

Analysis of Difficulties in Completing Mathematical Communication Problem Solving in Terms of Learning Styles Using Inquiry Learning

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Abstract-The purpose of this research is analysis of difficulties in completing mathematical communication problem solving in terms of learning styles using inquiry learning. The research was a qualitative descriptive study. Data analysis method used the Miles and Huberman Methods. The results showed that: students who has convergent learning style, divergent, assimilation and accommodation has different mathematical communication difficulties, namely difficulties was facts, concepts, procedures and principles.

Keywords-*Inquiry Learning , Learning Style, Mathematics Communication.*

I. INTRODUCTION

Mathematics is a universal science that underlies the development of modern technology, has an important role in various disciplines and advances the power of human thought. Mathematics subjects need to be given to all students at each level, so as to be able to obtain, manage, and utilize information to survive in a state that is always changing, uncertain, and competitive [1]

The purpose of learning mathematics, namely: Students must learn mathematics through understanding and actively building new knowledge from the experience and knowledge they have. One of the efforts in realizing this is formulated five basic standards of mathematics learning including problem solving, reasoning and verification, communication, connection, and representation [2].

One of the skills or abilities that students must possess was communication in mathematics. There were at least two important reasons, why communication in mathematics needs to be developed among students, namely (1) mathematics as language, meaning that mathematics is not just a tool to aid thinking, a tool to find patterns, solve problems or take conclusions, but mathematics is also a valuable tool for communicating various ideas clearly, and carefully; (2) mathematics learning activity; that is, as a social activity in learning mathematics, mathematics was also a vehicle for interaction between students, and also communication between teachers and students [3].

Weak mathematical communication skills will result in a lack of other mathematical abilities. Students who have good

mathematical communication skills can create diverse representations, and it will be easier to find alternatives in solving problems. To overcome this is by applying learning strategies, one of the strategies in teaching was to know the student's learning style. Learning styles has been shown to provide an important role in the learning process. This was because each person has his own learning style that determines how he interacts with his learning environment [4].

Inquiry learning has a significant influence on Kolb students' learning styles, namely students who learn with direct experience, activists, and students who like practical ideas [5].

To foster students' mathematical communication skills, the teacher needs to apply the appropriate learning model. One way that teachers can do to overcome students' problems in learning mathematics was to apply the appropriate learning model. Learning models that should be applied are learning models that provide opportunities for students to construct their own knowledge so that students are easier to understand the concepts taught and communicate their ideas [6].

Inquiry learning models can maximize students' mathematical communication skills in investigating something systematically, critically, logically and analyzing independently. Students find ideas through their own discovery process [7].

II. THE LITERATURE

A. Mathematical Object

According to Begins, there were four kinds of mathematical objects, those were fact, concept, operation, and principle. Bell argues that the mathematical objects consist of facts, skills, concepts and principles. Fact in mathematics was a convention, a specific method in expressed mathematical knowledge in words or symbols. The concept was an abstract idea that gives the chance to group some objects or situations and to determine whether an object or situation is an example or not according to the abstract idea. Operation is a function which includes one and another mathematical object. Principle was a connection of two or more mathematical objects [8].

B. Application of Thinking Strategies in Problem Solving

Problem solving was an effective way of learning to achieve good mastery of matter. This is because students with the provisions of the rules they have learned, will easily apply them to problems in various situations. Gagne in his learning hierarchy places problem solving as a form of high-level learning. By practicing working on many questions, students will have the potential to solve new problems. Conditions that allow students to successfully solve problems are two, namely internal conditions and external conditions in the form of learning situations. Internal conditions needed to be able to solve the problem is the readiness of students to be able to easily remember the rules that are relevant to the problems that have been learned previously. External conditions that support the problem solving process are usually instructions. Instructions should be in the form of stimuli that can stimulate students to prepare relevant rules. Conceptual failure in the final settlement is caused by misconceptions experienced by students and followed by errors in the modeling (picture). Misconception has something to do with learning irregularities, so it is less accustomed to completing training questions given by the teacher [9].

C. Mathematical Communication Ability

Understanding mathematics could be related to mathematics as a language, the language of symbols, which was saw in the symbolization and formulation that converts statements into formulas, symbols, or images. The relationship between language and mathematics as a symbol of language is very close. Symbolic language was a tool to explain mathematical concepts to be simple. In contrast, mathematics was a tool to simplify one's mathematical understanding into symbolic language. [10]

Communication was an interaction, a symbolic process that requires people to regulate their environment in a way, namely: (1) building relationships between fellow human beings, (2) through exchange of information, ideas, skills, using symbols, pictures and so on; (3) to strengthen the attitudes and behavior of others; and (4) trying to change that attitude and behavior. In general, it can be interpreted as an event conveying messages that take place in a community and cultural context [9]. Communication as a process of delivering messages from the sender of the message to the recipient of the message through certain channels for a specific purpose. [11]

It can be concluded that communication is an interaction carried out by people in the process of delivering messages through the exchange of information, ideas, skills, using symbols, images and so on to produce certain information with a specific purpose.

Mathematical communication as a verbal explanation of mathematical reasoning is measured through three dimensions, namely truth (correctness), fluency in providing various correct answers and mathematical representations, in formal form, visual, algebraic equations, and diagrams. [12]

Mathematical communication has an important role for students including helping students to solve problems by communicating mathematical ideas that are done by discussing mathematical ideas between students and the teacher.

Indicators of mathematical communication skills, namely (1) to explain an idea or situation of an image that is described in its own words in writing; (2) to state a situation with an image; and (3) to state the situation into a mathematical model [2].

Mathematical communication skills need to be developed in learning situations through these indicators, because one of the functions of mathematics is as a way of communicating ideas in a practical, systematic and efficient manner. Communication skills are an important part of mathematics education. So in learning mathematics, when a concept of mathematical information is given by a teacher to students or students are actively involved in solving mathematical problems and convey ideas or ideas and clarify understanding in explaining the completion of an item through communication of ideas into objects refinement reflection, discussion, and overhaul then at that time transformation of mathematical information from the communicator to the communicant, or mathematical communication is happening.

Based on these opinions, the indicator of mathematical communication skills in this study is tailored to the needs of researchers, which is limited to written communication, which is grouped into three, namely (1) to explain ideas or situations that are described in their own words in writing; (2) to state a situation with an image; and (3) to state the situation into a mathematical model.

D. Difficulties in Thinking Process in Resolving Student Mathematical Communication Problem Solving

Results of research in several high schools in the city of Bandung in 2004 indicate that mathematical communication skills can be influenced by students' understanding of concepts, principles and strategies of resolution. The higher the students' mathematical communication skills, the higher the understanding required of students. as well as problem solving [9].

It states that the difficulty of the thinking process in solving the students' mathematical communication problems is continuous with understanding mathematical objects. for example, in the difficulty of concepts where students' inability to explain their own ideas in writing, the difficulty of the procedure in which students' inability to express a situation in the form of pictures, the principle of patience in which students are unable to express a situation into a mathematical model, is the inability of students to apply rules or mathematical formulas in problem solving.

E. Learning Style Learning

styles are the key to developing performance in work, school and in interpersonal situations[13]. Learning styles are: The most sensitive response in one's brain to receive data or

information and information providers and their environment. Information will be more quickly accepted by the brain when it is in accordance with one's learning style (recipient of information). If the information that contains learning material has been received by the brain, it can be said that the indicator of a person's learning outcomes has been completed. That is, children as recipients of information have understood the material presented by their teacher well. If teaching with methods that are appropriate to students' learning styles, then all subject matter will be well understood by their students [14].

An individual's learning style not only shows how he learns but also provides information about how to design a learning environment [15].

Learning styles describe individual unique ways through the learning cycle based on their tendency towards four different learning modes CE (*Concrete Experience*), RO (*Reflective Observation*), AC (*Abstract Conceptualization*), & AE (*Active Experimentation*) [16].

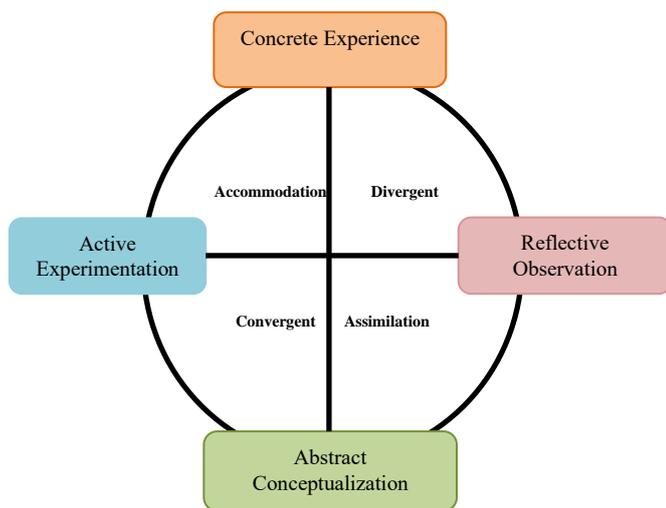


Fig 2.1 Cycle of Learning Style Kolb

In relation to this matter there are four models of learning styles Kolb. namely: (1) Divergent prefers to see the situation from a number of different perspectives, (2) Assimilation is competent in understanding various kinds of information including it in a logical and concise sequence and superior in creating theory; (3) Convergence likes to apply practical ideas to problems and do their best when there is only one answer, (4) Accommodation enjoys direct experience and develops in new and challenging situations [17].

E. Inquiry Learning Model Inquiry

learning is an engineering study of situations in such a way that students can play as scientists. The main technical inquiry learning activities are the maximum involvement of students in the process of learning activities, and the maximum direction of activities in the learning process and

students can develop a confident attitude about what is found in the inquiry learning process[18]

Inquiry learning models can increase students' confidence in the ability to find solutions from the subject matter given [19]. In the inquiry learning process students work like scientists and find answers to questions and problems through their own research [20-21]. Inquiry learning allows students to actively participate and gain hands-on experience, they learn by asking questions, collecting and processing the data they have collected, and using it to find answers to these questions [22].

Technical implementation of Inquiry Learning Model: (1) Do orientation; (2) Learning to formulate problems; (3) Formulating hypotheses; (4) Collect data; (5) Test the hypothesis; (6) Formulating conclusions [18].

III. METHODOLOGY

This research was conducted at senior high school 11 Medan. The reason for choosing the location of thus research was because of the importance of the mathematical communication skills of high school students, the absence of similar research in the school, namely the research on the analysis of mathematical communication skills in terms of student learning styles in inquiry learning models conducted at senior high school 11 Medan.

This study uses descriptive qualitative research using a case study method. This type of qualitative research, meaning that this type of research aims to describe mathematical communication skills in terms of students' learning styles in the application of inquiry learning models. Subjects in this study were 35 students, interview subjects were selected based on Kolb's learning style.

The mechanism used in this study includes three stages, namely (1) the preparation stage of learning tools and research instruments; (2) the stage of validation and testing of instruments and instrument study research; (3) the stages of carrying out research and data analysis. Each stage is designed in such a way as to obtain valid data for research purposes. While the data analysis process follows the concept given by Mile and Huberman consisting of three activities that occur interactively and lasts continuously until the end. Activities in data analysis are: Data Reduction, Data Display and Conclusion.

IV. RESEARCH RESULT

A. Klob's Learning Style Questionnaire Kolbs Learning Style Questionnaire

Based on the results of filling out questionnaires that have been conducted by 35 studentsuses a learning style questionnaire, the results of learning styles are shown in Table 4.1.

TABLE 4.1 Results of Questionnaire Learning Style

Learning Style	Number of Students	Percentage
Convergence	13	37.14%
Divergent	6	17.14%
Accommodation	6	17.14%
Assimilation	10	28.57%

Research conducted with 123 selected students, the dominant students with convergent learning styles (62.60%), followed by assimilation learning styles (17.89%), accommodation (11.38%) and divergent (8.13%). The tendency of students to converge and assimilation learning styles implies that they prefer practical applications of opinions with little emotion, assessment and development of abstract theories and ideas [17]. Different in the next research, it was obtained the results of the study, from 37 students of were obtained who had convergent learning styles amounted to 6 students, diverging learning styles amounted to 14 students, learning style accommodation was 14 students, assimilation learning styles amounted to 3 students [23].

B. Mathematical Communication Results Test

Qualitatively, students' level of mathematical communication ability can be seen in Table 4.3 below.

TABLE 4.3 Mathematical Communication Ability Test Results Student

Value Interval	Number of Students	Percentage	Assessment Category
$80 \leq SK \leq 100$	8	22.86%	Height
$65 \leq SK \leq 80$	12	34.28%	Moderate
$0 \leq SK \leq 65$	15	42.85%	Low

Ket: SK = Conversion Score (Student Value)

Based on Table 4.3 it can be seen that the level of students' mathematical communication skills with the inquiry learning model has a low level of mathematical communication ability test results. It also occurs in research conducted that students' mathematical communication skills are low by using the inkuri learning model [7]. Based on the results of the study it can be concluded that the mathematical communication skills of students were still low, so it is needed to be taken into consideration for further research [24].

C. Analysis of students' difficulties in solving students' mathematical communication problems in terms of learning styles

1) Analysis of difficulties in students' mathematical communication problem solving processes in terms of convergent learning styles are, as follows:

- a. Explain ideas or situations described in their own words in writing

Students are able to explain ideas with his own words in writing, but students are less able to apply concepts in solving mathematical problems, he does not think deeply, students only think practically it is classified as a concept difficulty, where one of the indicators in concept difficulty is the inability of students to apply the concept in solving mathematical problems.

b. Stating the situation into a mathematical model

Students have not been able to state the situation into a mathematical model, for example as students do not know the formulas in a problem, lack of understanding the facts and students do not know the mathematical symbols that have been explained. and students prefer practical things, and do not think of an effective solution in working on the problem. Students are included in the difficulty of facts, where the inability to distinguish symbols and mathematical symbols.

c. Stating a situation in the form of an image

Students have not been able to state a situation in the form of an image, because students do not understand the problem given, then students have not understood how to describe a statement on the given problem. Students experience procedural difficulties, where students cannot express the situation with pictures.

2) Analysis of difficulties in the process of solving mathematical communication problems of students in terms of divergent learning styles are, as follows:

a. Stating the situation into a mathematical model

In divergent learning styles students find difficulty in expressing a situation in a mathematical model, for example students do not know the formulas in doing the problem this, students are not able to remember the formula that has been learned, because they feel difficulties in applying these formulas in solving problems in math problems, so that students with divergent learning styles experience principle difficulties, students also feel difficulties in planning mathematical problem solving, namely students experience procedure difficulties. Students also feel concept difficulties, for example as students cannot apply the concepts they know in mathematics learning.

b. Stating a situation in the form of an image

Students have not been able to express a situation in the form of an image, because students do not understand the problem given, then students do not understand how to describe a statement on the given problem. Students experience procedural difficulties, where students cannot express the situation with pictures.

3) Analysis of difficulties in the process of solving mathematical communication problems of students in terms of accommodation learning styles are, as follows:

a. Stating the situation into a mathematical model

In the accommodation learning style students find it difficult to write formulas in doing the given questions, it is caused by lack of information it has. This causes

students to experience difficulties students are not able to remember the formula that has been learned, because they find it difficult to apply these formulas in solving problems in math problems, so that students with divergent learning styles experience principle difficulties, students also feel difficulties in planning mathematical problem solving , namely students experiencing procedural difficulties. Students also feel concept difficulties, for example as students cannot apply the concepts they know in mathematics learning.

b. Stating a situation in the form of an image

Students have not been able to express a situation in the form of an image, because students do not understand the problem given, then students do not understand how to describe a statement on the given problem. Students experience procedural difficulties, where students cannot express the situation with pictures.

4) Analysis of the difficulties in the students' mathematical communication problem solving process in terms of assimilation learning styles are, as follows:

a. Stating the situation into a mathematical model

In assimilation learning styles students find it difficult to express a situation in the form of a mathematical model, for example students do not know the formula in solving problems given, it is caused by a lack of understanding of the facts and students are not aware of the mathematical symbols that have been explained.

b. Stating a situation in the form of an image

Students have not been able to express a situation in the form of an image, because students do not understand the problem given, then students do not understand how to describe a statement on the given problem. Students experience procedural difficulties, where students cannot express the situation with pictures.

V. CONCLUSIONS

Based on the research, it is found that the students' thinking process difficulties in solving mathematical communication problems in terms of learning styles are: in convergent learning styles students experience difficulties in concepts, facts and procedures. Judging from the divergent learning style, students experience difficulties in concepts and procedures. Judging from the learning style of accommodation, students experience difficulties in principles, concepts and procedures. Judging from the style of learning assimilation, students experience difficulties in facts and procedures.

REFERENCES

[1] Depdiknas. Permendiknas. 2006. No 22 Tahun 2006 Tentang Standar Isi. Jakarta :Depdiknas.
 [2] NCTM. "Principles and Standarts for Mathematics, Reaston", 2000. VA:NCTM

[3] A.J. Barody "Problem Solving, Reasoning, and Communicating", K-8. Helping Children Think Mathematically. New York: Merrill, an imprint of Macmillan Publishing, Company. 1993.
 [4] Y. A. Anintya , E. Pujiastuti, Mashuri, "Analysis of Mathematical Communication Skills Viewed from Student Learning Styles in Eighth Grader Students in Learning Resource Based Learning Model".Unnes Journal Of Mathematics Education. 2017. 6 (1): 37-43.
 [5] J. Skoda, J, P. Doulik, M.Bilek, M &I. Simonova, "Learning Style As A Factor Influencing The Effectiveness Of The Inquiry -Based Science Education At Lower Secondary Schools". *Journal Of Baltic Science Education*. 2016. 15 (5): 588-601
 [6] S. Hadijah, Hasrattudin, E. Napitupulu, "Pengaruh Pembelajaran Kooperatif Tipe Jigsaw Terhadap Kemampuan Pemahaman Konsep Dan Komunikasi Matematik Siswa SMP Negeri 4 Percut Sei Tuan".*Jurnal Tabularasa PPs Unimed*.2016. 13 (3): 285-298
 [7] I.S Hasibuan, &Z. Amry, "Differences Of Students Mathematical Communication Ability Between Problems Based Learning, Realistic Mathematical Education And Inquiri Learning In Smp Negeri 1 Labuhan Deli".*Journal of Research & Method in Education*.2017. 7 (6): 54-60
 [8] S. Siahaan, "Artikel Pengajaran"*Hibah: 2006. 3-4; 23-30*. Medan: Universitas Negeri Medan.
 [9] B. Ansari, "Komunikasi Matematika Konsep dan Aplikasi". 2016. Banda Aceh: Yayasan Pena.
 [10] I. Dewi, "Profil Komunikasi Matematika Mahasiswa Calon Guru ditinjau dari Perbedaan Jenis Kelamin". 2009.Disertasi Tesis tidak dipublikasikan. Program Pascasarjana Surabaya: Surabaya.
 [11] I. Abdulhak,"Komunikasi Pembelajaran Pendekatan Konvergensi dalam Peningkatan Kualitas dan Efektifitas Pembelajaran". 2001. Bandung
 [12] B.A. Kramarski,"The Effects of Different Four Instructional Methods on The Ability to Communicate Mathematical Reasoning". 2000. Japan.
 [13] B. Deporter,&M.Hernacki, "*Quantum learning*". 2016. Bandung: Kaifa
 [14] M. Chatib, "*Orangtuanya Manusia*".2016.Bandung:Kaifa
 [15] A. Ozerem, "Learning Environments Designed According to Learning Styles and its Effects on Mathematics Achievement". *Eurasian Journal of Educational Research*.2017.(61): 61-80
 [16] Kolb, "A Comprehensive Guide to the Theory, Psychometrics, Research on Validity and Educational Applications". 2013.
 [17] M.J. Gohar&N. Sadhegi, "The Impact of Learning Style Preferences on Foreign language Achievement: A Case Study of Iranian EFL Students".*Procedia Behavioral Science*.171. 2015. 754 – 764
 [18] I. Kurniasih& S. Berlin,"*Model Pembelajaran*".2016.Yogyakarta: Kata pena
 [19] S.L. Laursen, "*Implementation and outcomes of inquiry-based learning in mathematics content courses for pre-service teachers*". *International Journal of Mathematical Education in Science and Technology*. 2015.
 [20] S. Sen&O.Ooskay, "The Effects of 5E Inquiry Learning Activities on Achievement and Attitude toward Chemistry".*Journal of Education and Learning*. 2017. 6 (1): 1-9
 [21] S. Veronika&A. Stanislav, "*Enviromental Education and Training Using Inquiry Based Learning*".2015
 [22] T. Xie, F. Zhang, &E. Wu, "Perceived Effectiveness of Science Inquiry in the 3D Virtual World". *Eurasia Journal of Mathematics Science and Technology Education*.2017.13 (8): 5871-5881
 [23] S. Banjarnahor, B. Sinaga, &E. Napitupulu, "Analysis of Problem Solving Ability in Applying Problem Based Learning Reviewed From the Learning Style".*Journal of Education and Practice*. 2017. 8 (34): 127-135
 [24] F. Tiffany, E. Surya, A. Panjaitan, & E. Syahputra,"Analysis Mathematical Communication Skills Student At The Grade IX Junior High School". *IJARRIE*.2017. 3 (2): 2160-2164