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Extrovert Students' Communication Effectiveness in Solving Mathematical Problems

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Abstract: The purpose of this article is to describe the effectiveness of communication of extroverted students in mathematical problem solving. The trial subjects were two high school students in class XII who had extroverted personalities. Measurement of the level of similarity in understanding or effectiveness of communication seen based on the results of interviews with two research subjects. Based on observations during the problem solving process and analysis of communication effectiveness it is found that students' mathematical communication in solving problems is very effective.

Key Words: effectiveness; mathematical communication; troubleshooting' extrovert

Abstrak: Tujuan dari artikel ini adalah untuk mendeskripsikan efektivitas komunikasi siswa berkepribadian ekstrovert dalam pemecahan masalah matematis. Subyek uji coba adalah dua siswa kelas XII SMA yang memiliki kepribadian ekstrovert. Pengukuran tingkat kesamaan pemahaman atau efektivitas komunikasi dilihat berdasarkan hasil wawancara dengan dua subjek penelitian. Berdasarkan hasil pengamatan selama proses pemecahan masalah dan analisis efektivitas komunikasi didapatkan bahwa komunikasi matematis siswa dalam memecahkan masalah sangat efektif.

Kata kunci: efektivitas; komunikasi matematis; pemecahan masalah' ekstrovert

INTRODUCTION

Communication is an attempt to convey messages, ideas, or information from the message sender to the message recipient (Tinungki, 2017). Communication is the most basic instrument in meeting the needs of life (Eliöz, 2016). Communication is one of the standard processes in Mathematics learning (NCTM, 2000). Communication is an important part of Mathematics and Mathematics education (Tinungki, 2017).

According to Yaniawati et al (2019) mathematical communication skills are very influential on many things in everyday life. One of the competencies that students must acquire at the intermediate level is the ability to communicate mathematical ideas clearly and effectively (Kemendikbud, 2016). In the learning process students are not only required to be able to understand mathematical concepts individually, but must be able to communicate their understanding to others (Tinungki, 2017). In the 2013 Curriculum, the learning process was developed on the principle of active student learning through observing, questioning, analyzing, and communicating (Kemendikbud, 2016). The process of communicating mathematical ideas can occur both between students and teachers, and among students.

Based on the researcher's experience during teaching, there are differences in written communication between introvert and extrovert students in solving mathematical problems. Problem solving problems given to the two students are as follows. "*Pak* Ahmad wants to distribute pocket money to his five children who successively form an arithmetic sequence. The amount of cash money received by the second and third children was Rp. 185,000.00 and the amount of allowance received by the fifth child was Rp. 80,000.00. How much allowance did the first child receive? Pl Explain!". The results of the work of the two students are as follows.

In solving the written problem, there are several differences between extroverted and introverted students, specifically: (1) extroverted students are more complete in providing information through mathe-

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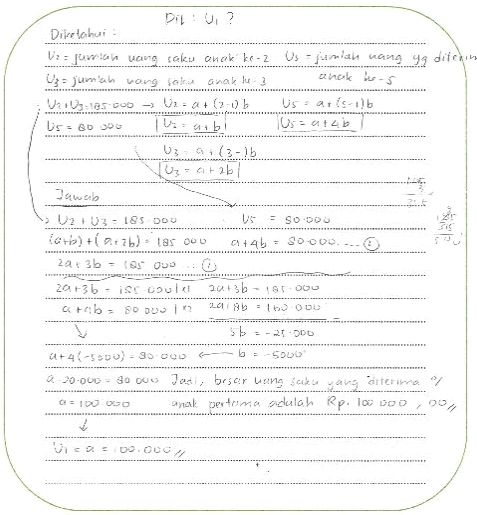

Figure 1. The Results of Problem Done by Extrovert Student

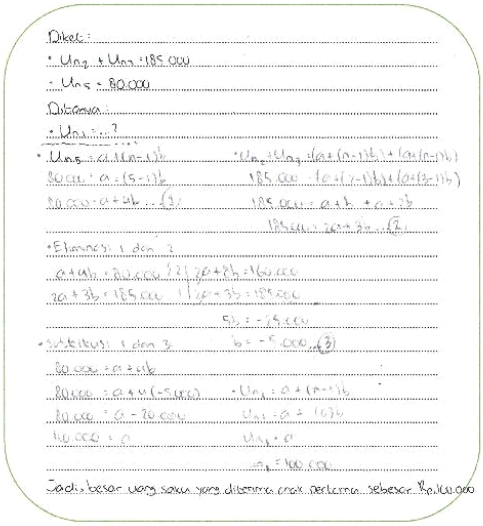

Figure 2. The Results of Problem Done by Introvert Student

matical symbols thus, other students better understand the meaning of writing mathematical symbols compared to mathematical symbols written by introverted students, (2) introverted students made mistakes in writing mathematical symbols, (3) based on the results of interviews with other students, it was found that the students had a better understanding of the solutions written by the extroverted students compared to introverted one.

Currently, cooperative learning is an alternative model for learning mathematics. The importance of cooperative learning is conveyed by Karali and Aydemir (2018) which states that the cooperative learning model is more effective in increasing student academic achievement in learning mathematics when compared to teacher-centered teaching. In cooperative learning students are actively involved in the learning process (Gamit et al, 2017). Cooperative learning requires direct communication skills both between teachers and students and among students.

A number of research on mathematical communication have been carried out. Research conducted by Qohar and Sumarmo (2013) states that students from reciprocal teaching demonstrates more active involvement in discussions. They are more active in expressing their ideas, asking questions, explaining, clarifying, and proposing arguments along with reasons. They are better able to construct mathematical models, and they are more systematic in solving mathematical communication problems than students taught by conventional teaching. The next research on communication was conducted by Ryve et al. (2013) where the results of this study indicate that visual mediators and technical terms are very important in students' efforts to communicate effectively.

Research on the analysis of mathematical communication skills by Sari (2017) states that in the application of cooperative learning the way students answer problem solving questions is different. The results of research by Kosko and Gao (2017) state that there is a significant relationship between students' verbal communication and written communication and the use of manipulative objects. Research by Lee (2015) emphasizes that it is important for teachers to plan strategies and question grouping carefully in order to provide opportunities for students to practice mathematical communication as part of the process of rationalizing and justifying their mathematical thinking.

Research by Morgan et al (2014) discusses theories about the relationship between language and mathematical communication. Research by Jung and Reifel (2011) reveals that teachers' conceptions of communication use come from teacher beliefs and teaching experiences about how to develop children's mathematical thinking. Research by Parida et al (2018) discusses improving mathematical communication skills by applying the Realistic Mathematics Education approach.

Research by Sumaji et al (2019) reveals that the problem experienced by students in communicating mathematical problem solving in the form of mathematical expressions is that they have not been able to use symbolic language. Research by Anggraini & Fauzan (2018) shows that students' mathematical communication skills are higher when they are taught us-

ing the RME approach than using the conventional approach. Research by Zakiah et al (2018) states that the efficiency of students' mathematical communication skills who obtain instructional videos is more effective than those who are taught traditionally.

Based on the studies that have been described above, there are limited studies that explain the effectiveness of mathematical communication in terms of personality, especially in the learning process of mathematics. Research on extroverted and introverted personality of students was still limited to the field of language learning by Ahour & Haradasht (2014) and there has been no research on personality in the field of mathematics, particularly in relation to the effectiveness of mathematical communication. Meanwhile, according to Noprianto (2017), identifying student characteristics or personalities is useful in achieving learning objectives. The personality referred to in this study is an extroverted personality.

According to Zainuddin (2016), there is a correlation between personality and students' writing skills. In addition, in the observations during teaching, there was one student who had a low ability who had difficulty understanding the explanations given by introverted students but was easy to understand the explanations given by extrovert students. Lunenburg (2010) states that in effective communication there is a two-way process that requires effort and skill between the sender of the information and the recipient of the information. Thus, an effective communication is characterized by the same understanding between the information provider and the information receiver. Oral mathematical communication directly includes the exchange of information between the informant and the receiver of the information. Thus, oral mathematical communication is regarded to be effective if there is a direct exchange of information between the information provider and the recipient of the information and results in the same understanding between the two.

Personality theory states that everyone is different and has unique characteristics (Ginting, 2018). Based on the researcher's experience during teaching, personality types influence the discussion process, especially in cooperative learning. According to Suliman (2015), an extroverted individual is more concerned with what is happening around him/her rather than his/her own emotions and thoughts. In addition, according to Fishman, Ng, & Bellugi (2011), a person with extroverted personality is active in social activities and has more social interaction than working individually. Hence, it can be stated that students who have extroverted personalities like to interact socially and are active in the discussion process.

Based on the researchers' observations, there was one extroverted students who had a high emotional level and had difficulty accepting suggestions from others. Thus, the researchers were interested in observing how the effectiveness of oral mathematical communication in extroverted students. The researchers aimed at identifying comprehensively how the effectiveness of oral mathematical communication by these extroverted students.

This study is useful for teachers because it is to maximize the results and learning process by knowing the effectiveness of students' mathematical communication directly to students with extroverted personality. Given the benefits and importance of communication that has been described and research related to the influence of extrovert personality on the effectiveness of student communication is very minimal and still limited to the field of language. Then, the researcher considered that there was prominent need to identify how the effectiveness of mathematical communication of students with extroverted personality in solving mathematical problems.

METHOD

This research employed a descriptive qualitative design to identify the effectiveness level of student communication in solving problem. Creswell (2012) states that qualitative research is a research method used to explore and understand the meaning of a number of individuals or groups. The research subjects were students of class XII SMAN 4 Malang in the odd semester of the 2019/2020 academic year which consisted of two students with high levels of ability. The selection of participants was taken from the results of personality tests, students who have extroverted personalities and have high abilities. The reason for choosing these two students was to focus more on the effectiveness of communication that occurs during the problem solving process. The two participants were familiar with technical terms or had received lesson topic contained in problem solving problems, that was, a lesson topic about two-variable linear equations and reversing value comparisons. The analysis used in this research wato match the similarity of understanding between the two subjects through interviews based on the conversation results of the two subjects. The two participants wee AL and AF.

Furthermore, the percentage of the similarity of understanding between two students in the discussion process was calculated by the following formula.

$$P = \frac{X}{IT} \times 100\% \text{.....(1)}$$

Annotation

P = The similarity percentage of two students during discussions process

$X =$ The total points obtained during the interviews process related to the understanding of both students in the discussion

$IT =$ The amount of questions in the process of interviews related to the understanding during the discussion

To determine the effectiveness of students' mathematical communication based on the calculation of the formula, it used the following criteria presented in Table 1.

Table 1. The Effectiveness Criteria of Students' Mathematical Communication

Similarity Percentage of Understanding (p)	**Criteria**
$81\% < (p) \leq 100\%$	Strongly effective
$61\% < (p) \leq 81\%$	Effective
$41\% < (p) \leq 61\%$	Moderately effective
$21\% < (p) \leq 41\%$	Less effective
$(p) \leq 21\%$	Ineffective

The authors took a role as an observer during the discussion. The main task of the observer was to present problem solving questions to the two students, observe the discussion process, conduct interviews after the discussion process regarding the understanding of each student during the discussion process, record the discussion process, and perform interviews with two students. The following is a problem solving that the two subjects discussed.

1) Five years ago Putri's father was four times the age of my daughter. Currently her father is three times the age of Putri. In five years, the number of their ages will be?

2) A job is planned to be completed in 40 days by 25 workers. After 12 days work, the workers take eight days off. To finish the project on time, how many additional workers do you need?

RESULTS

The researchers' observations started from two students' understanding of the two mathematical problems given during the discussion process. In the process of solving the first mathematical problem, the students read the questions while understanding the meaning of the questions given. The following is the first problem-solving communication process.

1. AL, AF : Five years ago Putri's father was four times the age of my daughter. Currently her father is three times the age of Putri. In five years, the number of their ages will be?
2. AL : So, $a - 5 = 4p - 5$
3. AF : No, it should be, $a - 5 = 4p$ and $a = 3p$
4. AL : Putri's age should be reduced by 5 since it was five years ago, so $p - 5$
5. AF : Ahh I see, so $a - 5 = 4(p - 5)$
   $a - 5 = 4p - 20$
6. AL, AF : $a - 4p = -15$
7. AL : Currently, Putri's father age is three times of Putri. It means that $a = 3p$. Then it is distributed to the first equation.
8. AF : so, $3p - 4p = -15$
   $-p = -15$
   $p = 15$
   In the upcoming five years, the total number of their ages is ...
9. AL : We need to determine a first.
10. AF : Yes
11. AL : $a = 3(15) = 45$
    In the upcoming five years, the total number of their ages is $(a + 5) + (p + 5) = 70$

Based on the results of the conversation in the first problem-solving process, it was seen that the two students shared information with one another. In this case, each subject can have two roles not only as a sender of information but also as a recipient of information. Based on the results of the interview, the effective communication of the two subjects during the discussion process occurred in every conversation in the discussion process. the effectiveness of communication between the two subjects in the discussion process for solving the first problem is described as follows.

Effective communication on the first problem between two subjects occurred in each of their conversations. The effective communication started from the conversation [1], the understanding between AL and AF on the questions given was identical. In conversation [2], AL elaborated that means five years ago, father's age was four time of Putri. The understanding of AL was identical with AF. Similarly, in conversation [3], AF had identical understanding with AL about and . As well as in conversation [4],

both students had identical understanding about , thus they wrote that Putri's age should be reduced by 5.

Furthermore, when understanding in the conversation [5], both students, AF as the sender and AL as the recipient, acquired similar comprehension. In conversation [6], it indicated that both students provided similar reason for the equation. When substituting to , both students had identical comprehension (see conversation [7]). The conversation [8] shows that AF as the sender and AL as the recipient similarly explained the process in determining the value of . In conversation [11] both AF and A had similar understanding in determining the value of , by substituting the value of to . As a result, when determining the total age of Father's and Putri's in five years ahead, both students had similar comprehension, by adding 5 in each age.

When answering the second question, both students read together the second question and conjointly comprehended it.

12. AL, AF : A job is planned to be completed in 40 days by 25 workers. After 12 days of work, the workers take eight days off. To finish the project on time, how many additional workers do you need?
13. AF : 40 days →25 workers
    After 12 days of work, the workers take eight days off
14. AL : It means 40–12–8 → x workers.
15. AF : 20 days → x workers

In the conversation [12], both students had identical comprehension about the second problem. Furthermore, AF explained that if the work was done by 25 workers for 40 days, and after 12 days of work, the work was postponed eight days. This understanding was similar with AL. In the conversation [14] and [15], both students understood that the time remaining for the work was 20 days and it requires *x* workers.

In the next conversation, it seemed that both students were difficult in discovering the result. The researches attempted to give them clue to help them by asking both students to write coherently from 40 days, 28 days, and 20 days.

16. AL : 40 days workers
    28 days 25 workers.
    Day off: 8 days
17. AF : Then, 20 days → x workers

In the conversation [16] above, both AF and AL had identical understanding: if 40 days were completed by 25 workers, then 28 days were still completed by 25 workers. Since there was 8 days off, then, the remaining days were 20 days. Thus, in 20 days, it requires *x* workers.

18. AL: It should use comparison of reverse values
19. AF : Ahh I see, we need to make a comparison between days and workers
20. AL : $\frac{28}{20} = \frac{x}{25}$
    $20x = 700$
    $x = 35$
21. AL,AF: Then, we need an additional workers of 35 – 25 = 10 workers

In the conversation [18], both students demonstrated ineffective communication. The understanding and reasons for using the concept of a value-reversed comparison conveyed by AL were that the longer the work day, the fewer workers needed, while AF could not convey the reasons for using the concept of reversing value comparisons. However, in conversation [19] the understanding of AL and AF was the same, in specific, comparing days with the number of workers. Furthermore, AL's understanding of the equations conveyed in the conversation [20] is the same as that received by AF, which is based on the concept of value-reversed comparison. The similarity in their understanding of the conversation [21] is very visible, that is by giving the same reason, because the number of workers needed is 35 people while the existing workers are 25 people thus 10 additional workers are needed.

The Figure 3 and Figure 4 are the results of the written discussion of the two subjects in solving the first and second problems.

DISCUSSION

Based on the results of the explanation in Figure 3 and Figure 4, from twenty-one conversations, only one conversation indicated an ineffective communication or both students did not have the same understanding. Thus, the percentage of common understanding is obtained as follows.

Therefore, based on Table 1 about the criteria for the effectiveness of students' mathematical communication, it can be concluded that the effectiveness level of two students' mathematical

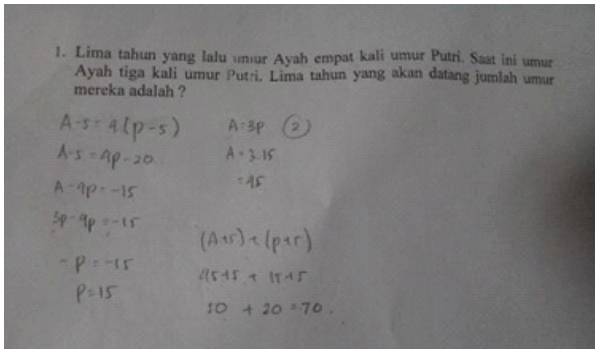

Figure 3. The Results of Problem 1

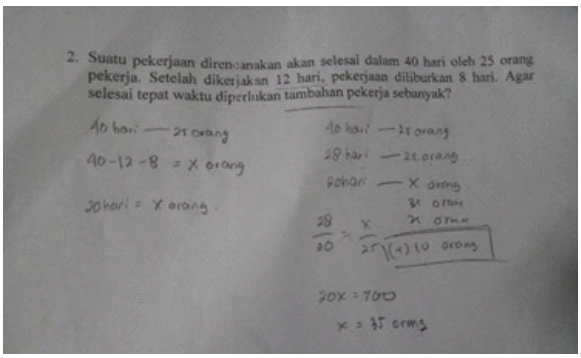

Figure 4. The Results of Problem 2

communication in solving problem solving problems is very effective.

The high level of mathematical communication effectiveness by the two extroverted students is influenced by several factors. The first factor affecting the level of effectiveness of the communication is the role of peer tutors. According to Maheady & Gard (2010), through peer tutors, students obtain substantial learning outcomes and improve their academic-related behavior. According to Chung et al (2012) positive peer relationships can facilitate academic learning, skill development, and student emotional well-being which contains complex communication challenges.

The second factor that affects the effectiveness of communication is cooperative learning. Cooperative learning is an effective method for improving students' communication skills, especially in interactive skills (Baghcheghi et al, 2011). The last factor that supports the level of communication effectiveness is that both students have extroverted personalities. Beukeboom et al (2013) stated that there is a significant positive correlation between extroverts and language abstraction and level of interpretation.

CONCLUSION

Based on the description of the similarity of understanding in each conversation during the discussion process, the percentage of similarities in understanding during the discussion, and the criteria for the effectiveness of students' mathematical communication, it can be concluded that students' mathematical communication in solving problem solving problems is very effective.

With the high level of effectiveness of oral mathematical communication by extroverted students in solving these mathematical problems, the teacher can take advantage of these advantages to apply them in cooperative learning, especially in the case of peer tutors, where extroverted students have high abilities as information senders. The weakness of students with extroverted personalities in this effective communication process is that they spontaneously write a mathematical form without examining in detail the problems given, thus the researcher provided some assistance in order to further bring out the communication process of the two students. This can also be caused by a lack of learning in schools which can improve effective communication between students.

Taking into account the various deficiencies that occurred during the discussion process, it is suggested that further detailed research on the effectiveness of communication for all abilities, not only students with high abilities but also students with moderate and low abilities. In addition, it is also suggested that there should be research on the effectiveness of mathematical communication, not only for extroverted students but also for introvert students considering that the characteristics between introverted and extroverted students are very different, especially in socializing and discussing.

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