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## Developing Instructional Instruments Based on The Local Wisdom of Osingese Society's of Banyuwangi Through Guided Discovery to Enhance The Students Mathematical Communication Ability

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### Abstract:

Mathematical communication is an important ability to be mastered by students and developed in the world of education because the ability of mathematical communication is prevalently required. Mastering the ability, students are able to represent and solve various mathematical problems both in learning Mathematics and in everyday life. In the current implementation of 2013 curriculum, the existence of innovative and creative learning instruments need to be developed in order to enable students to communicate mathematical ideas and construct their own concept or knowledge based on their own experiences. The purposes of this research are (1) to describe the process and result of development of instructional instrument in the form of lesson plan, worksheet, and learning achievement test based on local wisdom of Osingese Banyuwangi society through guided discovery model; (2) to describe students' mathematical communication ability on topic pertinent to trapezium. The present study applied research and development method, using modification of 4-D development model through four stages, inter alia: defining, designing, developing, and developing. Subjects in this study were teachers and students of grade VII-D at The Public Junior High School 2 of Genteng. The results of the research evinced that (1) learning instruments based on local wisdom of Osingese Banyuwangi Society;s through guided discovery model were proven valid, practical and effective by validators and (2) that students' mathematical communication ability on topic concerned with trapezium was improved after using the developed instructional instrument.

**Keywords:** instructional instruments, local wisdom of Osingese society of Banyuwangi, guided discovery model, and mathematical communication ability

### 1. Introduction

One of the abilities that become the goal of Mathematics instruction in the 2013 curriculum to support the achievement of optimal learning outcomes is the mathematical communication ability. In the same wavelength, it is also the expected goal in learning Mathematics by National Council of Teachers of Mathematics (2000:12), stipulating that there are five indicators of mathematical ability that must be mastered by students, one of which is having communication skills.

The ability of mathematical communication outlined by Greenes & Schulman (1996:159) denotes the ability to: (1) express mathematical ideas; (2) understand, interpret and evaluate ideas presented in written, spoken or in visual form; and (3) interpret and relate various representations of ideas and

relationships through speech, writing, demonstration, and visual painting in different types. By contrast, in reality it appears that mathematical communication ability of grade VII-D students at The Public Junior High School 2 of Genteng is still found low, especially in the material determining the area of 2 dimensional figure, especially trapezium. The results of field observations, interviews with Mathematics teachers, and preliminary research on the students corroborated that students still made mistakes in communicating the concept of trapezium, aligning the alignment of the trapezoidal side, presenting trapezoidal sketches precisely, and writing procedures devoted to determining the area of the trapezium. There are still many students found poorly skilled in writing coherent and clear answer. This is in line with the results of research by Kusnaeni and Retnawati (2013: 34), which concludes that the low mathematical communication

skills of students occurs because teachers are so much dominant by explaining and demanding students to do the problem based on examples they give. In addition, students are hardly given the opportunity to communicate ideas, either by asking questions to the teacher or by delivering the answers.

The availability of instructional instruments by using the right learning model is of prominent importance because instructional instruments facilitate the teachers in their instruction and students will be more at advantage in learning, thus supporting the success of the learning process (Juliana, 2012:3). One of the learning models that is envisaged to facilitate students in improving the communication skills of Mathematics concept is guided discovery learning model (Riska, 2016:2). Riska further contends that in guided discovery, students are encouraged to actively engage in finding concepts or principles, so students are able to discover new knowledge based on their own experience. New knowledge gained from real experience lingers more extensively if students are directly involved in the learning process and able to construct the concept or principle of knowledge.

The guided discovery learning model used in lesson plan and worksheet in this study applied 6 learning stages, adapted according to Syah (2004:244), comprising of (1) giving stimulus, (2) guiding problem identification, (3) data collection, (4) data processing, (5) data analysis, and (6) drawing conclusions. The study material in this research is trapezium covering trapezoidal and trapezium based on local wisdom of Osingese society of Banyuwangi. The source of local wisdom learning based on Osingese Banyuwangi societies used in this research include bamboo woven crafts, traditional musical instruments in the form of *Gamelan Gender*, *Angklung Paglak*, and *Angklung Caruk*, and traditional house of Banyuwangi using trapezoidal surface.

Through the instruction based on local wisdom, instructional process is expected to be more varied, interesting, and optimizing students' ability in identifying problems and solving Mathematics problems related to local wisdom in students' environment. In addition, the instruction also aims at introducing and preserving Banyuwangi native culture.

Based on the background of the study, the researcher delves into developing the instructional instruments in Mathematics for the students of class

VII at The Public Junior High School 2 of Genteng based on the local wisdom of the Osingese society of Banyuwangi through effective guided discovery model, which can be used to improve students' mathematical communication skills on topics concerning trapezium.

## 2. Method

The present study applied research-and-development method. This study aimed to develop instructional instruments in the form of lesson plan, students' worksheet, and learning achievement test based on local wisdom in Osingese community of Banyuwangi through guided discovery model. The development model used in this study was the 4-D model developed by Thiagarajan (1974), using evaluation criteria from Nieven (1999) as the criteria of product quality assessment consisting of three aspects, including validity, practicality, and effectiveness. This development model consists of four stages, covering definition, design, development, and dissemination (Hobri, 2010: 26).

Before the instructional instruments were field-tested, they were first validated by three experts, then analyzed. The subject of research was the teacher of Mathematics and students of class VII-D at The Public Junior High School 2 of Genteng in Banyuwangi district in the even semester of 2016/2017 academic year. The research data consisted of the developed instruments, the data on instructional process, observation data on teacher and students' activity, test result data, and also mathematical communication ability test.

The research instruments under development were assessed using three criteria involving validity, practicality and effectiveness. To measure the validity of the instruments, lesson plan, worksheets and learning achievement tests were operative. To measure the practicality of the instruments, observation sheet of teacher's activity, observation sheet on students' activity, questionnaire to students, and worksheets were applied. Measuring the effectiveness of the instruments, learning achievement test and student's mathematical communication skills test were at work. Data analysis dealt with instruments' validity, instruments' practicality, instruments effectiveness, and the students' mathematical communication ability.

The instructional instruments were considered valid if the validation scores reached at least a score of 3

(Suharsini, 2002). The instructional instruments were considered to possess fine practicality if the observation result reached a minimum score of  $\geq 80\%$  (Yuni, 2010:4). The instructional instruments were effective if more than 60% of students were able to achieve the minimum passing criteria (Eko, 2011:24). In this case, the passing criterion was to meet a minimum score of 75.

### 3. Results and Discussion

#### 3.1 Results

This study produced instructional instruments in the form of lesson plans, students' worksheets, and learning achievement test on Trapezium materials based on local wisdom of Osingese society in Banyuwangi. This research developed three lesson plans projected to cover three meetings. The stages of learning process included in the lesson plans applied the stages in guided discovery mode, which covered the provision of stimulus, problem identification, data collection, data processing, verification and drawing conclusions (Syah, 2004:244).

The developed worksheets were also devoted to covering three meetings. Students' worksheets applied along with some images of local wisdom related to Osingese community, involving (1) the bamboo wicker crafts. (2) traditional musical instruments and *gamelan*, including *Angklung Paglak*, *Angklung Caruk*, and *Gender Gamelan*, and (3) traditional house of Banyuwangi society, which had trapezoidal surface. The learning steps in worksheets also applied the guided discovery model stage, with reference to the indicators of students' mathematical communication achievement.

The test developed covered questions relating to the area of trapezium accompanied by some images of local wisdom relevant to Osingese community, which had a trapezoidal surface. The test was given to students with the aim to measure students' ability, especially the ability of mathematical communication after being involved in the learning process.

The validity test of instructional instruments was assured through validation of instructional instruments by three validators. The results of validators' assessment of instructional instruments developed are presented in table 1 below.

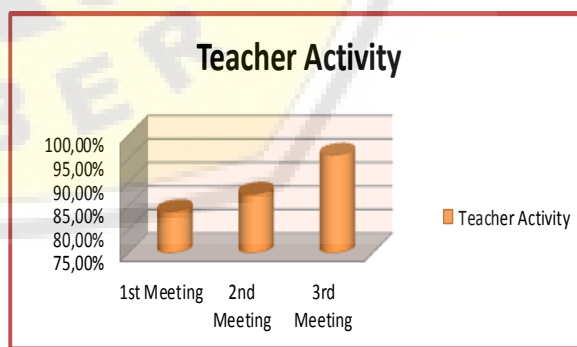
**Table 1:** Score Results Validation Learning Tool

Validator	RPP	LKS	THB
1	4.46	4.4	4.5
2	4.14	4.4	4.12
3	4.81	4.9	4.75
Total Score	13.41	13.7	13.37
Average	4.45	4.57	4.6

The result of observation in Table 1 shows that the average validation scores on lesson plans, worksheets, and learning achievement test are 4.45, 4.57 and 4.6, respectively. Based on the validity criteria and instructional instruments, it can be concluded that the instructional instruments developed already satisfied *very valid* categories.

Instructional instruments which have been revised and validated by the validators were then put into a try-out involving the students of class VII-D at The Public Junior High School 2 of Genteng Banyuwangi to scrutinize their effectiveness. The process of finding the formula of trapezium progressed through six learning stages of guided discovery model, comprising of the provision of stimulus, problem identification, data collection, data processing, validation, and drawing the conclusion of the trapezium formula by using the concept of the area of parallelogram.

The data for analysis on the practicality aspect of the instruments were obtained from result of observation analysis on teacher's activity during three meetings.



**Figure 1:** The Analysis Results of Teacher's Activity

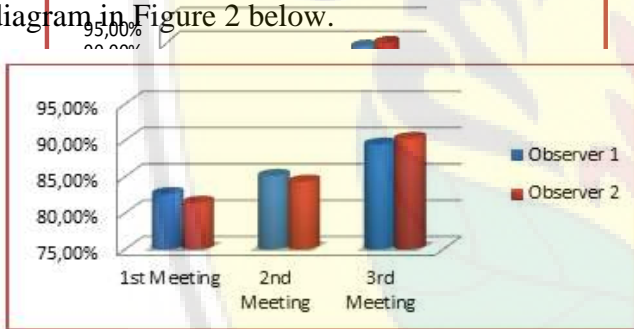
The observation on the learning process was also done in each meeting and aimed to evaluate the practicality of instructional instruments under development. The percentage of learning activity at each meeting is presented in Table 2 below.

**Table 1:** Percentage Observation of Learning Implementation at each Meeting

Score at the meeting to			Average	Category
1	2	3		
84	88	96	89,3	Practical

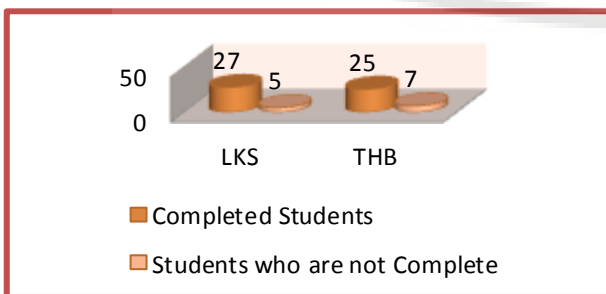
The analysis result of the learning process analysis shows that it exceeds the minimum criteria which must be achieved (80%) that is 89.3%. As such, it can be concluded that the developed instruments already satisfied the criteria of practicality. The practicality of these instructional instrument was corroborated by the alignment with the stages of guided discovery models (Riska, 2014:34).

The data analysis of effectiveness aspect was obtained from observation of students' activity, the learning achievement test, and students' responses. The result of data analysis on students' activeness during 3 observations generated an average 85,5%. The analysis on observation result of students' activity is shown in the form of student activity diagram in Figure 2 below.



**Figure 2:** The Analysis Results of Students' Activity

The effectiveness aspect of instructional instruments were scrutinized from the percentage of students' achievement in that 75% of the total students in one class had to meet the minimum passing criteria.



**Figure 3:** The Analysis Results of Students' Achievement

The result of learning achievement test evinces that the average score reaches 86,7%, hence it can be concluded that classically more than 75% of the students have already met the minimum criteria. This is also seen in Table 3 showing the results of mathematical communication skills taken from six students who posed different mathematical communication skills of in that two students were found to master high level mathematical communication skills, two students were at medium level, and two students were at low-level category.

**Table 3:** Test Test Results of Students' Mathematical communication Skills

No	Indicator of Mathematical Communication Ability	The Number of Students Who Answered			
		Complete Right	Almost Complete is True	Partly True	Vague Procedures
1	Describe the problem situation and declare solution problem by using image, chart, table, and algebraically	4		1	1
2	Declare results in written form	3	3		
3	Use a thorough representation to express the mathematical concepts and solutions	4		2	
4	Create a mathematical situation by providing ideas and information in written form	2	3	1	
5	Use mathematical language and symbols appropriately	3	2		1
Average		80 %	40 %	20 %	10 %

Test Results on mathematical communication in Table 3 shows that students' mathematical communication ability reaches an average above 75%. This is also in line with the results of the students' responses which showed an average of 84.4%. As a result, it can be concluded that the students provide a positive response to the instructional instruments. This is in line with the conclusion of Basman's research (2016:5685), pointing out that generally students respond positively to discovery learning model. From the result of data analysis concerning the effectiveness of instructional instruments, it can be concluded that the instructional instruments developed were at the *effective* category.

### 3.2 Discussion

The instructional instruments were found effective to improve the students' mathematical communication. Pugalee (2001:3) contends that in learning students need to be familiarized with providing argument on each answer and to respond to the answers given by others, making the learning experience more meaningful to them.

During active learning process, involving students will result in more effective results if the teacher is able to choose and implement the apt instructional method in the instructional process. In addition, teachers should also be able to develop instructional instruments that are appropriate to the characteristics of the subjects and instructional methods operative. One of the instructional instruments that can be used to encourage students' active involvement is the worksheets created based on the local wisdom of Osingese community of Banyuwangi through guided discovery. Implementing the worksheets in learning will open the widest opportunity to the students to take active roles in learning.

Based on the validation results by the experts, inputs and suggestions for the development of products were obtained. After making revisions based on the validators' suggestion, the researcher found that the instructional instruments have reached valid criteria. The validity of instructional instruments resulted from complying the instruments with the 2013 curriculum.

The results of try-out evinced that the instruments were very practical. Practicality was measured based on the teacher and students' appraisal and observation on the instruction effectiveness. The results of the assessment was found to reach a very practical category.

In addition, based on the results of try-out, the *effective* criteria were evident. The instructional instruments were considered effective as the results of achievement test and test results of students' mathematical communication skills have met the minimum criteria, that was 75%. The result of learning achievement test corroborated that the classical class achievement was less than 75%. Hereunder are the results of mathematical communication skills from the answers of students with high ability on the matter of trapezium.

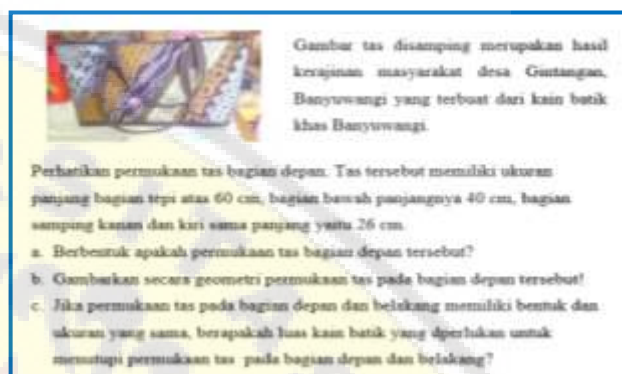


Figure 4: The Problem in Mathematical Communication Ability Test

The work of one of the students with high categories mathematical communication ability is shown in figure 5 below.

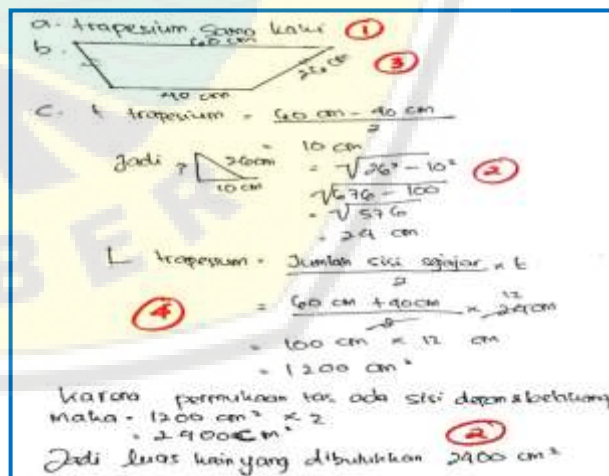


Figure 5: The Work of Student with High Mathematical Communication Ability

Figure 5 shows students' high-ability mathematical communication skills. The students were able to transfer ideas from the problem into the sketch they made. They were able to sketch the trapezoidal side, although imperfectly, because the opposite side of the pair should be the same length. In response (c), it was clear that the students could use mathematical

symbols appropriately and structure process generalization correctly. They were able to communicate the steps in the problem solving coherently in determining the required fabric. As in response (d), the students were able to construct a mathematical situation by elaborating his mathematical ideas into discovering the width of the bag cloth completely and correctly, and in response (e) the students were able to understand a discourse by using representation through coherent steps.

Based on findings, it can be concluded that the instructional instruments coupled with the local wisdom of Osingese community have been found effective. It also indicates that the students' understanding on the material area of the trapezium is satisfactory. This is in line with Brodie's (2010) opinion claiming that students' understanding on Mathematics is optimized through mathematical communication.

The results of this study are in line with research conducted by Rahma Dwi Khoirunnisa (2013). The conclusion from Rahma's research point out that instructional instrument through guided discovery model in the form of lesson plan, worksheets, and learning achievement test were evinced to be valid, practical and effective. However, the results of research developed by Rahma is only aimed at improving the ability of mathematical communication in writing, whereas with learning guided discovery model not only can improve the communication skills in writing but also can improve the ability of mathematical communication. This is evident when students are able to present the results of discussion flawlessly. The worksheets and learning achievement test she developed do not include local wisdom, making it less varied.

The advantages of instructional instruments developed in this study are as follows. First, the instruments can be used to improve the students' written and spoken communication. Second, the instruments are effective to generate passion, liveliness, and students' creativity. In addition, they can also cultivate the students' curiosity about Mathematics and enhance their knowledge related to various artistic cultures and local wisdoms existing in Banyuwangi society, particularly Osingese society of Banyuwangi, encouraging more interest and insights pertinent to both mathematics and cultures in Indonesia.

#### 4. Conclusions and Suggestions

Based on the research findings and discussion, the following conclusions are drawn. (1) The instructional instruments based on the local wisdom

of Osingese community of Banyuwangi were proven valid, practical and effective. (2) The students' ability of mathematical communication was satisfactory as they were able to convey their ideas through drawings, using mathematical symbols and representing thoroughly in preparing the steps of completion in accordance with the formulas or concepts studied.

As regard with the development of instructional instruments, there were some suggestions worth pondering. (1) The instructional instruments can be used as the guidance to conduct instruction based on local wisdom of Osingese society through guided discovery model in other materials. (2) Mathematics teachers need to be more innovative in their instruction by applying an innovative learning model such as local wisdom-based learning through guided discovery models.

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