The mathematics communication of students in learning based on ethnomathematics Rejang Lebong

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Abstract. The objective of study was to describe the metacognition of students in the mathematical communication process of high school students in learning mathematics oriented ethnomathematics Rejang Lebong. This research method is descriptive qualitative research, with the subject of the student of Senior High School in Rejang Lebong. The results showed that subjects with high cognitive level were able to think metacognitive with the mathematical communication process through planning, monitoring and evaluating the thinking process in the mathematical communication process. Subjects with cognitive level are doing mathematical communication in the form of planning, and monitoring but not exactly in evaluating the thinking process. While subjects with low cognitive level can make planning but cannot monitor and cannot evaluate the thinking process.

1. Introduction
In the learning process sometimes there is a misconception on the information obtained by students with information that has been conveyed by the teacher [1]. In this regard, metacognition can monitor students' thinking stages so that they can explain the way of thinking and the results of their thinking. Ozsoy [2] argues that metacognition is an awareness of the learning process, planning, strategy selection, monitoring the learning process, being able to correct one's own mistakes, to be able to check whether the strategies used are useful or not, to be able to change learning methods or strategies if needed.

Flavell [3] argues that metacognition also plays an important role in fields such as communication, reading comprehension, language learning, social cognition, attention, self-examination, memory, self-learning, writing and problem solving. According to Flavell [3] defines metacognition as thinking about thinking or thinking about thinking. Metacognition, according to him is the ability to think where the object of thinking is the process of thinking that occurs in oneself. Wellman [4] states that "metacognition is a form of cognition, second or higher order thinking process which involves active coprol over cognitive processes. It can be simply defined as thinking about thinking or as a person’s cognition about cognition. That is, metacognition is a form of cognition or a two-level or more thinking process that involves controlling cognitive activity. Therefore, metacognition can be said to be someone's thinking about his own thinking or one’s cognition about his own cognition). Furthermore, Huitt [5] argued that "metacognition is thinking about thinking, knowing what we know and what we do not know" which means metacognition is an awareness of what is known and what is not known. Thus, it can be seen that metacognition is knowledge, awareness and control of a person towards the process and the results of his thinking.
According to Huitt [5] defines metacognition as a person's knowledge of his cognitive system, one's thinking about his thinking, and one's essential skills in "learning to learn". Furthermore Huitt [5] suggested two components included in metacognition, namely (a) what we know or don't know, and (b) regulation of how we learn. Similar opinion was expressed by Flavell [3], as quoted by Livingston [4] metacognition consists of metacognitive knowledge and experience or regulation of metacognitive experiences (regulation).

Woolfolk [6] explains that there are several strategies in metacognition, namely planning, monitoring and evaluating. Planning includes how to decide how long it will take to complete a task, which strategy will be used, how to start a task, what resources will be used, how it will work, how much attention is needed on a task, etc. Monitoring is an awareness of what is being done. Evaluating (evaluating) involves making decisions about the process and results that have been achieved referring to ways to raise awareness about the thinking and learning processes that apply. This awareness can help a person to be based on the results of thinking and learning. The metacognition strategy controls his mind by designing, monitoring and assessing what is learned. Therefore, in using metacognition strategies students can control their learning such as designing what they want to learn, monitoring the progress of self-learning, and assessing what is learned.

NCTM [7] suggests that communication is a vehicle between teachers and students to respect each other when the problem solving and reasoning process occurs. But communication by itself also becomes important, because students must learn to describe phenomena or problems through various ways, both written, verbal and other visual forms in mathematics learning. In this quote it is implied that communication in learning is usually seen when the problem solving and reasoning process is carried out, communication does play an important role in mathematics learning. According to Barton [1] mathematical ideas that will be communicated must be systematic, so that mathematics is produced. This causes mathematics and language to develop together. In addition, to providing freedom of communication to students, in the process of learning mathematics the teacher must be able to optimize the learning potential of students, namely by activating their metacognitive abilities. With metacognition abilities students will be able to control the thinking activities that occur in themselves. Thinking activities like this will be able to make students learn more directed and obtain optimal learning outcomes. This can happen because when students are able to control their cognitive activities they will look for the right strategies to solve a problem, so learning will be more effective and efficient. Students at this stage have a dialogue within themselves about what they can do and what is most effective in this situation.

The nature of mathematics tends to be linear and rigid, but if it is integrated with something soft like culture, then the thought becomes flexible [8,9]. For example, thinking about the forms of architectural beauty. The structure of the building is thought of with mathematics but its ornaments use aesthetics. The flexibility arises when thinking of the structure of the building not only from the aspect of the form (two-dimensional geometry and three-dimensional geometry), but also considers the sense of beauty of the form. Various Rejang Lebong cultural products of our ancestral heritage reveal artistic creativity that contains mathematical elements. For example, in rejang woven motifs that contain two-dimensional geometry formations, carving ornaments and architectural forms in traditional houses that contain geometric patterns of flat build. Efforts to link mathematics with culture are better known as Etnomatematics.

Research on Ethnomathematics was first introduced in 1977 by D’Ambrosio [10,11], who was a Brazilian mathematician. He defines Ethnomathematics as follows: "The ethno prefix is today accepted as a very broad term that refers to the social cultural context and therefore includes language, jargon, and codes of behavior, myths, and symbols. The derivation of mathematics is difficult, but it tends to mean to explain, to know, to understand, and to do activities such as ciphering, measuring, classifying, inferring, and modeling. The suffix tics is derived from technology, and has the same root as technique" [12]. In language, Ethnomathematics consists of three words, the prefix "ethno" is defined as something very broad which refers to the socio-cultural context, including language, jargon, code of behavior, myths, and symbols.
The second basic word "mathema" tends to mean explaining, knowing, understanding, and carrying out activities such as coding, measuring, classifying, concluding, and finally modeling. The suffix "rik" comes from techne, and means the same as technique. Whereas in terms of Ethnomathematics is defined as: "The mathematics which is practiced among identifiable cultural groups such as national tribe societies, labor groups, children of certain age brackets and professional classes" [11]. The term was later refined to: "I have been using word ethnomathematics as modes, styles, and techniques of explanation, understanding, and coping with the natural and cultural environment (mathema) in distinct cultural systems (ethno)" [10,13-17]. Thus, this paper describes students' mathematical communication during ethnomathematics-based learning.

2. Methods
This research is a qualitative descriptive study. This study uses qualitative data and is described to get a clear and detailed picture of the students' metacognition profile in the mathematical communication process of high school students in the mathematics learning ethnomatics-oriented Rejang Lebong. Bogdan and Taylor [8] suggested that qualitative research produces descriptive data in the form of written or oral words from people or observable behavior.

3. Results and discussions
Subjects were chosen based on the cognitive level of students into 3 groups: high, medium and low groups. The researcher first gives the initial test, Rejang Lebong's ethnomatically oriented mathematical communication questions which have been validated by the expert team and declared valid. From the results of the test obtained a cognitive picture of Senior High School students. This cognitive level is obtained from the results of students' answers on the answer sheet given. Subjects selected 6 people based on students' cognitive level. Each group was represented by 2 high-class students, 2 middle-class students, and 2 low-class students. So 6 students were selected with a mathematical communication ability test (see Table 1).

| No. | Subject Code | Group | Test          |
|-----|--------------|-------|---------------|
| 1   | VPS          | High  | Mathematical  |
| 2   | TPI          | High  | Communication |
| 3   | TDP          | Medium| Ability       |
| 4   | MFY          | Medium|              |
| 5   | IMI          | Low   |              |
| 6   | RAI          | Low   |              |

Based on Table 1, data from the subject is described according to the mathematical communication process. The metacognition will be viewed from each mathematical communication process of each given question. Furthermore, the research data will be analyzed based on the level of metacognition conducted by students. The number of students in each student's metacognition abilities in the mathematical communication process is viewed from the cognitive level of high, medium, and low ability students. After selecting 6 research subjects, then each subject was asked to be interviewed by the researcher related to the mathematical communication ability test that had been done by students with an interview guide that had been prepared in advance by the researcher. Data collection is done by interviewing the results of the subject's work. The interview was conducted two days, May 14 and 15, 2018, which was assisted by a sound recording taker.

The cognitive level of senior high school student of Rejang Lebong 4 State High School can be seen in the following Table 2:
Table 2. Cognitive level of senior high school students of Rejang Lebong 4 state senior high school from mathematical communication test.

| The number of students | High | Medium | Low |
|------------------------|------|--------|-----|
| Percentage             | 37.5%| 37.5%  | 25% |

Based on Table 2 the results of the class X IPA 2 mathematical communication test results at Rejang Lebong 4 State High School obtained the ability of students in mathematical communication test with a total number of students 32 people including 12 high level cognitive students or 37.5% and students who were cognitive level there were 12 people or 37.5% while students with low cognitive level consisted of 8 people or 25%. Here is one excerpt from a high cognitive level student interview activity:

3.1. Phase reflecting images, tables, graphs into mathematical ideas

Transcripts of VPS student interviews in reflecting images into mathematical ideas related to the Rejang Lebong traditional house on May 14, 2018 are figure 1.

![Figure 1](image)

**Figure 1.** Results reflect images into VPS students' mathematical ideas.

Researcher: "Good morning Viona, how are you today?"
VPS Subject: "Okay, ma'am.
Researcher: "Are you ready to interview?"
VPS Subject: "Yes, Mom.
Researcher: "Based on the picture of the Rejang Lebong traditional house on the question, which part of the traditional house meets the mathematical concepts of right triangle?"
VPS Subjects: "Side roof, front roof, rear roof, and staircase on the roof of the Rejang Lebong traditional house."
Researcher: "Why are the parts in the Rejang Lebong traditional house included in a right triangle?"
VPS Subject: "Because these parts have lines that are perpendicular to each other and one of the corners is formed at a 90° angle"
Researcher: "Yes, that's right. So the answers that you have written for questions number 1, 2 and 3 are correct." However, to draw a right triangle you should use a ruler to make it neater and clearer.
VPS subject: "OK, ma'am."

Based on the results of the interview subject transcript above, it can be concluded that VPS students in an effort to reflect the picture into mathematical ideas on the problem of mathematical communication skills as follows:

- To understand the students' metacognition in the VPS mathematical communication test, they first observe the pictures of each part of the Rejang Lebong Traditional House in the form of a right triangle.
- After observing the picture of the Rejang Lebong traditional house found in the mathematical communication test, VPS students can determine the parts of the Rejang Lebong traditional house in the form of a right triangle because the VPS has understood the properties of right triangles.
3.2. Stage of Declaring Everyday Events in Language or Mathematical Symbols

Transcripts of interviewing VPS students in expressing daily events in language or mathematical symbols relating to the Rejang Lebong traditional house on May 14, 2018, see Figure 2.

![Image](image1.png)

**Figure 2.** Results declare daily events in VPS student mathematical symbols.

Researcher: "Can you state the parts of the Rejang Lebong traditional house in the form of mathematics?"
VPS subject: "Yes, ma'am."
Researcher: "How?"
VPS subject: "by making a right triangle that is found in the parts of the Rejang Lebong traditional house, then symbolizing each corner of the triangle. Suppose the ABC triangle. Then, give a sign of the right angle formed.
Researcher: "yes, that's right. So the answer you wrote for problem number 4 is correct. "To draw a right triangle you use a ruler so the picture is neater and clearer.
VPS subject: "OK, ma'am."

Based on the results of the interview subject transcript above, it can be concluded that VPS students in an effort to express daily events in language or mathematical symbols in the matter of mathematical communication skills as follows: To understand the students' metacognition in the VPS mathematical communication test first draw each part of the Rejang Lebong Traditional House in the form of a right triangle and then symbolize each right triangle that has been drawn. VPS students have understood the test of mathematical communication skills in expressing everyday events in language or mathematical symbols related to the traditional house of Rejang Lebong. Stage Provides Explanation of Ideas, Concepts, or Mathematical Situations with Your Own Language in the Form of Mathematical Writing.

![Image](image2.png)

**Figure 3.** Results of explanation of VPS students.
Transcript of interview of VPS students in giving an explanation of ideas, concepts, or mathematical situations with their own language in writing mathematically related to the Rejang Lebong traditional house (see Figure 3). Piece of the interview on May 14, 2018 as follows:

Researcher: "how do you determine the length of the AC side for problem number 5?"

VPS Subject: "Using the Pythagoras formula, ma'am."

Researcher: "How is the formula for determining the AC value?"

VPS Subject: \[ AC = \sqrt{BC^2 - BA^2}. \]

Researcher: "If the right triangle ABC in question number 5 all sides are known, namely AB = 4, AC = 3, and BC = 5. What is the trigonometric ratio to determine the value of sin C, cos C, tan C, cosec C, sec C, and cotan C. Explain!"

\[ \frac{4}{5}, \frac{3}{5}, \frac{4}{5}, \frac{5}{5}, \frac{5}{3}, \frac{3}{3}, \]

VP Subject: "sin C = \frac{4}{5}, cos C = \frac{3}{5}, tan C = \frac{4}{3}, cosec C = \frac{5}{4}, sec C = \frac{5}{3}, and cotan C = \frac{3}{4}."

Researcher: "after determining the trigonometric comparison value, can you explain the meaning of the comparison of trigonometry sin C, cos C, tan C, cosec C, sec C, and cot C?"

VPS subject: "Yes, ma'am."

Researcher: "Yes, try to explain."

VPS Subject: "Sinus C is a comparison of the length of the side in front of the angle C with the side hypotenuse of the triangle. Cosine C is a comparison of the length of the side beside the angle C with the hypotenuse side of the triangle. Tangent C is the ratio of the length of the side in front of angle C with the side beside the angle C. Cosecant C is a comparison of the side length of the hypotenuse of the triangle with the side in front of the angle C. Secant C is a comparison of the side length of the hypotenuse of the triangle with the side beside the angle C. Cotangent is a comparison of the sides beside the angle C with the side in front of angle C."

Researcher: "Good, very complete explanation. So your answers to questions number 5, 6 and 7 are correct."

Based on the results of the interview subject transcript above, it can be concluded that VPS students in providing an explanation of ideas, concepts, or mathematical situations with their own language in the form of writing mathematically on the problem of mathematical communication skills as follows:

To understand students' metacognition in VPS mathematical communication tests first use the Pythagoras formula to determine the value of one side of the triangle that is not yet known. VPS students use the concept of trigonometric comparisons to determine the values of \( sin C, cos C, tan C, cosec C, sec C, \) and \( cotan C. \) So VPS has understood the concept of trigonometry comparison.

So that VPS students already understand the test of mathematical communication skills in expressing everyday events in language or mathematical symbols related to the traditional house of Rejang Lebong Bengkulu. These results support several previous studies; such as studies on ethnomathematics in Bengkulu [see: 13-17].

4. Conclusion

Based on the results of the study, it was concluded that metacognition of high-level students had metacognitive thinking and reflected images into mathematics. Students use daily activities in mathematical symbols related to the Rejang Lebong traditional house, and can provide an explanation of ideas, concepts, or mathematical situations with their own language. Subjects with a cognitive level are able to express daily events in mathematical language or symbols related to the Rejang Lebong traditional house, but it is not appropriate to provide an explanation of ideas, concepts, or mathematical situations with their own language. Subjects are able to plan, monitor but are not yet right in evaluating the thought process in the process of mathematical communication. Subjects with a low cognitive level cannot express daily events in a language or mathematical symbol. Students are able to make plans but cannot monitor and evaluate the thinking process in the process of mathematical communication.
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