

The Instrument Measures Students' Mathematical Communication Ability Based on Javanese Culture: Validity

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ABSTRACT

This study is part of the research description of the mathematical ability profile of students based on Javanese Culture in Mathematics material in junior high school. Study on the profile of students' mathematical abilities based on Javanese Culture and interview guidelines. At the stage of preparing the instrument, it must go through the stages of expert validation, both in the field of Education and experts in the field of Mathematics. In this study involved each of the two validators experts in Education and in the field of Mathematics. The results of the validation will be displayed in this article. The validation results from four validators show that the instrument can be used with a little bit revision.

Keywords: *Mathematics education, Javanese Culture, validity, junior high school*

1. INTRODUCTION

The National Council of Teachers of Mathematics states that there are five basic abilities students must have, namely: Reasoning, Representation, Communication, Problem Solving, and Connections. Meanwhile the Indonesian Minister of Education Regulation stipulates the Content Standards for primary and secondary education units in Mathematics subjects that are students having the ability to communicate ideas with symbols, tables, diagrams or other media to clarify the problem. The purpose of the Ministry of Education is in line with those formulated by NCTM (2000)^[1]. But there are still some teachers who have not paid attention to the ability of this mathematical communication to students.

Mathematical communication ability are the ability of students to convey mathematical ideas both orally and in writing. Mathematical communication ability of students can be developed through the learning process at school, one of which is the process of learning mathematics. This happens because one element of mathematics is the science of logic that is able to develop students' thinking abilities. Thus, mathematics has an important role in the development of mathematical communication abilities. Because of the importance of these mathematical communication abilities, an educator must understand mathematical communication and know aspects or indicators of mathematical communication.

According to PISA's three-yearly report, which monitors literacy, mathematics and science literacy, Indonesia ranks among the top ten lowest. The low ability of Indonesian mathematics is also evident from the results of the Trends in International Mathematics and Science Study (TIMSS)

report. A study from the Indonesian Student Competency Assessment (SCAI), which is also an Indonesian government program, shows similar results. Seeing the gap between expectations and conditions in the field, it is felt necessary to conduct research on mathematical communication abilities.

2. LITERATURE REVIEW

2.1. Ability

The word ability comes from the word "able" which means power, can, can, can, do something, have excessive assets. Ability is an ability to do something. A person is said to be capable when he does something he must do. According to Robbins, Stephen P. & Judge, Timonhy A. (2009)^[2] ability means the capacity of an individual to perform various tasks in a job. Ability can also be called competency. The word competence comes from the English "competence" which means ability, power, authority, skills, knowledge, and skills and authority. So the word competence from the word competence means to have the ability and skills in their field, so they have the authority or authority to do something within the limits of their knowledge. What is meant by abilities is a talent inherent in someone to carry out an activity physically or mentally which is obtained from birth, learning, and from experience

From the above explanation, it can be concluded that the ability (ability) is the ability or the potential to master something that is innate or is the result of training or practice and is used to do something that is realized through its actions.

2.2. Mathematics Communication

Communication is the delivery of messages from one person to another person orally and in writing. . The communication process can be interpreted as "transfer of information" or a message (message) from the recipient of the message as a communicator and to the recipient as a communicant.

Mathematical communication is the process of expressing mathematical ideas and understanding verbally, visually, and in writing, using numbers, symbols, images, graphs, diagrams, and words (Umar, 2012) [3]. Mathematical communication is the process of expressing mathematical ideas and understanding verbally, visually, and in writing, using numbers, symbols, images, graphs, diagrams, and words (Fuson, 2019)[4].

2.3. Mathematics Communication Ability

Communication abilities in learning can be assessed in two different contexts namely for written communication abilities can be assessed from the results while for verbal communication abilities can be assessed from the learning process. oral and written communication carried out by students is able to provide experience for students in conveying student ideas by showing arguments logically (Hossain, 2015)[5].

Mathematical communication abilities are the ability of students to convey mathematical ideas both orally and in writing. Mathematical communication abilities of students can be developed through the learning process at school, one of which is the process of learning mathematics. This happens because one element of mathematics is the science of logic that is able to develop students' thinking abilities. Thus, mathematics has an important role in the development of mathematical communication abilities.

Prayitno (2013)[6] said mathematical communication is a way for students to express and interpret mathematical ideas verbally and in writing, both in the form of pictures, tables, diagrams, formulas, or demonstrations. Furthermore, NCTM in the Principles and Standards for School Mathematics, formulates communication standards to ensure mathematics learning activities that are able to develop students' abilities, namely: 1. Arrange and integrate mathematical thinking through communication. 2. Communicate mathematical thinking logically and systematically to fellow students, teachers, and others. 3. Analyzing and evaluating the thinking and mathematical strategies of others. 4. Using mathematical language to express mathematical ideas precisely.

Furthermore Hodiyanto (2017)[7] revealed that the measurement of students 'mathematical communication skills was carried out by giving scores to students' abilities in giving answers to questions by drawing, making mathematical expressions, and writing answers in their own language (written texts). The scoring of student answers is arranged based on these three abilities.

1. Writing is explaining the idea or solution of a problem or picture using your own language.
2. Drawing is to explain ideas or solutions to mathematical problems in the form of images.
3. Mathematical expression that is expressing daily problems or events in the language of the mathematical model.

Based on the following description of NCTM^[1], a mathematical communication indicator for junior high school students will be presented :

1. Make a model of an oral situation, written, concrete objects, pictures, graphics, and algebraic methods.
2. Compile reflection and make clarifications about mathematical ideas.
3. Use the ability to read, listen, and observe to interpret and evaluate mathematical ideas.
4. Appreciate the values of a mathematical notation including its rules in developing mathematical ideas.

So the ability of mathematical communication can be interpreted as the ability to express mathematical ideas orally and in writing (pictures, graphics, symbols, problem solving) as a reflection and clarification after learning mathematics. Based on this opinion it can be concluded that the indicators of students' mathematical communication abilities used in this study include:

1. Ability to understand mathematical ideas.
2. Ability to express mathematical ideas.
3. Ability to use mathematical language approaches (notation, terms and symbols) to express mathematical information.
4. Ability to use mathematical representations (formulas, diagrams, tables, graphs, models) to express mathematical information.
5. The ability to change and interpret mathematical information in different mathematical representations.

Furthermore, the assessment indicators for students' mathematical communication abilities according to Widjayanti are as follows: (2013)[8] are as follows:

Table 1 Indicators of Mathematical Communication Capability Assessment

Indicators of Mathematical Communication	Explanation
The ability to understand mathematical ideas	Students are able to write down and describe the information that is in the problem
The ability to express mathematical ideas	Students are able to determine ways / formulas to solve problems
The ability to use mathematical language approaches (notations, terms and symbols) to express mathematical information	Students are able to use notations or symbols to solve problems.

Indicators of Mathematical Communication	Explanation
The ability to use mathematical representations (formulas, diagrams, tables, graphs, models) to express mathematical information	Students are able to use formulas correctly in solving problems correctly
The ability to change and interpret mathematical information in different mathematical representations	Students are able to solve and conclude from the answers obtained correctly.

2.4. Javanese Culture

Javanese culture is a culture that originated from Java and is embraced by the Javanese community, especially in Central Java, the Special Region of Jogjakarta (DIY) and East Java. Javanese culture can be broadly divided into 3 namely Banyumasan culture, Central Java-DIY culture and East Java culture. Javanese culture prioritizes balance, harmony and harmony in daily life and upholds modesty and simplicity.

Some argue that Javanese culture is identical with feudal and syncretic. That opinion is not quite right because feudal culture exists in all countries including Europe. Javanese culture respects all religions and plurality so that it is considered syncretic by certain cultures which only recognize one particular religion and sectarian (Koentjaraningrat, 2002)^[9].

The majority of Javanese people now adhere to the religion of Islam and a small proportion of Javanese people follow Christianity or Catholicism. In the past, the Javanese were Hindu, Buddhist and Kejawen. Even Javanese people spread Islam, Hinduism, Buddhism, Christianity or Catholicism in Indonesia. Javanese are unique because they are the only tribe in Indonesia who have an important role in spreading five major religions (Sadiek, 2016)^[10].

3. METHOD

This research is included in the type of descriptive qualitative research. Descriptive research is research aimed at describing or describing existing phenomena, both natural phenomena and human engineering. While qualitative research is a study aimed at describing and analyzing phenomena, events, social activities, attitudes of trust. Qualitative research is inductive, that is, researchers allow problems to arise from data or are left open for interpretation including descriptions in detailed contexts accompanied by notes from in-depth interviews, as well as analysis of documents and records (Cresswel, 2014)^[11]. So this research is categorized as a qualitative descriptive study because the study was conducted to provide a description or information of an event, where the results of the study are described in words. This study aims to

describe the students' mathematical communication abilities.

3.1. Determination of Research Subjects

The subjects of this study were students from seventh class SMP N 37 Semarang.

3.2. Research Instruments

Data collection in this study uses the following instruments:

3.2.1 Main Instruments

The main instrument of qualitative research is the researcher himself. Researchers who act as the main tool in research. This means that the researcher will determine the success or failure of a study. The researcher will determine what the quality of the field data will be like.

3.2.2 Supporting Instruments

Mathematical Communication Abilities Test Instrument. The test instrument compiled for this study is a matter that can measure students' mathematical communication skills based on Javanese Culture. There are three questions used, that is:

Question 1



Traditional housing *Genteng Wawungan* is one of traditional houses in central java made from clay roof. On the picture below, what shape is VWXY? If the length of $VW = 4$ meter, $XY = 9$ meter and $YZ = 6$ meter. Define wide of VWXY!

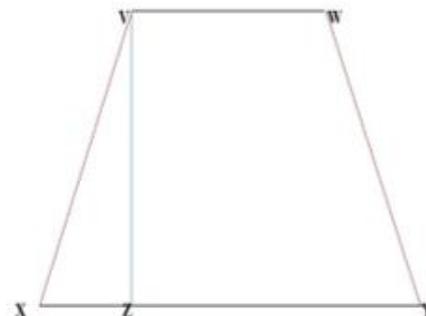


Figure 1 Item question for students

Question 2



If it is noticed, batik patterns above show ellipsis or oval patterns. Do you know the wide of that ellipsis/oval? Write your answer!

Figure 2 Item question about ellipsis batik pattern

Question 3



A religious event in Java, especially in Central Java, is called as *Bodo Kupa*t or *Syawal*an. In that event, our mother make *Wajik* cake made of sticky rice, coconut milk, and palm sugar.
 If a mother divides cake *Wajik* $\frac{2}{3}$ for father, $\frac{1}{4}$ for sister, and the remain is for a brother. If the wide of cake *Wajik* is 140 cm^2 , how wide is cake *Wajik* for a sister? (in cm). Do you think the mother is fair? If she is not, how should it be?

Figure 3 Item question about wajik relating to wide

3.3. Interview Guidelines

Interview is a dialogue conducted by the interviewer to obtain information from the interviewee (Cresswell, 2014)^[1]. Interview guidelines in the form of questions compiled to conduct questions and answers on students' mathematical abilities in solving problems. Interview guidelines used in this study are interview guidelines to determine the subject's mathematical communication abilities.

In the interview stage, the researcher is directly dealing with the subject and asking questions and answers to dig deeper information about students' mathematical communication skills. The interview steps in this study are :

1. Determine students to be interviewed.
2. Prepare an interview guide that will be used as a talk.
3. Opening the flow of interviews to selected students.
4. Hold an interview.
5. Confirm the results of the interview and end it.
6. Write down the results of the interview into the field notes.
7. Identifying follow-up interviews that have been obtained.

In this study researchers used data collection techniques namely written tests, interviews, documentation, audio recordings and field notes. However, in this paper, only the written test validation and interview guidelines will be discussed.

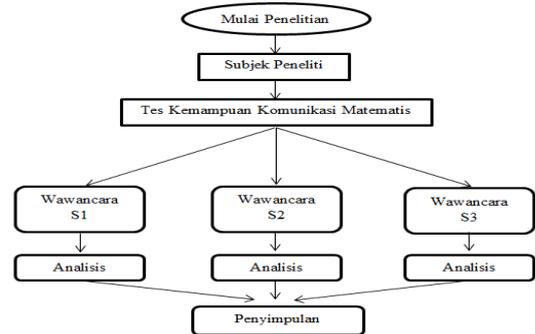


Chart 1 Data Collection Techniques

4. RESULT AND DISCUSSION

4.1. Results of Validation of Instrument Test

The test instrument that was made, was further validated by two education experts. The following is a summary of the results of the validation from the two experts:

Table 2 Mathematical Communication Ability Test Validation Results

to-Valid ator	Question Number	Suggestions / Comments	Correction
1	1	There was a mistake in question number one, which is: "Shown in the picture below, what shape is CWXY? If the length of VW = 4 meters, length XY = 9 meters and YZ = 6 meters. Determine the area of XYZW! "	Shown in the picture below, what shape is VWXY? If the length of VW = 4 meters, length XY = 9 meters and YZ = 6 meters. Determine the area of VWXY!
	3	In item three, originally written "Lebaran Ketupat" which is a translation of "Bodo Kupa" (Javanese). In order to keep appearing Javanese Cultures, you should still use the original language of "Bodo Kupa"	In the activities of Religious Holidays in Java, especially in Central Java, the term "Bodo Kupa" or "Syawalan" is known. At the celebration, our mother made a WAJIK cake made from sticky rice, coconut milk and brown sugar.

2	2	There are only two examples of pictures of Batik motifs on the question, namely the Parang Kusumo Motif and the Sekar Jagad Motif, two more need to be added.	The number of examples of batik motifs are four, namely Parang Kusumo Motif, Kawung Gurdo Motif, and Sekar Jagad Motif
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From the table above, it can actually be concluded that an assistive instrument in the form of a mathematical communication ability test can be used with a slight revision. For feedback from the first validator, test number one found an error in writing the naming of the vertices in the image. According to the validator, even though the error seems trivial, it will hinder the subject in answering questions that will affect the results of the study. Test question number three, suggested by the first validator not to translate terms in Javanese into Indonesian. This is done in order to adjust to the theme of research based on Javanese Culture. For feedback from the second validator, it is only suggested that questions number two are added to the batik motifs involved. Two researchers have added two types of batik motifs, from which originally there were two to four batik motifs. After receiving feedback / suggestions from the validators, then we will improve the mathematical communication abilities test instrument and then return it to the validator. So the research instrument is feasible to use.

4.2. Results of Interview Guidelines Validation

Interview guidelines that have been made, are then validated by two education experts. The following is a summary of the results of the validation from the two experts:

Table 3 Results of Interview Guideline Validation

to- valid ator	questi on numb er	Suggestions / Comments	correction
1	1	In the first indicator, in item one, it should be added to the information given: "What information do you think is known from the matter?"	"What information do you think is known from the questions given?"
	2	In the second indicator, in question four, written: "Try to explain what you have made! Why?" The word "why" should be removed.	"Try to explain what you have made!"
	3	In the third indicator, one more question should be	Initially there was

		added about the explanation of mathematical symbols / notations.	only one question, added to two questions: 1. What symbols, notations or symbols do you use to solve the problem? 2. Try to explain the notations and symbols that you write in your answer sheet
2	1	In the first indicator, the editor of the second question, added the question word "Why"? "Do you find it difficult to find and write information that is known and asked about the problem? Explain !"	Do you find it difficult to find and write information that is known and asked about the problem? Explain Why!
	2	In the interview guidelines in the third indicator written: The ability to use mathematical language approaches (notations, terms, symbols and symbols) to express mathematical information. The word "symbol" should be removed because the word symbol is synonymous with the word symbol.	The ability to use mathematical language approaches (notations and terms) to express mathematical information.
	3	In the fourth indicator, only one question should be asked. 1. Try to explain how you solved this problem?	1. Try to explain how you solved this problem? 2. Do you feel difficulty in solving the problem?

From the table above, it can actually be concluded that an assistive instrument in the form of a mathematical communication ability test can be used with a slight revision. For feedback from the first validator, items one and two were only found to have been confused with the question sentences. Then for the third question, besides adding symbols or notations used in answering questions, the subject should also be asked to explain about the symbols or notations. Meanwhile, the feedback from the second validator, was only found in the preparation of the sentence in question. For the third question, the validator suggests adding additional questions, which are the difficulties faced by the subjects in completing written test questions.

After receiving feedback or suggestions from the validators, then we will improve the mathematical communication abilities test instrument and then return it to the validator. So the research instrument is feasible to use.

5. CONCLUSION

This study involved each of two expert validators in the field of education and in the field of Mathematics. The results of the validation of the four validators showed that the mathematical ability test instrument of students based on Javanese Culture and the interview guide instruments that had been made, still needed to be added / edited to fit the research objective of measuring mathematical communication abilities based on Javanese Culture. So that the instrument can be concluded that it can be used with a slight revision. After the validation of this instrument is complete, then further research will be conducted on the test of mathematical communication abilities based on Javanese Culture.

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REFERENCES

- [1] National Council of Teacher of Mathematics. 2000. *Executive Summary Principles and Standards for School Mathematics*. Reston, VA: NCTM.
- [2] Robbins, Stephen P. & Judge, Timonhy A. 2009. *Organizational Behavior*. USA: Pearson International Edition.
- [3] Umar, W. (2012). Membangun Kemampuan Komunikasi Matematis dalam Pembelajaran Matematika. *Jurnal Ilmiah Program Studi Matematika STKIP Siliwangi Bandung*, Vol. 1 No.1.
- [4] Fuson, Karen C. 2019. Relating Math Words, Visual Images, and Math Symbols for Understanding and Competence. *International Journal of Dissability, Development, and Education*. Vol. 66, Issue 2.
- [5] Hossain, MI. 2015. Teaching Productive Skills to The Students: A Secondary Level Scenario. A Thesis. Department of English and Humanities. BRCA University. Daka. Bangladesh.
- [6] Prayitno, S., Suwarsono, & Siswono, T. Y. 2013. Identifikasi Indikator Kemampuan Komunikasi Matematis Siswa dalam Menyelesaikan Soal Matematika Berjenjang pada Tiap-Tiap Jenjangnya. *Konferensi Nasional Pendidikan*,
- [7] Hodiyanto. 2017. Kemampuan Komunikasi Matematis Dalam Pembelajaran Matematika. *AdMathEdu*, Vol. 7, No. 1.
- [8] Widjajanti, D. B. (2013). The Communication Skills and Mathematical Connections of Prospective Mathematics Teacher: A Case Study on Mathematics Education Studies, Yogyakarta State University, *Indonesia Jurnal Teknologi (Social Science)*, Vol 63, No 2, Hal 39-43.
- [9] Koentjaraningrat. 2002. *Pengantar Antropologi Pokok-Pokok Etnografi II*. Jakarta: PT Rineka Cipta
- [10] Sadiq, F. 2016. *Javanese Cultural Studies (Kajian Kebudayaan Jawa)*. academia.edu.
- [11] Creswell, John W. 2014. *Research Design: Pendekatan Kualitatif-Kuantitatif, dan Mixed*. Buku Beta. Jogjakarta.