners of human life cannot certainly be separated from science and technology (Jafar et al., 2020). One of the foundations that support the development of science and technology, such as mathematics today. Sudrajat said that the rapid development of science and technology took place with the support of mathematics (Ahmar & Rahman, 2017). The rapid advancement of information encourages teachers to train their students to be highly competitive in the global marketplace. Students must be able to solve problems in order to understand the value of mathematics in everyday life (Rahman & Ahmar, 2016).

Problem solving that is creative is beneficial at any level of the design process, but it is especially important at the conceptual design stage (Robertson & Radcliffe, 2009). Cognitive processes connected with creativity are seen as important to the development of creative output, as evidenced by the models outlined above. There are several theories that focus primarily on the cognitive processes involved in creative problem solving, and they have identified a core set of processes that are essential to creative issue solving (Reiter-Palmon & Illies, 2004).

Problem solving is “engaging in a task for which the solution method is not known in advance” (Boesen et al., 2014). Their CPS model includes three main components: (1) understanding the challenge (2) generating ideas, and (3) preparing for action. The goals of the understanding the challenge stage are orientation, preparation, and the construction of opportunities to kick-start idea generation and to retain focus at the same time (van Hooijdonk et al., 2020). Within this first stage, students apply fact finding by exploring and defining their knowledge on the problem. In addition, they apply problem finding by identifying the problem at stake. In the second idea generation stage, students are asked to diverge and come up with creative ideas to solve the problem (Isaksen & Treffinger, 2004). Thus the teaching materials developed in the form of creative problem solving (CPS) based modules improve the problem solving abilities of elementary school students (Purwaningrum et al., 2021; Kosasih et al., 2021).

## Research Methods

This type of research is development research or known as Research & Development (R&D) with a Four-D device development model consisting of 4 stages of development, namely: Define, Design, Develop and Disseminate. This study developed a creative problem solving (CPS)-based elementary school mathematics module. Research by developing a creative problem solving (CPS)-based mathematics module in grade V elementary school in South Sulawesi, which consists of a limited trial of 9 elementary school students and a CPS product test of 30 elementary school students (Van der Lugt, 2000; Kandemir & Gür, 2009).

The techniques used in collecting research data for this development are: observation and problem-solving ability tests, with teaching materials in the form of creative problem solving (CPS) based class V elementary school mathematics

learning modules. The quality of the product that has been developed by producing a CPS based elementary school mathematics module teaching materials product with the analytical techniques used: 1) validation analysis, 2) practical analysis, and 3) problem solving analysis (Williamson, 2011; Şimşek & Kabapınar, 2010). Problem solving of students in elementary schools based on the criteria set out as table 1.

Table 1  
Problem solving criteria

Absolute Value	Category
86-100	Very good
71-85	Good
56-70	Enough
41-55	Not enough
<40	Very less

## Results and Discussion

Development of creative problem solving (CPS) based mathematics modules at the SD Tunas Bangsa Makassar. The development model used refers to the 4-D model which is divided into 4 stages, namely the define stage, design stage, development stage and dissemination stage. Each stage in developing is in accordance with the steps for developing creative problem solving (CPS)-based elementary school mathematics modules (Hughes & Kwok, 2006; Lipponen et al., 2003).

### Define stage

The observation results were carried out at SD Tunas Bangsa Makassar show that the students were not enthusiastic and difficult to solve problems in their learning in the mathematics learning process because the modules used were not interesting and did not require students to look for problems, understand problems, determine problems and solve solutions of the problem. So that, a mathematics learning module was needed to be able to improve students' ability in solving problems, by developing learning tools, namely the creative problem solving (CPS) based elementary school mathematics learning modules (Van der Merwe et al., 2020; Bryant et al., 2020).

### Design stage

The mathematics learning module based on creative problem solving (CPS) that was developed equipped with simple problems that were easy to understand. There is a brief description of the modules that have been developed that will be used in a limited trial. Based on the results of limited trials on teaching materials for elementary school mathematics learning modules based on creative problem solving (CPS), there were revisions and improvements as well as suggestions from various parties concerned so that they were equipped and designed in detail, more precise and easy to understand. Based on the results of improvements so as to develop a device module used in product testing. There was a brief description

of the modules that have been developed based on the product results (Rabe & Kohlhase, 2013; Köğce et al., 2009).

**Development stage**

Develop teaching materials in the form of modules with the aim of producing creative problem solving (CPS) based on mathematics teaching materials that have been validated and obtained in limited trials and product tests. The results of the limited trial validation are as follows in table 1. Based on table 1, the average validation results from validators I, II and III of 4.05 were valid category. This shows that CPS based mathematics module in elementary schools that was developed included the valid category, with information that can be used with minor revisions (Widana et al., 2020; Oviogun & Veerdee, 2020). Solving mathematical problems using creative problem solving (CPS) based module learning tools. After learning activities with the CPS based learning module for mathematics subjects, the results of a limited trial are presented in the table 2.

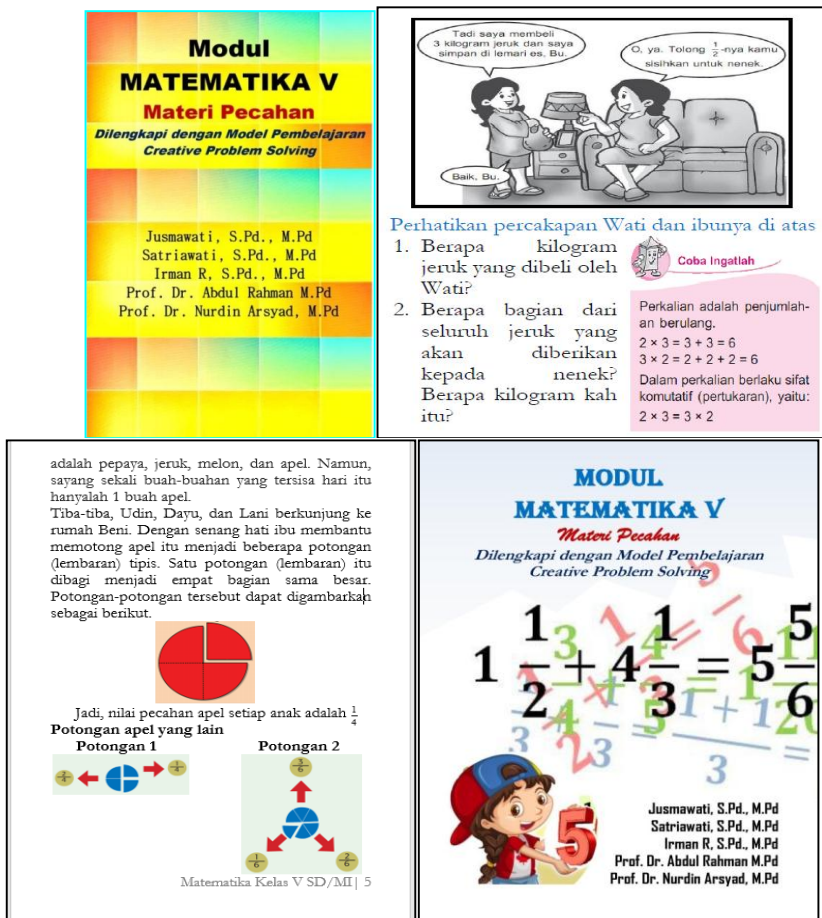


Figure 1. The design of mathematics module

Table 1  
Validation results of test module for limited trial

No	Aspects	Validator I	Validator II	Validator III	Average
1	Format	4.16	4.09	4.07	4.11
2	Language	3.81	3.95	3.88	3.88
3	Illustration	4.11	4.17	4.22	4.17
4	Contents	4.08	4.10	3.99	4.06
	Total	4.04	4.08	4.04	4.05

Table 2  
Frequency distribution of problem solving results of limited trial

Absolute Value	Frequency	Percentage	Category
86-100	0	0%	Very good
71-85	1	11.11%	Good
56-70	5	55.56%	Enough
41-55	2	22.22%	Not enough
<40	1	11.11%	Very less

The table 2 shows that the problem-solving abilities of elementary school students after being treated with CPS based module teaching materials in mathematics subjects, this is a limited trial conducted on 9 elementary school students, it appears that none of the students were very good category, 1 student was good category (11.11%), 5 students (55.56%) with score 56-70 had enough category, 2 students (22.22%) with score 41-55 had poor category, and 1 student (11.11%) with score less than 40 had very less category. This shows that the average of mathematical problem solving ability of elementary school students with a score of 60.17 was sufficient category.

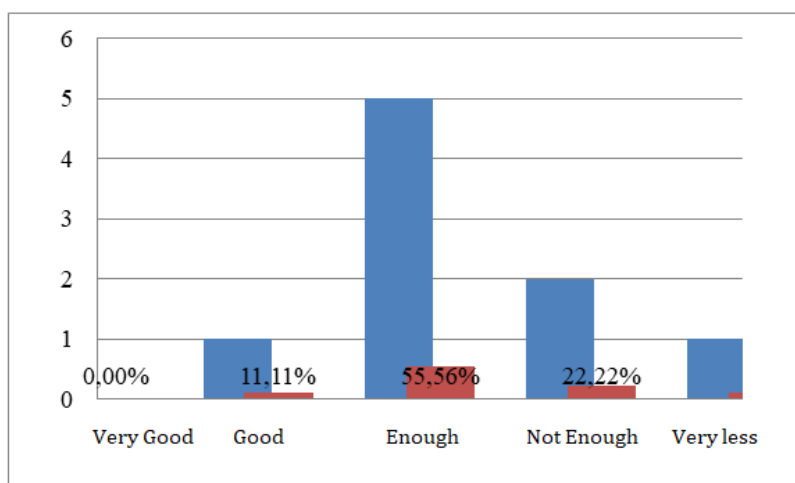


Figure 2. Diagram of problem solving

Based on the figure 2, it shows that the problem solving ability of elementary school students after being treated with a CPS based on mathematics learning

module, this was a limited trial conducted on 9 elementary school students, the percentage of problem solving ability shows that 0% was very good category, 11.11% were good category, 55.56% were enough category, 22.22% were less category and 11.11% were very poor category. Thus the mathematical problem solving ability of elementary school students did not meet the criteria for classical completeness, so revisions were made to continue product testing (Hoach, 2021; Putrayasa & Ramendra, 2021).

Based on the results of the revision and input from experts for module improvement, further validation of the module for product testing was carried out, while the results of product test validation on the module teaching materials are as table 3.

Table 3  
Module validation results for product test

No	Aspect	Validator I	Validator II	Validator III	Average
1	Format	4.90	4.89	4.91	4.90
2	Language	4.89	4.87	4.90	4.88
3	Illustration	4.95	4.93	4.90	4.93
4	Contents	4.91	4.90	4.88	4.89
	Total	4.91	4.89	4.89	4.90

The average validation results from validators I, II and III of 4.90 are in the very valid category. This shows that the CPS based mathematics module in elementary schools that was developed is included in the very valid category, with information that it can be used without any revisions. To solve mathematical problems using creative problem solving (CPS) based on module as teaching materials. After learning activities with the CPS based learning module for mathematics subjects, the product test results are presented in the table 4.

Table 4  
Frequency distribution of problem solving product test results

Absolute Value	Frequency	Percentage	Category
86-100	25	83.33%	Very good
71-85	5	16.67%	Good
56-70	0	0%	Enough
41-55	0	0%	Not enough
<40	0	0%	Very less

Based on the table 5, it shows that the problem-solving abilities of elementary school students after being treated with CPS based module teaching materials in mathematics subjects, this is a product test conducted on 30 elementary school students, it appears that 25 students with score 86-100 had very good category, 5 students with score 71-85 had good category, this shows the average mathematical problem solving ability of elementary school students with score of 87.63 or it had very good category.

Based on the figure 3, it shows that the problem solving ability of elementary school students after being treated with a CPS based mathematics learning module, this is a product test conducted on 30 elementary school students, the percentage of problem solving ability shows that 83.33% were in the category very good, 16.67% were in the good category, 0% was in the sufficient category, 0% was in the less category and 0% was in the very poor category. Thus the mathematical problem solving ability of elementary school students is in classical completeness criteria.

### Dissemination stage

The last stage in the development of a CPS based on mathematics module was dissemination. The product results in this study were distributed to students, teachers, principals and students who were doing micro teaching or teaching practice.

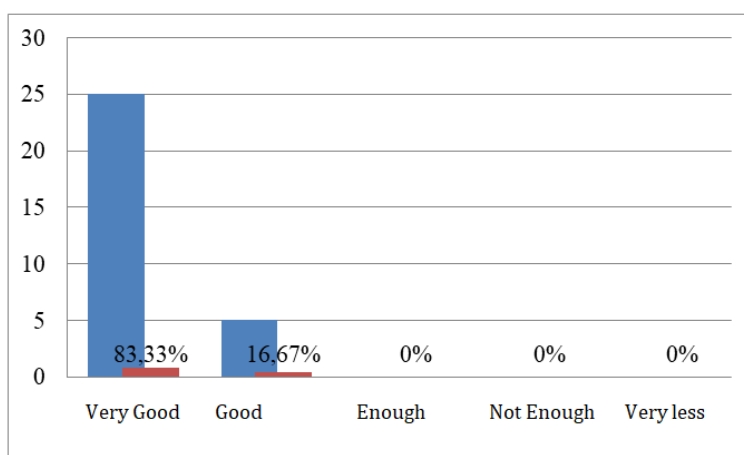


Figure 3. Diagram of problem solving

### Conclusion

This research concludes that the development of creative problem solving (CPS) based on mathematics module improves the classical elementary school students' mathematical problem solving ability.

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