ANALYSIS OF STUDENTS' MATHEMATICAL COMMUNICATION SKILL FOR ALGEBRAIC FACTORIZATION USING ALGEBRA BLOCK

Ch. Erlin Disasmitowati[1,b)] and Anisa Suba Utami[1, b)]

[1,2] *Department of Mathematics Education, Faculty of Teacher Training and Education, Sanata Dharma University, Mrican, Tromol Pos 29, Yogyakarta 55002, INDONESIA*

[a)]erlindisasmitowati@gmail.com
[b)]chaicha1990@gmail.com

Abstract

Based on the results of interviews from teachers, students' mathematical communication skills in algebraic factorization are lacking. This can be reinforced from the observation of the two classes, the students are less responsive to the material given by the teacher. The activities of the students in the classroom are only listening and writing, because the teacher uses the conventional method. The research was conducted at SMP BOPKRI 1 Yogyakarta in grade VIII students. There are 6 students who were taken randomly in this research. This research is a qualitative descriptive research. This research aims to analyze students' mathematical communication skills in algebraic factorization using Algebra Block props. In this study there are 3 indicators of students' mathematical communication skills. The students' mathematical communication skills are related to the cognitive and psychomotor aspects. If the cognitive and psychomotor aspects are good, then the students' mathematical communication skills are also good. After using Algebra Block, students' mathematical communication skill fulfills 3 indicator of mathematical communication skill which is expected. The results of this analysis are reinforced by student questionnaire which states that students are more helpful in solving algebraic modeling using Algebra Block. The results of this analysis can be used to change the method of learning so that students' mathematical communication skills will be better.

Keywords: Mathematical communication skill, Algebra Block, Analysis mathematical communication skill.

Introduction

During this time, learning math focuses more of calculations. Other aspects of mathematics learning are not applied like students mathematical communication skills. Communication is one of five standard process in NCTM (2000): (1) solving problems, (2) reasoning and proof, (3) communication, (4) connection, and (5) representation. With communication, students can express their own ideas. So, the use of students' mathematical communication skill is to understand, interpret, express, respond, and use mathematical symbols to present ideas in oral

and written form. The results from the observation of the researchers in two classes: students do not respond to the material given by the teacher, and the activities of students are only hearing and writing, because the teacher only uses conventional methods. This is reinforced by the results of interviews to students. Students say that math is difficult to understand, especially Algebra. Therefore, in this study we will take the material for factoring algebra with the use of Algebra book. Algebra block is a tool in the form of pieces of flat-shaped paper (square and rectangle) which will be arranged in accordance with the given algebraic form. Expectation by using Algebra Block, students will understand the material Factoring the Algebra, so that the students' mathematical communication skills will improve.

Mathematical Communication Skills

Opinions on how important communication in mathematics learning is proposed by NCTM (2000) which states that mathematics learning program should give opportunity to students to (1) arrange and link their mathematical thinking through communication, (2) communicating their logical and clear mathematical thinking to their friends, teachers and others; (3) analyze and assess mathematical thinking and strategies used by others; (4) using mathematical language to express mathematical ideas correctly. According to LACOE (2004), mathematical communication includes both written and oral or verbal communication.

Indicators of mathematical communication skills according to NCTM are as follows: (1) skill to express mathematical ideas through oral, written, and demonstrating them and visualizing them visually; (2) skill to understand, interpret, and evaluate mathematical ideas both orally and in other visual forms; (3) skill to use terms, mathematical notations and structures to present ideas, describe relation, and situational models. While Greenes and Schulman (1996) write the mathematical communication skill in three things :(1) expressed mathematical ideas through

speech, writing, demonstration, and portraying them visually in different types, (2) understand, interpret, and assess the ideas presented in writing, orally, or in visual form, and (3) construct, interpret and connect diverse representation of ideas and relation.

From some opinions about mathematical communication indicator above there are similarities between indicators to be used in this research, (1) expressing mathematical ideas in oral or written form, (2) understand, interpret and assess or respond to mathematical ideas in oral and written form, (3) using terms, notations, and symbols to present mathematical ideas in oral and written form. For more details can be seen in Table.1 below.

Table 1. Indicator of Mathematics Communication Skill

Communication Form	Indicator
Expressing mathematical ideas.	Students can express mathematical ideas in oral and written form.
Understand, interpret and assess or respond to mathematical ideas.	Students can understand, interpret and assess or respond to mathematical ideas in oral and written form.
Using terms, notations, and symbols to present mathematical ideas.	Students can use terms, notations, and symbols to present mathematical ideas in oral and written form.

Algebra Block and How to Use It

Algebra block is a prop in the form of pieces of flat-shaped paper (square and rectangle) which will be arranged according to the given algebraic form. For more clear by information can be seen below in **Figure.1**.

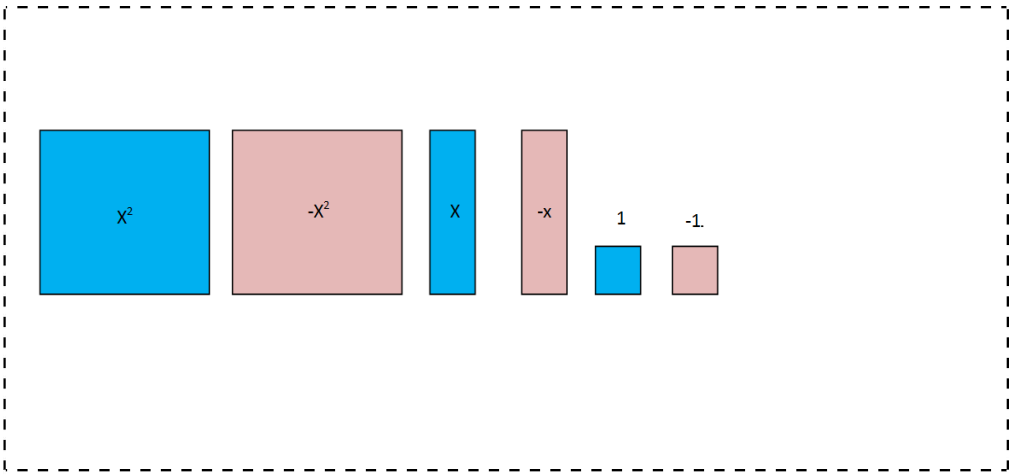

Figure 1. Algebra Block

The pieces of paper above can be arranged into square or rectangles according to the given algebraic form. The steps of constructing algebraic blocks are as follows.

1) Identify coefficients of each variable and constant whether positive or negative in algebra form.
2) Select or put pieces of paper according to coefficients and constants.
3) Arrange the pieces of paper to form a square or rectangles shape.
4) Determine the length and width of the square or rectangle formed.

For example, an algebraic form $x^2 + x - 6$, the possible arrangement of algebraic blocks is as follows.

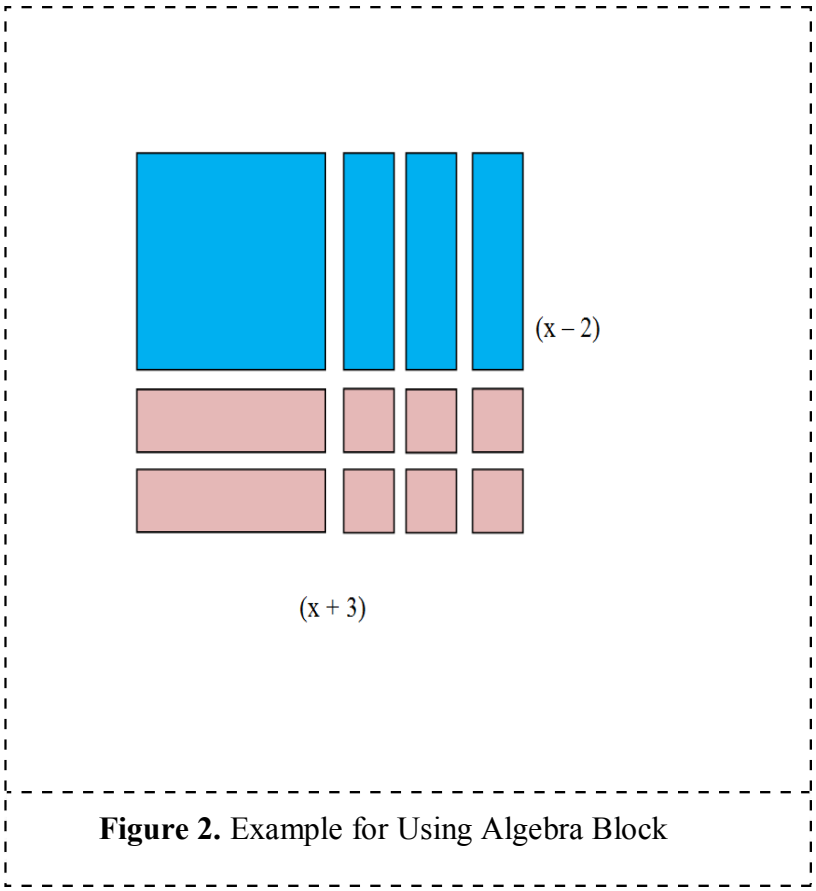

Figure 2. Example for Using Algebra Block

After the arrange of algebra blocks into square or rectangles, the next step determines the length and width. **Figure 2** shows that the length is (x + 3) and width is (x – 2). So the algebraic factorization of $x^2 + x - 6$ is (x – 2)(x + 3).

For factoring algebraic form using the distributive, it would be easier if you see blocks of algebra that has been formed. We see in **Figure 2**, pieces of build geometry (square or rectangle). There is one large blue square means that the representation of x^2, then there are 3 pieces of blue rectangle is a representation of 3x, then 2 pieces of red rectangle representation of -2x, and there are 6 small squares of red which are representations of constants -6 .

$$x^2 + x - 6 = x^2 + 3x - 2x - 6$$

$$= (x^2 + 3x) - (2x + 6)$$

$$= x(x + 3) - 2(x + 3)$$

$$= (x + 3)(x - 2)$$

Analysis of Mathematical Communication Skill

In this research, the students' mathematical communication skills were analyzed. The students' mathematical communication skill is the skill to understand, interpret, express, respond, and use mathematical symbols to present ideas in oral and written form. This skill is related to the cognitive and psychomotor aspects. The cognitive aspect in this study is knowledge of algebraic factorization. While for psychomotor aspect in this research is student skill in applying knowledge about algebraic factorization using Algebra Block. Both aspects are related to determining students' mathematical communication skills. If the cognitive aspects of the students are good, then to apply in psychomotor aspects on the use of Algebra Block props will look good. This is based on David Ausubel's Cognitive Theory. According to Ausubel the type of learning is 3, that is (1) learn with meaningful discoveries, (2) learning with invention is meaningless, and (3) learn to receive a meaningful expository. From the three types of learning, this study takes the type of learning number one that is learning a meaningful discovery by combining the knowledge possessed with learning materials learned. Or, students discover the knowledge of what they learn and then the new knowledge is combined with past knowledge.

In this case the students understood algebraic factorization, then the knowledge is combined with the use of Block Algebra for factoring algebraic form for easier, and without the use of conventional methods. This analysis is based on student questionnaire results, student work results, and student reasoning. The students' mathematical communication skills are good if the reasoning and skills are good.

Methodology

This research is a qualitative descriptive research. The research was conducted in August 2017. The research was conducted at SMP BOPKRI 1 Yogyakarta. Subjects in this study were students of class VIII taken at random from 2 parallel classes. The instrument in this study is divided into two main instruments and supporting instruments. The main instrument is the researcher, while the supporting instrument consists of Algebraic Factorization test using Algebra Block and questionnaire. Data collection techniques used observation techniques, interviews, written tests, and questionnaires. Data analysis techniques in this study in accordance with the disclosed Miles and Huberman which includes data reduction, data presentation, and withdrawal of conclusions.

Results and Discussion

In this discussion, will be discussed students with mathematical communication skills high, medium and low. The selection of students with high, medium and low mathematical communication skills is based on observations during the learning process and the students' initial ability derived from the results of last semester class test. Obtained by students with the highest ability that is S6 with result 84,375; students who have medium mathematical

communication ability that is S1, S3, S4 and S5 which value almost same that is 75; and students who have the lowest mathematical communication skill that is S2 with result of 66,25.

A. Students' with High Mathematical Communication Skill (S6)

When the research go on, S6 is not active, not much to ask, and faster to arrange the Algebra Block. S6 is more like working individually and when really having trouble ask the teacher to help solve questions 5 and 6. Here's an interview during the guidance:

S6 : Mom, why can not this be compiled? This coefficient is negative. Hard to set up.

Teacher : If it is difficult to be formed into a square or rectangular building, then it can add pieces of wake geometry the condition should be zero.

S6 : Ooo ... this must be blue and red, ma'am? A pair?

Teacher: Why a pair?

S6 : for example take -x and x, if it adds zero.

Teacher: Ok. That's right.

From the results of the conversation, it appears that students have good reasoning and in accordance with the expected mathematical communication. Psychomotor aspects are also good, can be seen from how to arrange the Algebra Block into a square or rectangular build, so that the arrangement will look neat. The psychomotor aspect is concerned with how to factoring algebraic forms using distributive.

When the teacher asks S6, to explain the results of the number 5, S6 is able to explain from the taking of the pieces of paper, then the way the algebra block is compiled and the

result of its factoring. S6 has also been able to explain the algebraic factorization with the distributive based on the algebraic blocks formed. This indicates that S6 has met 3 indicators of mathematical communication skill that have been determined.

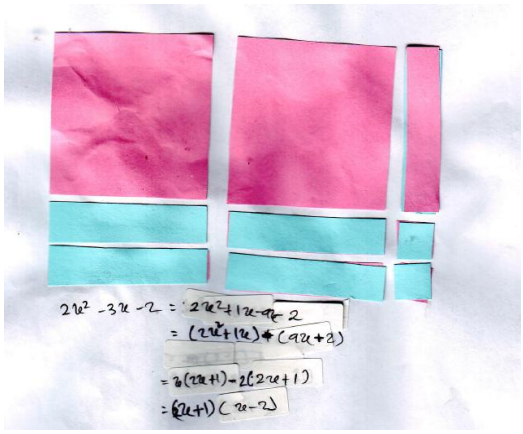

Figure 3. Work Result S6 No. 5

B. Students' with Medium Mathematical Communication Skill (S1, S3, S4, S5)

In this research, students with medium mathematical communication skills are there are some students, namely S1, S3, S4, and S5. When the learning process takes place, the cognitive aspects that include reasoning ability and understanding are almost the same. The psychomotor aspect of applying algebra blocks to the concept of algebraic factorization is same. They have difficulty in arranging algebra blocks especially in negative x coefficients and negative constants to add algebraic blocks of extent x still need help. As well as in arranging into a square or rectangular shape still needs guidance. In the case of numbers 5 and 6, the algebra blocks of x^2 extent are 2. So the students need guidance to compile into a square or rectangular build. From the algebra blocks obtained, students in algebraic

factorization using distributive method still need guidance. So the ability of application from image to nature of distributive still less. So it can be concluded that students' mathematical communication skills are still lacking.

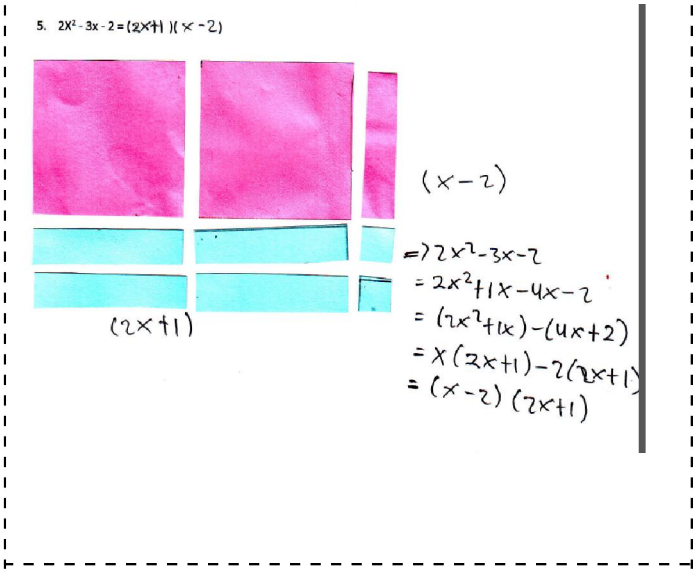

Figure 5. Work Result S6 No. 6

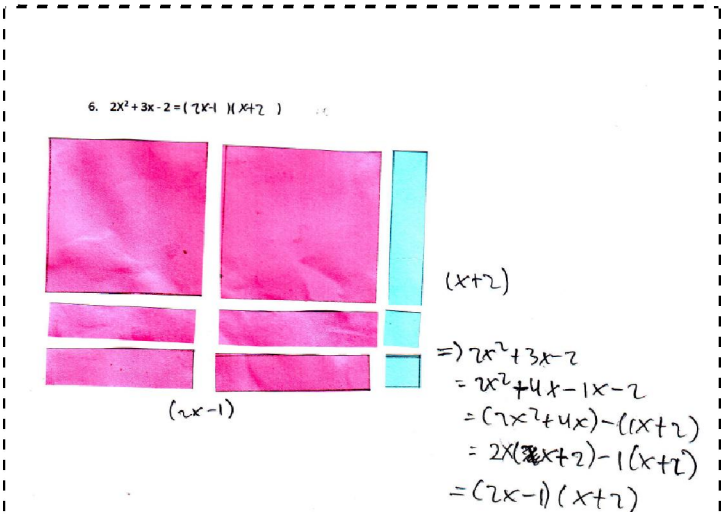

Figure 6. Work Result S6 No. 6

C. Students' with Low Mathematical Communication Skill (S2)

In preparing the Algebra Block S2 many ask for guidance and take a long time in doing. S2 is still confused to determine the number of square and rectangular geometry to build the Algebra Block. In determining the length and width of the rectangle of the build order of geometry also still need to be guided. In fact, the determination of length and width is a factor of the given algebraic form. In algebraic factorization by means of distributive of algebraic blocks that are formed still need guidance. It is seen that the cognitive aspects of S2 are still lacking that is not understood the concept of algebraic factorization, and psychomotor aspect is also still less marked by not yet able to apply its knowledge in Algebra Block. Because the ability to understand the concepts and skills of Algebra Blocks is still lacking, this has an impact on the mathematical communication skill. The skill of mathematical communication S2 is still low, seen when explaining the results of his work is still unclear because the knowledge is still lacking. In presenting the results of the work, S2 still needs help from the teacher.

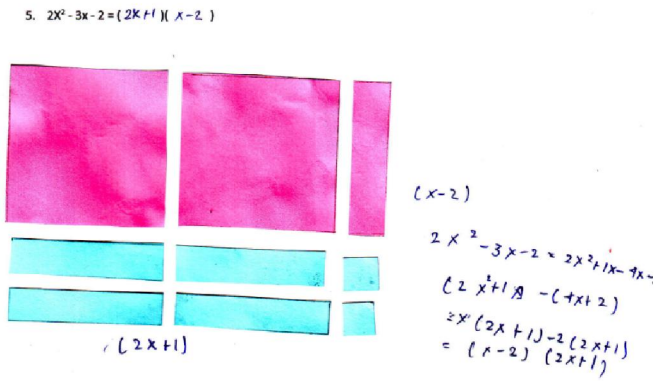

Figure 7. Work Result S5 No. 5

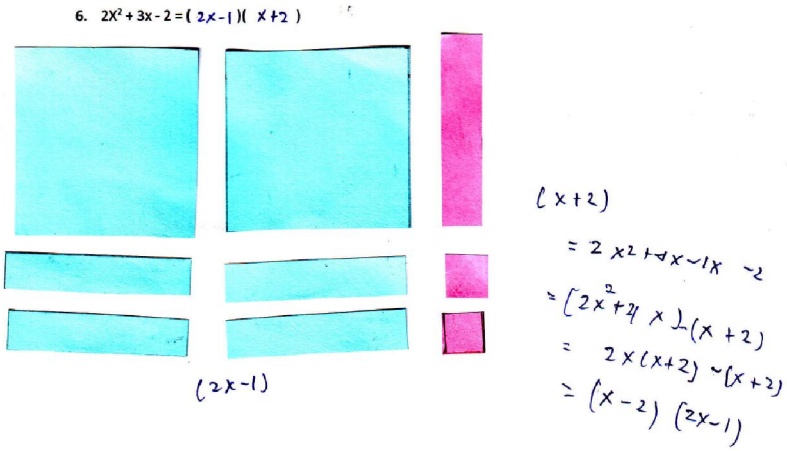

Figure 8. Work Result S5 No. 6

Tabel 2. Recap Analysis of Student Mathematical Communication Skills.

Indicator	Subject					
	S1	S2	S3	S4	S5	S6
● Students can express mathematical ideas in oral and written form.	v		v	v	v	v
● Students can understand, interpret and assess or respond to mathematical ideas in oral and written form.	v	v	v	v	v	v
● Students can using terms, notations, and symbols to present mathematical ideas in oral and written form.						v

Conclusion

Cognitive and psychomotor aspects are high, the students' mathematical communication skill is also high. So that impact on the provision of guidance on the learning process. While students with cognitive and psychomotor aspects are low, the students' mathematical communication skill is also low. Therefore, in the learning process students with low communication skills in the learning process needs special guidance.

Reference

Amalianurjannah. 2013. *Teori Belajar Bermakna dari David P*. Retrieved from http://amalianurjannah.files.wordpress.com/2013/05/6-teori-belajar-bermakna-dari-david-p.pdf

Greenes and Schulman. 1996. *Communication Processes in Mathematical. Exploration and Investigation*. USA: The National Council of Teachers of Mathematics, Inc.

Los Angeles Country Office of Education (LACOE). 2004. *Communication*. Retrieved from : http://teams.lacoe.edu

National Council of Teachers of Mathematics (NCTM). 2000. *Principles and Standards for School Mathematics*. USA: The National Council of Teachers of Mathematics, Inc.