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DEVELOPMENT OF CONTEXT-BASED MATHEMATICS LEARNING TOOL FOR FIFTH-GRADE ELEMENTARY SCHOOL STUDENTS

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Abstract

Learning tool is an important factor that can influence the quality of education. A good learning tool should be able to facilitate students in finding and constructing the correct concepts independently, so that their logic and thought pattern can be fully developed. In this research, development of a context-based learning tool that can achieve these goals is shown. The main purpose of this learning tool development is to produce a valid, practical, and effective context-based mathematics learning tool. It is presented in the form of a Lesson Plan and a Student Worksheet. This development research is done using the 4-D model: define, design, develop, and disseminate. The tool validation is done by consulting mathematics, linguistics, and elementary education experts. Practicality is measured using practicality questionnaire for expert, analysis survey, observation sheet, and interviews with the teachers. Effectiveness is measured from students' learning activities and their learning outcomes. The research results show that the development of context-based learning tool is valid in terms of content and construct. The tool is practical as well since it is clear and easy to use in mathematics learning. The learning tools effectiveness is indicated by the fact that the students are able to reach the classical criterion of learning outcomes and the students' positive activities are also increased. Based on those results, it can be concluded that a valid, practical, and effective context-based mathematics learning tool for fifth-grade elementary school students has been successfully produced.

Keywords: *learning tool, context-based learning, fifth-year elementary students*

INTRODUCTION

Background

The quality of education in Indonesia is still relatively low. It can be seen from the results of Human Development Index (HDI) survey conducted by the United Nations Development Program (UNDP), which describes the quality of education in a country from primary to secondary schools. A 2012 survey showed that Indonesia's HDI was only 0.629 from the ideal value of 1, and Indonesia was only ranked 112th out of the 186 countries studied. Especially for Mathematics, it can be seen from the results of TIMSS report in 2011 that Indonesia was also only ranked 38th out of 42 countries. The PISA survey in 2009 also put Indonesia at rank 61 out of 65 countries in the field of Mathematics.

Low education quality is closely related to the quality of learning process. One factor that greatly affects the quality of learning is the availability of the learning tool. The selection of appropriate learning tool in a learning process is a very important factor in improving students' learning experience. In the Ministerial Decree number 41 of

2007, it is described that a good learning tool should be able to facilitate interactive learning, motivate students to actively participate during the learning process, and provide enough space for students' innovation and creativity. Unfortunately, many conventional mathematics learning tools used in schools, especially in elementary schools, still tend to be more teachers centered, rather than students centered. This makes the learning process in class lacks meanings, becomes monotone, and bores the students. This fact is supported by the results of an observation performed on the fifth-grade students of SDN 18 Air Tawar Selatan, Padang elementary school. On this observation, the students are given the following problem:

A diver was at a depth of 15 m below the sea level. His friend was on a boat tower 8 m high above the sea level. What is the height difference between the two of them?

Out of the 33 students, 21 answer that the height difference is either 7 m or -7 m. This clearly shows that students just try to blindly add or subtract the numbers listed on the problem without fully understanding the problem itself.

Furthermore, observation about the availability of learning tool used by teachers is also conducted at three primary schools in North Padang District, SDN 18 Air Tawar Selatan, SDN 25 Air Tawar Selatan, and SDN 19 Air Tawar Barat, Padang elementary school. From the observation, it is revealed that the efforts that the teachers spend in developing learning tool are still not optimal, so that the availability of good quality learning tools is still lacking. To overcome these deficiencies, teachers can buy the learning tools from publishers. One example of these purchased learning tools is student worksheet. However, unfortunately these student worksheets are often unable to facilitate students to actively construct knowledge and discover concepts independently. This makes the learning process in class lacks meanings and impedes the improvement the students' logic and creativity. Thus, development of mathematics learning tool that can train and increase the students' capabilities and understanding of the subjects while giving them the chance to construct their knowledge independently is sorely needed.

One pedagogy concept that can provide an opportunity to students to construct their own knowledge is learning with contextual approach. Contextual approach is chosen because it enables students to connect the content of academic subjects with the immediate context of their daily lives to discover meaning (Johnson, 2002). It can also further enlarge their personal context, by providing students with fresh experience that can stimulate the brain to make new connections, and thus to discover new meanings. By developing a context-based learning tool, students are expected to acquire knowledge through construction processes and in accordance with the context, so that the students can get the real essence of the lessons and not just memorize the concept. In this study, development of a context-based learning tool that can achieve these goals is shown.

Research Question

These are the research questions that we aim to answer at the end of this study:

1. How valid is the context-based mathematics learning tool for fifth grade elementary school students developed in this study?
2. How practical is the context-based mathematics learning tool for fifth grade elementary school students developed in this study?

3. How effective is the context-based mathematics learning tool for fifth grade elementary school students developed in this study?

Research Aim

The main purpose of this learning tool development is to produce a valid, practical, and effective context-based mathematics learning tool for fifth-grade elementary school students. It is presented in the form of a Lesson Plan and a Student Worksheet.

Method

This development research is done using the 4-D model: define, design, develop, and disseminate (Willis, 1995). The define stage is done by analyzing the curriculum, the availability of existing learning tools, and the students' characteristics. At the design stage, the context-based learning tool is designed based on the findings observed in the define stage. The main product of this developmental research is a context-based student worksheet. The worksheet is structured based on several main components: the title, the learning objectives, the time allocation, the learning tools and materials used, and the instructions for students (Prajitno, 2003). Meanwhile, the learning activities inside the worksheet are designed to conform to the seven contextual learning principles: constructivism, inquiry, questioning, learning community, modelling, reflection, and authentic assessment (Rusman, 2011).

The learning tool is designed to assist in the learning process of all the topics covered in the fifth-grade elementary school mathematics syllabus as described in the 2006 KTSP curriculum, which includes integer operations, geometry, and basic metrology. Especially, the topics on which the learning tool is implemented to test its practicality and effectiveness are the geometry topics about the area of kite, area of trapezoid, volume of cube, and volume of cuboid. The topics are discussed over four meetings.

At the develop stage, the tool is validated and tried out to determine its practicality and effectiveness. The learning tool is validated by consulting mathematics, linguistics, and elementary education experts. Validation result is analyzed by using descriptive quantitative method. The analysis is done by averaging out the ratings of every aspect in the validation sheet, such as the didactic, content, language, and appearance aspects. The data is obtained based on the Likert scale as shown in Table 1.

Table 1. Likert Scale

Rating	Scale Value
Very good	4
Good	3
Bad	2
Very bad	1

(Modified from Arikunto, 2006)

The average is calculated using the following formula,

$$R = \frac{\sum_{i=1}^n V_i}{n},$$

where R is the rating average, V_i is the score from the i^{th} validator of each aspect, and n is the number of validators (Mulyardi, 2006).

The learning tool is valid if the obtained average is > 2.40 . After the learning tool is stated as valid, it is tried out to fifth-grade elementary students. The experiments subjects of this study are the fifth-grade students of SDN 18 Air Tawar Selatan, Padang elementary school.

A characteristic of high quality materials is that teachers (or other expert) consider the materials to be usable and that it is easy for teachers and students to use (Nieveen, 2007). Thus, the practicality of this learning tool is measured using questionnaires to be filled in by experts, teachers, and students, observation sheet, and interviews with the teachers. These questionnaires are developed in accordance to the Likert scale, and analyzed using the following formula,

$$P = \frac{S}{M} \times 100\%$$

where P is the practicality percentage, S is the sum of collected data score, and M is the maximum score (Purwanto, 2004).

The interpretation of the obtained score percentage is shown in Table 2.

Table 2. Practicality Score Interpretation

Percentage	Criteria
85 – 100	Very practical
75 – 84	Practical
60 – 74	Quite practical
55 – 59	Less practical
0 – 54	Not practical

(Purwanto, 2004)

Thus, based on the criteria, the learning tool is practical if the percentage of each practicality aspect is $> 75\%$.

Effectiveness is measured from students' activities during study and their study results. The learning tool is effective if more than 70% of the students are able to reach the Minimum Passing Criterion (*Kriteria Ketuntasan Minimal*, abbreviated KKM) and the students' positive activities are increased.

The dissemination stage is done by implementing the learning tool to other selected subjects. This is done to make sure that the context-based mathematics learning tools is indeed practical and effective. To make it more understandable, the development methods are presented in chart form in Figure 1 below.

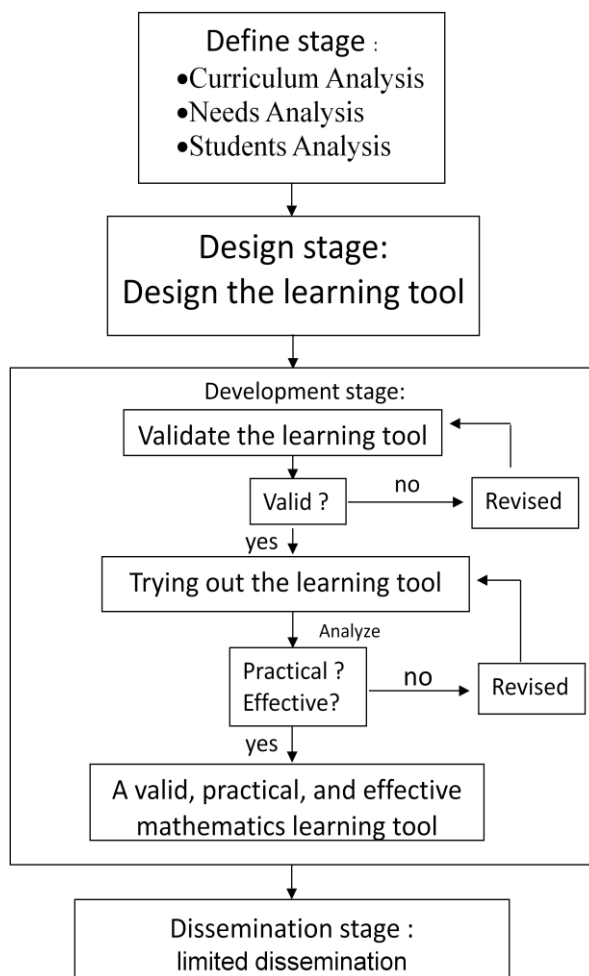


Figure 1. Development Process the Learning Tool Based on the 4-D Model (Modified from Trianto, 2009)

RESULT AND ANALYSIS

Validity of Context-Based Mathematics Learning Tool

Validity of Lesson Plan

The lesson plan validation is performed by five experts: two mathematicians, one linguistics expert, one educational expert, and one elementary education expert. In the validation of this lesson plan, there are two aspects to be observed: the component and the learning activities aspects. The component aspect consists of (a) completeness of subjects identities, (b) suitability of the defined indicators and basic competencies, (c) appropriateness of learning objectives and indicators, (d) conformity of time allocation and learning activities, (e) suitability of the teaching methods to the learning objectives, (f) indications whether the learning activities are challenging and able to motivate students, (g) diversity of learning resources, and (h) conformity of the evaluated instrument with the authentic assessment.

On the other hand, the learning activity aspect consist of (a) suitability of the learning model with the contextual approach, (b) clarity of the learning activity, (c) indications whether the learning activities can facilitate the students to construct their own

knowledge, (d) indications whether the learning activities can motivate students to improve their questioning ability, (e) indications whether the learning activities can guide students to discover their own concepts, (f) indications whether the learning activities can motivate students to discuss and form a learning community, (g) indications whether the learning activities can motivate students to learn from the environment, and (h) indications whether the learning activities can lead students to reflect on what they have learned.

Based on the analysis of data validation on both the above aspects, the overall results of the lesson plan validation are presented in Table 3.

Table 3. Validation Result of Lesson Plan

Aspect	Validity Average	Criteria
Component	3.45	Valid
Learning Activity	3.35	Valid

The results indicate that the well-designed lesson plan are valid in terms of content and construct. The RPP component has been developed in a clear and complete manner and the learning activities have been designed in accordance with the principles of the contextual approach.

Validity of Student Worksheet

Similar to the lesson plan, the student worksheet is also validated by five experts: two mathematicians, one linguistics expert, one educational expert, and one elementary education expert. In the validation of the student worksheet, there are four aspects to be observed: the didactical, contents, language, and appearance aspects.

Criteria in the didactical aspect are based on the following statements: (a) The student worksheet has been made in accordance with the Competency Standards (*Standar Kompetensi*, abbreviated SK) and the Basic Competency (*Kompetensi Dasar*, abbreviated KD); (b) The order of the material on the worksheets is prepared in accordance with the logical flow of learning; (c) The daily problems and learning steps can facilitate students to construct knowledge; (d) The activities in the student worksheet have been well designed to motivate students to ask questions; (e) The inquiry activities on the student worksheet have been designed to guide students to discover their own concepts; (f) The student worksheet can motivate students to discuss among themselves; (g) The student worksheet can help students to translate their daily problems into mathematical language; (h) Whether the student worksheet can facilitate students to reflect on what they have learned; and (i) The student worksheet can help teachers to assess the learning processes and outcomes properly.

The contents validation aspects are judged based on the following criteria: (a) There is compatibility between the materials, exercises, and reflection components on the student worksheet; (b) Illustrations in the worksheet can help students to relate concepts with their daily problems; (c) The student worksheet contains social and morality values; (d) The images and illustrations are used in accordance with the material being studied; and (e) The images and examples are used in accordance with the students' daily problems and environment.

The language aspect is related to the readability of the student worksheet and its conformity with the rules of *Bahasa Indonesia*. This validation aspect is based on the following criteria: (a) The sentences are used in accordance with the rules of *Bahasa*

Indonesia; (b) The grammar is in accordance with the rules of *Bahasa Indonesia*. (c) The choice of words is easy to be understood by fifth-grade students of elementary school; and (d) The sentence structures are clear and not confusing.

The last aspect is aspect of appearance. It is judged based on the following statements: (a) The font and size of the letters used are readable by the students; (b) The images and illustrations used can appeal to the students; (c) The placement of illustrations and images on the worksheets are neat and attractive; and (d) The design of student worksheet as a whole is attractive.

The overall results of student worksheet validation are presented in Table 4.

Table 4. Validation Result of Student Worksheet

Aspect	Validity Average	Criteria
Didactical	3.42	Valid
Content	3.44	Valid
Language	3.25	Valid
Appearance	3.35	Valid

The results show that the context-based student worksheet is valid in terms of its didactic, content, language, and appearance. In other words, the context-based student worksheet is indeed in accordance with the basic principles of learning, the curriculum content, and the learning objectives of mathematics. It is also easy to read and understand, and interesting for students.

Practicality of Context-Based Mathematics Learning Tool

After the development process is complete, this context-based mathematics learning tool is certified as practical by the experts, with experts' practicality score of 82.3% (practical). After the trial, the result also shows that this learning tool is also deemed practical by the students and teachers, with students practicality score of 82.7% (practical) and teachers practicality score of 85.7% (very practical).

Observation results and teacher interviews also further show that this learning tool is indeed practical. This result can be seen from the students' capability to derive the formula for the area of kite and trapezoid and the volume of cube and cuboid by themselves under the guidance of this context-based worksheet. Figure 2 shows some documentation photos taken during the implementation of the context-based learning tool.

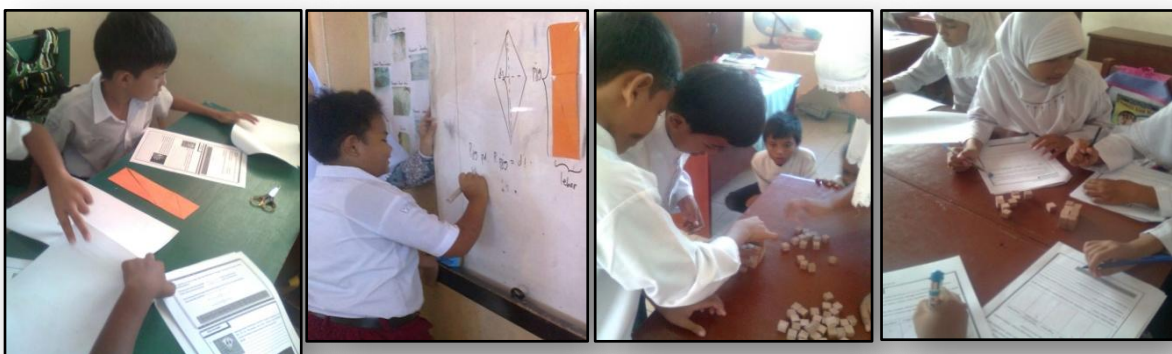


Figure 2. Students Doing Inquiry Activity under the Guidance of the Context-Based Student Worksheet.

This shows that the constructivism principle, which is the main principle of contextual learning, can be applied successfully using this worksheet. A constructivist learning environment would be a place where learners may work together and support each other as they use a variety of tools and information resources in their guide pursuit or learning goals and problem solving activities (Wilson,1996). Not only that, the other six contextual learning principles can also be integrated using this learning tool. This means that this context-based mathematics learning tool is usable, clear, and easy for teachers and students to use.

Effectiveness of Context-Based Mathematics Learning Tool

The learning tools effectiveness is indicated by the fact that 75% of the students are able to reach the KKM, along with the general increase of students' positive activities. At the dissemination stage, the results show that 79% of the students are able to reach the KKM, and the students' positive activities are also increased. Those results indicate that the context-based mathematics learning tool is effective, or in other words it has a good effect on the activity and students' learning outcomes.

CONCLUSION

Based on those results and analysis, it can be concluded several things:

1. The analysis of validation sheet shows that context-based mathematics learning tool for fifth-grade elementary school students is valid in terms of the didactical, content, language, and appearance.
2. The analysis of questionnaire shows that this learning tool is practical. Observation results, and teachers interview also show that this learning tool is usable and easy for teachers and students to use.
3. This mathematics learning tool is also effective along with its positive effect on the activity and students' learning outcomes.

Suggestion

Mathematics instruction should engage students in the discovery of concepts, by using instruction media and materials in such a way that can motivate the students to learn and develop their analytical ability and mindset independently, which ultimately lead to the improvement of learning outcomes.

For the learning process to proceed smoothly, teachers should be able to make their own learning tool, especially worksheets that can match with the characteristics of their students. Teachers can also use an existing learning tool, but its quality and compatibility with the learning objectives should be emphasized.

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