Mathematics Education Journals
Vol. 7 No. 1 February 2023

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

Analysis of Students' Analytical Thinking Ability and Mathematical Communication Using Online Group Investigation Learning Model

Jihan Azizah Al-Hanifah[1], Yus Mochamad Cholily[2], Siti Khoiruli Ummah[3]

Study Program of mathematics Education, Universitas Muhammadiyah Malang
Indonesia
Email: jihanazizah.alh@gmail.com

Corresponding author:

Jihan Azizah Al-Hanifah
jihanazizah.alh@gmail.com

Keywords:
analytical ability; mathematical ability; group investigations; online

Abstract

Analytical thinking and mathematical communication are abilities included in the learning process objectives. This study aims to describe students' analytical thinking skills and mathematical communication using the online group investigation cooperative learning model. The subjects of this research were 30 students of class VIII-C. The type of research used is descriptive qualitative. The data to determine the implementation of learning and the ability to think analytically and communicate mathematically are observations, documentation, and tests. The study results show that the online group investigation type cooperative learning model implementation takes place following the steps of group investigation learning. The results of the ability to think analytically and communicate mathematically meet all indicators. The distinguishing indicator of analytical thinking ability is the most widely achieved, and the one that has yet to be completed much is the attributing indicator. So that students' analytical thinking skills have an analytical category. The most widely conducted indicator of mathematical communication ability is the indicator of expressing mathematical ideas in writing. What has yet to be widely achieved is the indicator of analyzing and evaluating mathematical concepts. So that students' mathematical communication skills have a mathematical category.

Al-Hanifah, J., A., Cholily, Y., M., & Ummah, S., K.. (2023). Analysis of Students' Analytical Thinking Ability and Mathematical Communication Using Online Group Investigation Learning Model. *Mathematics Education Journal*, 7(1), 100-113. DOI: 10.22219/mej.v7i1.23342

INTRODUCTION

The development of technology has changed the pattern of people's lives by following its development and knowing how to use it to make life easier. Technological developments encourage potential in various fields, one of which is education (Hussin, 2018). Technology for the world of education is a tool that can be used as a medium in the learning process. No longer limited to a classroom, the use of technology has made it possible for distance learning to create teaching methods inside and outside the classroom (Almeida & Simoes, 2019). There are two ways to do the learning process: offline and online. Online learning is an educational innovation that involves elements of information technology in learning (Fitriyani et al., 2020).

Meanwhile, Kurniawan et al., (2020) said that online learning is the result of learning delivered electronically using computers and computer-based media as stated (Solikhin & Fauziah, 2021) that in online learning, applications such as WhatsApp, Google Classroom, and Zoom can be used to interact between teachers

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

and students when carrying out the online learning process. Anggraini (2018) said that e-learning, or online learning, is created to overcome the limitations between educators and students, especially in terms of space and time. This facilitates interaction between students and educators by ignoring these limitations. Apart from that, Winarti & Norhayan (2021) said that online learning is also the impact of the pandemic. Even though learning is done online, learning must still pay attention to achieving the learning objectives.

Analytical thinking and mathematical communication are abilities included in the learning process objectives. The ability to think analytically and communicate mathematically is essential for students to have and master learning mathematics (Sriwahyuni et al., 2018). Analytical thinking is a student's ability to structure information into related pieces of information and determine the relationships between parts (Anggraini, 2018). The ability to think analytically is related to distinguishing, organizing, and attributing (Aprilia & Ramlah, 2020). The ability to think analytically can develop the ability to solve problems, analyze data, and use information well (Annisa et al., 2016). In addition, according to Ilma et al., (2017) the ability to think analytically in solving problems is also influenced by learning styles. Not only thinking analytically in general, but communication is also a way to convey messages from the giver to the recipient to inform opinions or behavior, either in writing or orally (Wijayanto et al., 2018). According to Khadijah et al., (2018) communication is a relationship or exchange of opinions. Mathematical communication also means conveying, understanding, and accepting other people's mathematical ideas carefully, critically, analytically, and evaluatively to strengthen understanding (Babys, 2020). Mathematical communication skills are related to expressing mathematical ideas in writing, analyzing mathematical ideas in writing, and expressing mathematical situations into mathematical models (Maulyda, 2020).

Group investigation is cooperative learning that emphasizes students to be more active in learning activities (Hartoto, 2016). Meanwhile, according to Nisa et al., (2018) group investigation is a learning model that allows students to be directly and actively involved in the learning process from the beginning to the end of the learning activity. Meanwhile, according to previous research, the group investigation learning model has advantages for students: being independent and cooperative and fostering students' analytical thinking skills and mathematical communication (Perwitasari et al., 2016). The group investigation learning model has objectives, including so that students can think analytically and communicate in learning activities. Cooperative learning with the group investigation type trains students to think at a higher level, think independently, and involve students in the learning process of investigating the problems given by the teacher (Linuhung & Sudarman, 2016). However, because of online learning, how are students' analytical thinking skills and mathematical communication using the group investigation learning model? Based on this, it is necessary to have an analysis to describe students' analytical thinking skills and mathematical communication using the online group investigation type cooperative learning model in class VIII students with statistics material. This is because analytical thinking and mathematical communication are essential abilities. After all, they are one of the fundamental abilities. Because of the explanation above, this study aims to describe students'

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

analytical thinking and mathematical communication skills using Group Investigation (GI) cooperative learning online.

RESEARCH METHOD

This research uses descriptive qualitative research. This research uses descriptive qualitative aiming to describe students' analytical thinking and mathematical communication skills using the group investigation type cooperative learning model online based on the actual conditions during the study. This research was conducted at NU Pakis Middle School, Pakis District, Malang Regency, in the even semester of the 2021/2022 academic year. The subjects of this study were 30 students in class VIII-C. Research subjects as the primary source to obtain the data studied. The material used for collecting qualitative data is class VIII statistical material. Qualitative test results were obtained from qualitative data analysis and observations of the online learning process.

Data collection techniques used in this study were tests, observations, and documentation. The data collection used is to obtain the correct data according to research needs. The observation sheet was used in the first data collection to implement the group investigation learning model online. The second data collection in the form of a test sheet is used to determine the ability to think analytically and communicate mathematically in writing. The third data collection is in the form of documentation used as evidence, where evidence is in the form of pictures during online learning activities. Through documents, researchers can measure the ability to think analytically and communicate mathematically in writing that is done. The data analysis stage that will be carried out consists of three components, namely, 1) data reduction, 2) data presentation, and 3) conclusion. The score or value of the assessment of the ability to think analytically and communicate mathematically is analyzed using a percentage technique. In addition, teacher and student activities were also analyzed using percentage techniques.

Calculation of the Percentage of Analytical Thinking Ability of each student, namely:

$$x = \frac{Total\ score}{Total\ overall\ score} \times 100\%$$

The intervals and categories of student test results are as follows:

Table 1. Categories of Analytical Thinking Ability

Score	Categories
$0 \leq Score \leq 40$	Low
$40 \leq Score \leq 70$	Middle
$70 \leq Score$	High

The calculation of the classical average of students' analytical thinking skills is calculated by:

$$P_a = \frac{C}{N} \times 100\%$$

Information:

P_a = Percentage of analytical thinking ability

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

C=Total score achieved
N= Maximum amount

Based on the acquisition of each student's score, will be divided into four categories of analytical thinking ability levels which are presented in Table 2
Table 2. Levels of Analytical Thinking Ability

Percentage of Analytical Thinking Ability (P_a)	Categories
$0 \leq P_a \leq 25\%$	Not Analytical
$25\% \leq P_a \leq 50\%$	Less Analytical
$50\% \leq P_a \leq 75\%$	Analytical
$75\% \leq P_a$	Very Analytical

Calculation of the Percentage of Mathematical Communication Ability of each student, namely:

$$x = \frac{Total\ score}{Total\ overall\ score} \times 100\%$$

The intervals and categories of student test results are as follows:
Table 1. Categories of Mathematical Communication Ability

Score	Categories
$0 \leq Score \leq 40$	Low
$40 \leq Score \leq 70$	Middle
$70 \leq Score$	High

The calculation of the classical average of students' Mathematical Communication Ability is calculated by:

$$P_m = \frac{C}{N} \times 100\%$$

Information:
P_m = Percentage of Mathematical Communication Ability
C=Total score achieved
N= Maximum amount

Based on the acquisition of each student's score, will be divided into four categories of Mathematical Communication Ability levels which are presented in Table 2
Table 2. Levels of Mathematical Communication Ability

Percentage of Mathematical Communication Ability (Pm)	Categories
$0 \leq Pm \leq 25\%$	Not Analytical
$25\% \leq Pm \leq 50\%$	Less Analytical
$50\% \leq Pm \leq 75\%$	Analytical
$75\% \leq Pm$	Very Analytical

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

RESULTS AND DISCUSSION

1. Description of Learning Activities

In the learning activities of this research, it was found that the online group investigation cooperative learning model was implemented following the steps of group investigation learning. From the first to the fourth meeting, students are gathered in the WhatsApp group class; then, students are divided into groups of 4-5. Students are given worksheets, and educators carry out the learning process by giving instructions to the WhatsApp group. Students plan to learn assignments, carry out investigations, prepare reports on the results of investigations, and present reports on the results by presenting them via audio and evaluation.

In the learning process, 20 aspects are observed by the teacher after applying the group investigation cooperative learning model online. Based on student activities during learning, the results of observations of student activity obtained a score of 64%, which means that, generally, the activities of class VIII-C students of SMP NU Pakis fall into the excellent category. In addition, during the learning process, not only student activity is observed. In the implementation of learning, observations were made with 20 aspects observed by the homeroom teacher through the WhatsApp class group. Based on teacher activity during learning, the results of observations of teacher activity on the learning process obtained a score of 96.25% in the perfect category. Applying group investigation-type cooperative learning is intended so that students can practice analytical thinking skills and mathematical communication through this learning.

2. Description of Analytical Thinking Ability

The percentage of achievement that will be sought is the ability to think analytically with the data obtained from the knowledge test containing four questions. Based on the analysis of data from 30 students with 26 students who worked on statistical material test questions, that students' analytical thinking abilities are presented in Table 7.

Table 7. Average Analytical Thinking Ability Based on Knowledge Test Scores

Number of Indicator	Analytical Thinking Ability Indicator	Score	Overall Score	Average of Each Indicator (%)
I_1	Differentiating	201	360	56%
I_2	Organizing	173	360	48%
I_3	Attributing	178	360	49%
Overall Average			51%	
Category			Analitic	

Based on Table 7, the average analytical thinking ability of class VIII-C students is included in the analytical category with a percentage of 51%. It is presented based on the results of the category of analytical thinking abilities in the table below.

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

Table 8 Results of the Analytical Thinking Ability Category

Score	Categories	Total	Percentage
$0 \leq Score \leq 40$	Low	4	13%
$40 \leq Score \leq 70$	Middle	22	73%
$70 \leq Score$	High	4	13%

Based on Table 8, there are three categories, namely high, medium, and low ability. The following results of student work are described:

1) Students with High Ability

A03 is the code for students with high analytical thinking skills. The following are the results of student A03's answers with high ability in solving the questions presented in the image below.

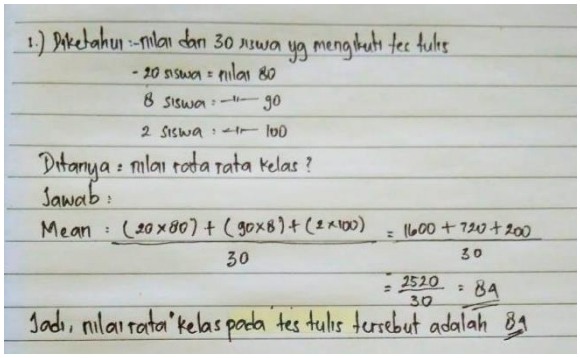

Figure 1. Student Work Results A03

Based on the test results in Figure 1, it is the result of students' analytical thinking based on indicators of analytical thinking (Fitriani et al., 2021). Student A03 can differentiating by sorting out the parts related to writing down what is known and what is asked in the problem. Student A03 wrote down what was known in the question, namely the values of the 30 students who took the test, 20 students with a score of 80, 8 students with a score of 90, and 2 students with a score of 100. Then students also wrote down what was asked in the question, namely, the average value class average. This proves that student A03 fulfills the distinguishing indicator by writing down what is known and what is asked in the questions, according to Figure 1.

Student A03 can organizing and identify related parts by identifying something known through completion. Student A03 identifies something that is known by writing down the solution, namely $\text{Mean} = \frac{(20\times80)+(8\times90)+(2\times100)}{30} = \frac{1600+720+200}{30} = \frac{2520}{30} = 84$. This proves that student A03 fulfills the organizing indicator by identifying related parts and something that is known by solving it, as shown in Figure 1.

Then student A03 can be attributed to determining goals by solving these problems and concluding. Student A03 determines the goal by solving the problem and concludes by writing the conclusion from solving the problem that the conclusion from solving the problem asked is. That the average class score on the written test is 84. This proves that student A03 fulfills the attribution

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

indicator by writing the conclusion from solving problems that have been done, as shown in Figure 1.

2) Students with Moderate Ability

N17 is the code for a student with a moderate category of analytical thinking ability. The following are the results of the answers of students N17 with moderate abilities in solving the questions presented in the image below.

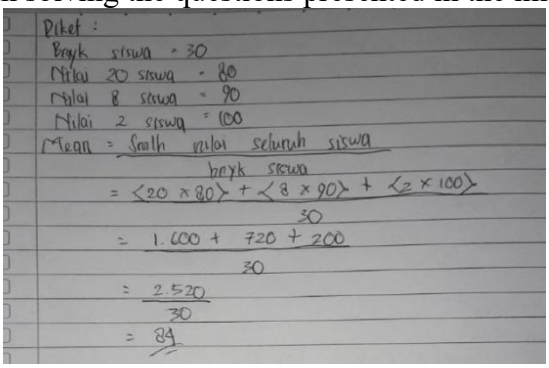

Figure 2. Student Work Results from N17

Based on the test results in Figure 2 it is the result of student N17's work. Student N17 can differentiating by sorting out the parts related to writing down what is known but not quite right and does not include what is asked in the problem. Student N17 writes down what is known in the problem: the number of students is 30, the value of 20 students = 80, the value of 8 students = 90, and the value of 2 students = is 100. However, student N17 needs to write down what is asked in the problem. This proves that student N17 can discriminate but still needs to correctly fulfill the indicators of distinguishing. Student N17 only writes down what is known but not what is asked in the questions, according to Figure 2.

N17 students can organize (organizing) and identify related parts by identifying something known by solving it. Student N17 identifies something that is known by writing down the solution, namely $\text{Mean} = \frac{\text{Jumlah nilai seluruh siswa}}{\text{Banyak siswa}} = \frac{(20\times80)+(8\times90)+(2\times100)}{30} = \frac{1600+720+200}{30} = \frac{2520}{30} = 84.$ This proves that student N17 fulfills the organizing indicator by identifying related parts by identifying something that is known by solving it, as shown in Figure 2.

Then student N17 is less able to attribute by not setting goals in solving the problem by concluding. Student N17 did not write the conclusion of the problem in the problem. Answer 84 is correct but needs to be corrected because N17 does not conclude it and has analytical abilities in the moderate category. This proves that student N17 still needs to fulfill the attributing indicator by not setting goals in solving the problem by concluding, as shown in Figure 2.

3) Students with Low Ability

S27 is the code for students with low analytical thinking skills. The following are the results of the answers of S27 students with low ability to solve the questions presented in the image below..

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

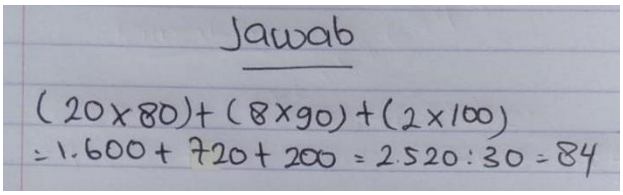

Figure 3. Results of S27 Student Work

Based on the test results in Figure 3 it is the result of the S27 student's work. S27 students cannot differentiating by sorting out the parts related to writing down what is known and asked. S27 students did not write down what was known and asked questions like in Figure 3. There was no known or asked information. This proves that S27 students need to meet the distinguishing indicators because students need to sort out the parts related to writing down what is known and asked in the questions.

S27 students are also less able to organize (organizing) by not accurately identifying related parts or identifying something known by its solution. Student S27 only answered $(20 \times 80) + (8 \times 90) + (2 \times 100) = 1600 + 720 + 200 = 2520 \div 30 = 84$ As in Figure 3. The answer is correct but not quite right because S27 needed to identify between what is known and the material and how to solve it. This proves that S27 students do not meet the organizing indicators because they need to identify the parts related by identifying something known by its solution.

Then S27 students are less able to attribute by not setting goals in solving problems and concluding. Answer 84 is correct but needs to be corrected because S27 does not conclude it and has low category analytical ability. So it was concluded that S27 students had low analytical thinking skills because they needed to fulfill the three indicators.

3. Description of Mathematical Communication Ability

The percentage of achievement that will be sought is the ability to communicate mathematics with data obtained from the knowledge test, which contains four questions. Based on the analysis of data from 30 students with 26 students who worked on statistical material test questions, the students' mathematical communication skills are presented in Table 9.

Table 9. Average Mathematical Communication Ability Based on Knowledge Test Scores

Number of Indicator	Indicator of Mathematical Communication Ability	Score	Overall Score	Average of Each Indicator (%)
I_1	Express mathematical ideas in writing.	198	360	55%
I_2	Analyze, and evaluate mathematical ideas in writing	172	360	48%
I_3	Stating a mathematical situation into a mathematical model	194	360	54%
Overall Average			52%	
Category			Matematics	

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

Based on Table 9, the average mathematical communication ability of class VIII-C students is included in the mathematical category with a percentage of 52%. It is presented based on the results of the category of mathematical communication skills in the table below.

Table 10. Results of the Mathematical Communication Ability Category

Score	Categories	Total	Percentage
$0 \leq Score \leq 40$	Low	5	17%
$40 \leq Score \leq 70$	Middle	20	67%
$70 \leq Score$	High	5	17%

Based on the categories in Table 10, there are three categories: high, medium, and low abilities. The following results of student work are described:

1) Students with High Ability

D09 is a student code with a high category of mathematical communication skills. The following are the results of the answers of D09 students with high ability in solving the questions presented in the image below.

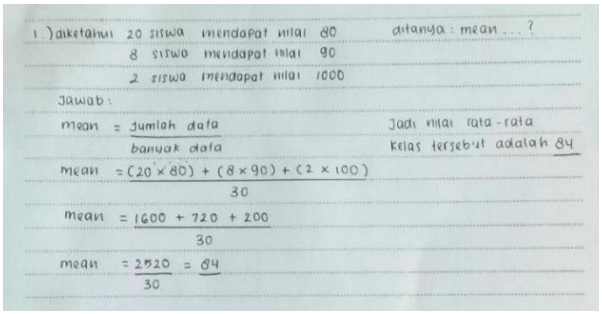

Figure 4. D09 Student Work Results

Based on the test results in Figure 4 it is the result of students' work based on mathematical communication indicators according to (Maulyda, 2020). D09 students can express mathematical ideas by writing down what information is known and asking from a problem in the problem. Student D09 writes down what is known in the problem. Namely, 20 students get a score of 80, 8 students get a score of 90, and 2 students get a score of 100 is the known part. Then student D09 also wrote down what was asked in the question, namely the average class score. This proves that D09 students fulfill the indicators in expressing mathematical ideas by writing down what information is known and asking from a problem in the problem, as shown in Figure 4.

D09 students can analyze or evaluate mathematical ideas in writing in carrying out plans to solve problems in questions. D09 students analyze and evaluate mathematical ideas in carrying out plans to solve problems by writing down how to solve them, namely $\text{Mean} = \frac{\text{Amount of Data}}{\text{Lots of data}} = \frac{(20\times80)+(8\times90)+(2\times100)}{30}$. This proves that D09 students fulfill the indicators of

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

analyzing or evaluating mathematical ideas in writing in solving problems in questions, as shown in Figure 4.

Then students can express mathematical situations or problems into mathematical models and conclude. D09 students expressed solving mathematical problems into a mathematical model and concluded by writing them into their mathematical form, namely $\text{Mean} = \frac{\text{Amount of Data}}{\text{Lots of data}} = \frac{(20\times80)+(8\times90)+(2\times100)}{30} = \frac{1600+720+200}{30} = \frac{2520}{30} = 84$ and the conclusion is that the average class score on the written test is 84; this section is part of modeling a problem to a mathematical model and concluding. This proves that student D09 fulfills the indicators of expressing a mathematical situation into a mathematical model, as in Figure 4.

2) Students with Moderate Ability

F10 is a student code with a moderate category of mathematical communication skills. Following are the results of the answers of F10 students with high ability in solving the questions presented in the image below.

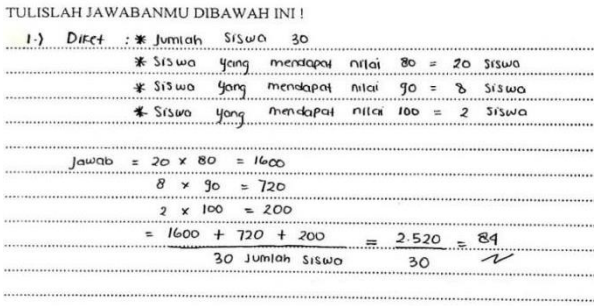
TULISLAH JAWABANMU DIBAWAH INI !
1.) Diket : * Jumlah siswa 30
* Siswa yang mendapat nilai 80 = 20 siswa
* Siswa yang mendapat nilai 90 = 8 siswa
* Siswa yang mendapat nilai 100 = 2 siswa
Jawab = 20 x 80 = 1600
8 x 90 = 720
2 x 100 = 200
= 1600 + 720 + 200 / 30 Jumlah siswa = 2.520 / 30 = 84

Figure 5. F10 Student Work Results

Based on the test results in Figure 5 it is the result of F10 students' work. F10 students can express mathematical ideas by writing down what information is known, but it needs to be more precise by not including what is asked of a problem in the problem. Student F10 writes down what is known in the problem, namely, the number of students is 30, students who score 80 = 20 students, students who score 90 = 8 students, and students who score 100 = 2 students. However, F10 students needed to write down what was asked in the questions. This proves that F10 students can express mathematical ideas by writing down what information is known but does not meet the indicators of expressing mathematical ideas in writing precisely because F10 students only write down what is known but not what is asked in the questions, according to Figure 5.

F10 students are also less able to analyze or evaluate mathematical ideas in writing in carrying out plans to solve problems in problems by needing to be more precise in writing plans to solve problems. Students in solving problems still need to be more precise in writing plans to solve problems where students write them with answers $20 \times 80 = 1600$; $8 \times 90 = 720$; $2 \times 100 = 200$ then next step $\frac{1600+720+200}{30} = \frac{2520}{30} = 84$. This proves that F10 students have not fulfilled the indicators of analyzing and evaluating

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

mathematical ideas in writing because they need to be more precise in writing mathematical ideas in solving problem plans, as shown in Figure 5, even though these answers are correct but not quite right, because F10 has mathematical communication skills medium category.

Then F10 students need to be more able to express mathematical situations or problems into mathematical models and draw conclusions. F10 students are less able to express it in a mathematical model, where students write their answers $= 20 \times 80 = 1600; \quad 8 \times 90 = 720; \quad 2 \times 100 = 200 \quad = \frac{1600+720+200}{30} = \frac{2520}{30} = 84$ The answer is correct, but not quite right because F10 does not model a mathematical model problem, concludes, and F10 has moderate category mathematical communication skills. This proves that F10 students still need to meet the indicators of expressing a mathematical situation into a mathematical model, as in Figure 5.

3) Students with Low Ability

R22 is a student code with low-category mathematical communication ability. The following are the results of the answers of R22 students with high ability in solving the questions presented in the image below.

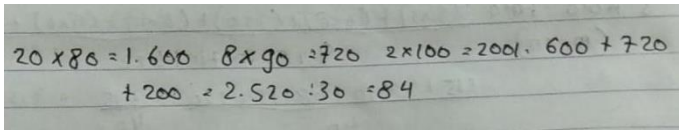

Figure 6. R22 Student Work Results

Based on the test results in Figure 6 it is the result of student R22's work. R22 students cannot express mathematical ideas by writing down what information is known and asked from a problem in the problem. Student R22 needed to write down what was known and asked about a problem in the problem, as shown in Figure 6. This proved that student R22 did not meet the indicators of expressing mathematical ideas in writing, as shown in Figure 6.

R22 students are also less able to analyze or evaluate mathematical ideas in writing in carrying out plans to solve problems in problems by not being precise in writing down plans to solve problems. Students in solving problems still need to be more precise in writing plans to solve problems where students write them down $20 \times 80 = 1600; 8 \times 90 = 720; 2 \times 100 = 200; 160 + 720 + 200 = 1520 \div 30 = 84$ As shown in Figure 6. The answer is correct but needs to be corrected because R22 has low-category mathematical communication skills. This proves that R22 students still need to meet the indicators of analyzing and evaluating mathematical ideas in writing, as shown in Figure 6.

Then student R22 needs to be more able to express mathematical situations or problems into mathematical models and draw conclusions. Student R22 is less able to express it in a mathematical model, where students write their answers $20 \times 80 = 1600; 8 \times 90 = 720; 2 \times 100 = 200; 160 + 720 + 200 = 1520 \div 30 = 84$ The answer is correct but needs to be corrected because R22 does not model a problem into a mathematical model, and R22 has low-category mathematical communication skills. So it was concluded that R22 students had low mathematical communication thinking skills

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

because they needed to fulfill the three indicators. This proves that student R22 still needs to meet the indicators of expressing a mathematical situation into a mathematical model, as in Figure 6.

Research on class VIII-C junior high school students found that the online group investigation type cooperative learning model followed the group investigation learning steps. Overall all the aspects observed fall into the excellent category, so it can be concluded that learning using the group investigation type cooperative learning model online is well applied in learning mathematics. This is reinforced by Hartoto (2016) that group investigation is cooperative learning, emphasizing students to be more active in learning activities. This was also conveyed by Nisa et al., (2018) Group investigation is a learning model that allows students to be directly and actively involved in the learning process from the beginning to the end of learning. The results of the ability to think analytically and communicate mathematically fulfill all indicators, namely the indicators of distinguishing, organizing, and attributing to indicators of analytical thinking ability. Then the indicators of mathematical communication are expressing mathematical ideas in writing, analyzing and evaluating mathematical ideas, and expressing mathematical situations in written mathematical models. The three indicators of analytical thinking ability that have been achieved the most are the distinguishing indicator, and the one that has yet to achieve much is the attributing indicator. So that students' analytical thinking skills have an analytical category. Then the three indicators of mathematical communication ability that were most achieved were indicators of expressing mathematical ideas in writing. What had yet to be achieved were indicators of analyzing and evaluating mathematical ideas. So that students' mathematical communication skills have a mathematical category.

CONCLUSION

Based on the results of this study, it was found that the online group investigation cooperative learning model implementation took place following the steps of group investigation learning. From the first to the fourth meeting, students are gathered in the WhatsApp group class; then, students are divided into groups of 4-5. Students are given worksheets, plan study assignments and investigations, prepare reports on the results of investigations or organize presentations and evaluations. The results of the ability to think analytically and communicate mathematically fulfill all indicators, namely the indicators of distinguishing, organizing, and attributing to indicators of analytical thinking ability. Then the indicators of mathematical communication are expressing mathematical ideas in writing, analyzing and evaluating mathematical ideas, and expressing mathematical situations in written mathematical models. The three indicators of analytical thinking ability that has been achieved the most are the distinguishing indicator, and the one that has not achieved much is the attributing indicator. So that students' analytical thinking skills have an analytical category. Then the three indicators of mathematical communication ability that were most achieved were indicators of expressing mathematical ideas in writing. What had not been achieved much were indicators of analyzing and evaluating mathematical ideas. So that students' mathematical communication skills have a mathematical category.

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

REFERENCES

Almeida, F., & Simoes, J. (2019). The Role of Serious Games , Gamification and Industry 4 . 0 Tools in the Education 4 . 0 Paradigm. *Contemporary Educational Technology*, *10*(2), 120–136.

Anggraini, A. (2018). Keefektifan Pembelajaran Elektronik (E-Learning) sebagai Pengganti Perkuliahan Konvensional untuk Meningkatkan Kemampuan Analitis Mahasiswa. *Jurnal Sosial Humaniora*, *9*, 95–105. https://doi.org/http://dx.doi.org/10.30997/jsh.v9i2.1101

Annisa, N., Dwiastuti, S., & Fatmawati, U. (2016). Peningkatan Kemampuan Berpikir Analitis Siswa Melalui Penerapan Model Pembelajaran Inkuiri Terbimbing. *Journal of Biology Education*, *5*(2), 163–170. https://doi.org/10.15294/jbe.v5i2.7153

Aprilia, V., & Ramlah. (2020). Deskripsi Kemampuan Berpikir Analitis Materi Bangun Datar Segiempat Pada Siswa SMP. *Prosiding Sesiomadika*, 1119–1126. https://journal.unsika.ac.id/index.php/sesiomadika/article/view/2485

Babys, U. (2020). Analisis Kemampuan Komunikasi Matematika Siswa Ditinjau dari Gender. *ANARGYA: Jurnal Ilmiah Pendidikan Matematika*, *3*(1), 25–29. https://doi.org/10.24176/anargya.v3i1.4771

Fitriani, Fadly, W., & Faizah, U. N. (2021). Analisis Keterampilan Berpikir Analitis Siswa pada Tema Pewarisan Sifat. *Jurnal Tadris IPA Indonesia*, *1*(1), 55–67.

Fitriyani, Y., Fauzi, I., & Sari, M. Z. (2020). Motivasi Belajar Mahasiswa Pada Pembelajaran Daring Selama Pandemik Covid-19. *Jurnal Kependidikan: Jurnal Hasil Penelitian Dan Kajian Kepustakaan*, *6*(2), 165–175. https://doi.org/https://doi.org/10.33394/jk.v6i2.2654

Hartoto, T. (2016). Model Pembelajaran Kooperatif Tipe Group Investigation (Gi) Meningkatkan Aktivitas dan Hasil Belajar Sejarah. *Historia*, *4*(2), 131. https://doi.org/10.24127/hj.v4i2.553

Hussin, A. A. (2018). Education 4 . 0 Made Simple : Ideas For Teaching. *International Journal of Education and Literacy Studies*, *6*(3), 92–98.

Ilma, R., Hamdani, A. S., & Lailiyah, S. (2017). Profil Berpikir Analitis Masalah Aljabar Siswa Ditinjau dari Gaya Kognitif Visualizer dan Verbalizer. *JRPM (Jurnal Review Pembelajaran Matematika)*, *2*(1), 1–14. https://doi.org/10.15642/jrpm.2017.2.1.1-14

Khadijah, I. N. A., Maya, R., & Setiawan, W. (2018). Analisis Kemampuan Komunikasi Matematis Siswa SMP Pada Materi Statistika. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *1*(6), 1–7.

Kurniawan, R. I., Nindiasari, H., & Setiani, Y. (2020). Analisis Kemampuan Pemecahan Masalah Matematis dengan Menggunakan Pembelajaran Daring. *Jurnal Inovasi Dan Riset Pendidikan Matematika*, *1*(2), 37–47. https://jurnal.untirta.ac.id/index.php/wilangan/article/view/8405

Linuhung, N., & Sudarman, S. W. (2016). Pengaruh Pembelajaran Kooperatif Tipe group Investigation (GI) terhadap Kemampuan Penalaran Matematika Siswa MTs. *Aksioma Jurnal Pendidikan Matematika*, *5*(1), 52–60. https://doi.org/http://dx.doi.org/10.24127/ajpm.v5i1.465

Maulyda, M. A. (2020). *Paradigma Pembelajaran Matematika Berbasis NCTM* (C. I. Gunawan, K. Ni'mah, & V. R. Hidayati (eds.); Issue January). CV IRDH.

Nisa, H., Disman, D., & Dahlan, D. (2018). Pengaruh Penerapan Model

ISSN : 2579-5724
ISSN : 2579-5260 (Online)
http://ejournal.umm.ac.id/index.php/MEJ

Pembelajaran Kolaboratif Teknik Group Investigation Terhadap Kemampuan Berpikir Analisis Peserta Didik. *Jurnal Manajerial*, *17*(2), 157. https://doi.org/10.17509/manajerial.v17i2.10277

Perwitasari, R., Sumarni, & Amirudin, A. (2016). Pengaruh Group Investigation Berbasis Outdoor Study Terhadap Kemampuan Berpikir Analitis Siswa. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *1*(3). https://doi.org/http://dx.doi.org/10.17977/jp.v1i2.6107

Solikhin, M., & Fauziah, A. N. M. (2021). Analisis Kemampuan Berpikir Kritis Siswa SMP Pada Pelajaran IPA Saat Pembelajaran Daring Selama Pandemi Covid-19. *Pensa E-Jurnal : Pendidikan Sains*, *9*(2), 188–192. https://ejournal.unesa.ac.id/index.php/pensa/article/view/38060

Sriwahyuni, T., Amelia, R., & Maya, R. (2018). Analisis Kemampuan Komunikasi Matematis Siswa SMP pada Materi Segiempat dan Segitiga. *Jurnal Kajian Pembelajaran Matematika*, *2*(1), 10. http://journal2.um.ac.id/index.php/jkpm

Wijayanto, A. D., Fajriah, S. N., & Anita, I. W. (2018). Analisis Kemampuan Komunikasi Matematis Siswa SMP pada Materi Segitiga dan Segiempat. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *2*(1). https://doi.org/10.31004/cendekia.v2i1.36

Winarti, C., & Norhayan, S. (2021). Efektivitas terhadap Kemampuan Komunikasi Matematis Melalui Pembelajaran daring Menggunakan Media WhatsApp Group. *Journal of Innovation Research and Knowledge*, *1*(5).