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Collaborative Problem-Solving Skills of Heterogeneous Groups on Statistics Material Assisted by *Microsoft Excel*

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Abstract

Collaboration is an important skill in the 21st century. This qualitative research is to describe the collaborative problem-solving ability of heterogeneous groups of statistics material assisted by Microsoft Excel. This research is a case study of 2 high and low math ability VIII grade students who were paired into one group in solving statistical problems with Microsoft Excel. The instruments used were math ability tests, problem solving tests, and interviews. Data were analyzed by data reduction, data presentation, and conclusion drawing based on collaborative problem solving ability indicators. The results showed that high mathematics ability students can provide ideas in determining the solution strategy, find Microsoft Excel-assisted solutions, and help low mathematics ability students so that they dominate in the problem solving process. However, low math ability students tend to follow the ideas of high math ability students. There were discussion activities, information sharing, and task sharing in the problem solving process. Therefore, for teachers to improve collaborative solving skills, especially for low math ability students and consider all effective strategies in solving problems.

Keywords: collaborative problem-solving skills, statistics, microsoft excel

Abstrak

Kolaboratif merupakan kemampuan yang penting di abad ke-21. Penelitian kualitatif ini untuk mendeskripsikan kemampuan pemecahan masalah kolaboratif kelompok heterogen materi statistika berbantuan *Microsoft Excel*. Penelitian ini merupakan studi kasus terhadap 2 siswa kelas VIII SMP berkemampuan matematika tinggi dan rendah yang dipasangkan menjadi satu kelompok dalam menyelesaikan masalah statistika berbantuan *Microsoft Excel*. Instrumen yang digunakan yaitu tes kemampuan matematika, tes pemecahan masalah, dan wawancara. Data dianalisis dengan reduksi data, penyajian data, dan penarikan kesimpulan berdasarkan indikator kemampuan pemecahan masalah kolaboratif. Hasil penelitian menunjukkan siswa berkemampuan matematika tinggi dapat memberikan ide dalam menentukan strategi penyelesaian, menemukan penyelesaian berbantuan *Microsoft Excel*, dan membantu siswa berkemampuan matematika rendah sehingga mendominasi dalam proses penyelesaian masalah. Namun, siswa berkemampuan matematika rendah cenderung mengikuti ide dari siswa berkemampuan matematika tinggi. Terjadi aktivitas diskusi, berbagi informasi, dan berbagi tugas dalam proses penyelesaian masalah. Oleh karena itu, diharapkan bagi guru untuk meningkatkan kemampuan pemecahan secara kolaboratif terutama bagi siswa berkemampuan matematika rendah serta mempertimbangkan segala strategi yang efektif dalam menyelesaikan masalah.

Kata kunci: kemampuan pemecahan masalah kolaboratif, statistika, *microsoft excel*

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Introduction

Collaborative is a skill that must be mastered in 21-century (Kemdikbud, 2022). Collaborative skills are needed in everyday life, one of which is in the school environment. Students can work together to complete school assignments in the school. During learning, students can learn together with other students to understand the material or solve a problem. Dillenbourg (1999) state collaborative if peers are more or less at the same level, can perform the same actions, have a common goal, and work together. Collaborative is the ability of individuals to work together in certain groups through activities

to formulate, implement, and defend a conception to achieve certain goals (Hikmah & Siswono, 2020).

Pemendikbud No. 21 of 2016, in mathematics learning the focus is on problem-solving abilities (Pemendikbud, 2016). Problem-solving abilities are very important for students in solving a problem, students gain experience using the abilities and knowledge they have to be used in finding a solution (Nurdiana et al., 2021). Students must be equipped with problem-solving skills to overcome various problems in everyday life (Sukmawati & Siswono, 2021). The more practice in solving problems, the more experience will gain in finding solutions using skill and knowledge. In addition, Hendriani et al. (2023) state that the ability to solve a problem in various contexts can help the process of developing critical, analytical, and creative thinking.

However, students still experience difficulties in solving problems. Based on the results of research conducted by Mardatillah et al., (2021) that most students only have problem-solving abilities at the stage of understanding the problem. At this stage, students can understand the problem by writing down what they know and asking about the problem. The results of other research conducted by Latifah & Afriansyah (2021) there are several indicators of problem-solving abilities in statistical material showing a low percentage of 60% at the transformation stage and 73% at the skills stage of students still having difficulty compiling mathematical models so that they can't convert them into mathematical models correctly. This show that students have difficulty in converting information from statistical problems into the form of mathematical models so students only write down the information.

One of the efforts that can be made to improve individual students' problem-solving skills is collaboration because according to Sears & Reagin (2013) many studies have found that working in small groups can improve problem-solving performance. The combination of collaboration and problem-solving can enable students to participate in a problem-solving project that is completed together so that it can be said to be collaborative problem-solving (Sukmawati & Permadani, 2021). Collaborative problem-solving is a complex skill requiring both social and cognitive (Griffin & Care, 2014). Cognitive skills are problem-solving, while social skills are collaboration.

Collaborative problem-solving in learning is supported by the role of technology in facilitating collaborative interactions and building meaning in simpler contexts (Nento & Manto, 2023). Pagau & Mytra (2023) revealed many studies that state the role of technology can make the learning process more effective, easier to develop student knowledge, more in-depth learning materials, and provide broader information and can improve student achievement. A technology that is particularly suited to the topic of statistics is *Microsoft Excel*. Yalta (2008) state that *Microsoft Excel* is *software* used to manage and analyze data in education, business, and government that allows more statistical calculations than other *software*. *Microsoft Excel* is well-suited for statistics topics as it includes data presentation features and measures required in statistics (Minarni et al., 2020).

Based on the problem of low collaborative problem solving skills in low math ability students and the lack of contribution to problem solving as well as the advantages of Microfot Excel in finding statistical problem solving, the researcher aims to describe students' collaborative problem-solving skills in heterogeneous group of statistics material assisted by *Microsoft Excel*. It is expected to be reference and reflection material for teachers in developing students' collaborative problem-solving skills in heterogeneous groups of statistics material in the future.

Method

This research describes the collaborative problem-solving skills of heterogeneous groups of statistics assisted by *Microsoft Excel*. This research is a type of descriptive qualitative research with a case study approach. This descriptive qualitative research involves two students in grade 8 SMP Negeri in Surabaya where students will collaborate to solve a statistical problem assisted by *Microsoft Excel.* This research was conducted in the academic year 2023-2024. The instrument used to obtain data on

students' collaborative problem-solving ability in this study are math ability test, problem solving test, and interview. Math ability test to categorize students into high, medium, and low math ability group. The problem-solving test of statistics material and the interview aim to find out and confirm the collaborative problem-solving skills of students in solving the problem-solving test given. In this study, before giving the collaborative problem-solving test, a mathematics ability test was conducted to categorize students into high, medium, and low mathematics ability categories.

The selection of research subjects began with the administration of math ability test questions to students. Furthermore, the research selected two students with high math ability and low math ability to become research subjects. The selection of subjects was based on the category of mathematical ability and consideration of suggestions from mathematics teachers regarding good communication skills and willingness to become research subjects. The following are the categories of students' mathematical ability grouping.

Tabel 1. Math Ability Category

Category	**Score** (x)
High	$80 \leq x \leq 100$
Moderate	$60 \leq x < 80$
Low	$0 \leq x < 60$

Source: Ratumanan and Laurens (in Intan et al., 2024)

Based on the results of the categorization results in Table 1, 2 students were selected to be used as research subjects, namely students will high and low math ability and students with the criteria have good communication and are willing to be research subjects. The subjects of this research were high math-ability students and low math-ability students who were grouped into heterogeneous groups.

Tabel 2. Research Subjects

Subject	**Gender**	**Score**	**Category**	**Code**
AZL	Female	100	High	ST
ECFS	Female	42	Low	SR

Based on Table 2 of this research subject the first high mathematics-ability subject was coded "ST" and the low mathematics-ability subject was coded "SR". The heterogeneous groups ST and SR are coded "K1". Furthermore, the problem-solving test data was analyzed qualitatively based on indicators of collaborative problem-solving skills adaptation by OECD (2017); (Hannania et al., 2022) results in Tables 3.

Table 3. Indicators of Collaborative Problem-Solving Skills

Code	**Indicators**	**Description of Activity**
A1	Discovering perspectives and abilities of team members	• Checking the adequacy of information needed to solve the problem • Restate the problem using own language
A2	Discovering the type of collaborative interaction to solve the problem, along with goals	• Write down what is known and ask about the problem • Ask and answer questions to group members to understand the problem deeply
A3	Understanding roles to solve the problem	• Communicating to group members to understand the problem

Code	Indicators	Description of Activity
B1	Building a shared representation and negotiating the meaning of the problem (common ground)	• Giving opinions or input regarding the problem description on the problem • Helping friends who have difficulty understanding the problem description on the problem • Explain the problem description in the problem
B2	Identifying and describing tasks to be completed	• Presenting information in the form of tables or graphs
B3	Describing roles and team organisation (communication protocol/rules of engagement)	• Share tasks in solving problems • Interdependence between group members
C1	Communicating with team members about the actions to be/being performed	• Plan a strategy to solve the problem • Encouraging group members to express their opinions
C2	Enacting plans	• Determine the strategy used in solving the problem • Accept opinions and don't interrupt the conversation of friends who are arguing in determining the solution strategy
C3	Following rules of engagement (e.g. prompting other team members to perform their tasks)	• Explain the strategy used in solving the problem • Max the potential possessed in solving the problem
D1	Monitoring and repairing the shared understanding	• Recheck the steps and solution results with group members
D2	Monitoring results of actions and evaluating success in solving the problem	• Recheck the steps and results of the solution to ensure that there are no errors
D3	Monitoring, providing feedback and adapting the team organisation and roles	• Appreciate the work of the group by reflecting on the results that have been obtained

Adaptation OECD (2017); (Hannania et al., 2022)

Analysis of interview data was carried out in three stages, namely data reduction, data presentation, and drawing conclusions (Miles & Huberman, 1992). Data reduction aims to summarize information, select key points, and simplify unnecessary information. After the data is reduced, the data will be presented more simply and conclusions will be drawn in narrative form.

Result and Discussion

Researchers collect data by giving math ability test, problem solving test, and interview. The results of the collaborative problem-solving ability of heterogeneous group consisting of high math-ability students and low math-ability students are as follows.

Exploring and Understanding

The following are the results of the written answers to the collaborative problem-solving test and *Microsoft Excel* calculations by K1 at the exploring and understanding stages:

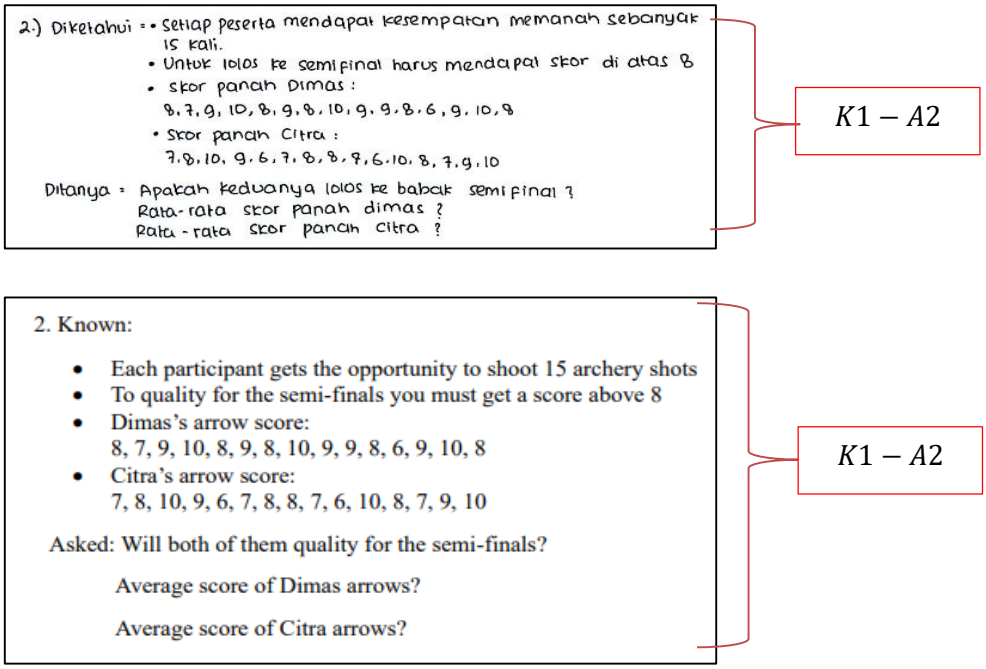


Figure 1. Written answers' K1 exploring and understanding stage

The following are except of interview with ST and SR regarding the exploring and understanding stage in Figure 1, the researcher interviewed K1 as follows:

PK1-01 : "What is known information on the matter?"
ST-01 : "In the preliminary round, there were 15 opportunities to shoot archery. Well, to qualify for the semifinals, you must score above 8. Then here there is Dimas' arrow score and Citra's arrow score, then Mr. RT suspects that both of them have qualified for the semifinals" **(A2)**
PK1-02 : "What kind of problem is asked about it?"
K1-01 : "Asked whether Mr. RT's allegations are true or false" **(A2)**
PK1-03 : "What do you do if you don't understand the meaning of the problem?"
K1-02 : "Reread more carefully"
ST-02 : "Continue to discuss with each other to find the purpose of the problem" **(A3)**
PK1-04 : "What are you asked for the problem?"
K1-03 : "Asked to determine whether Mr. RT's allegations are true or not" **(A1)**
PK1-05 : "Is the information provided enough?"
K1-04 : "Enough is enough"
PK1-06 : "How can you know if it's enough?"
ST-03 : "Because there is already data on Dimas's arrow score and Citra's arrow score, I continue to have the opportunity to shoot 15 times" **(A1)**

Based on the writer's answer and interview, K1 said the information was sufficient to answer the problem (ST-03). In addition, K1 could state the problem in own language during the interview (K1-03). K1 wrote down the things known and asked about the problem in detail ($K1 - A2$). However, when interviewed K1 could not restate in their language in detail (ST-01 dan K1-01). From the (PK1-03)'s question and (ST-02)'s answer, it reflects that K1 understands that they are a team, exchanging

opinions, and working together to understand the problems. From the description, it can be concluded that the exploration and understanding stage shows that K1 understands the information written and what is asked in the problem.

Representing and Formulating

The following are the results of the written answers to the collaborative problem-solving test *Microsoft Excel* calculations by K1 at the representing and formulating stage:

Figure 2. Written answers' K1 representing and formulating stage

Figure 3. The results of calculations in *Microsoft Excel* at the stage of representing and formulating

The following are except of interview with ST and SR regarding the representing and formulating stage in Figure 2 and 3, the researcher interviewed K1 as follows:

PK1-07 : "Is there a problem in your group in solving it? Is there a difference in understanding perhaps?"

SR-01 : "There was a difference in understanding, I thought that Citra's arrow score qualified, so both of them qualified for the semifinals. Then ST explained that the question is above 8, so if 8 passes, it will not pass**" (B1)**

PK1-08 : "For the question, obviously not?"
K1-05 : "Obviously, but it has to be read over and over again"
PK1-09 : "What is the description of the problem?"
ST-04 : "Here, there is an archery competition during the preliminary round, you are allowed to shoot 15 times. To qualify for the semifinals, they must have an average score above 8. Well, here is also the score of Dimas and Citra's arrows, then Mr. RT suspects that both of them qualified for the semifinals, but Mr. Rt's guess is true or not" **(B2)**
PK1-10 : "Well, why did you make Dimas's arrow score and Citra's arrow score in the form of this table?"
K1-06 : "Because it is easier to find answers and read them" **(B2)**
PK1-11 : "If you don't make a table, why not?"
K1-07 : "It's harder to understand and work on it" **(B2)**
PK1-12 : "Do you share tasks with each other or not?"
SR-02 : "We continue to discuss with each other, the division is the same as I calculated in *Microsoft Excel* and then ST which wrote on the paper" **(B3)**

Based on the writer's answer and interview, K1 had a different understanding of solving the problem. From the (SR-01)'s answer, K1 helped subjects who had difficulty understanding the problem. K1 understands the problem description and explains it in detail when interviewed (ST-04). K1 presented the data in tabular form on the written information, namely Dimas' arrow score and Citra's arrow score. During the interview, K1 explained the reason for the table was to make it easier to read and find answers (K1-05). K1 also said that if not by making a table, it would be difficult to understand and solve it (K1-06). K1 divided the tasks while still discussing with each other (SR-02). From the description, it can be concluded that the representing and formulating stage shows that K1 can give an opinion about the problem description. K1 can present the data in tabular form. Although there were differences in understanding, K1 helped friends who had difficulty understanding the problem. K1 discussed and shared tasks in solving the problem which reflected that K1 was interdependent between group members.

Planning and Executing

The following are the results of the written answers to the collaborative problem-solving test *Microsoft Excel* calculations by K1 at the planning and executing stage:

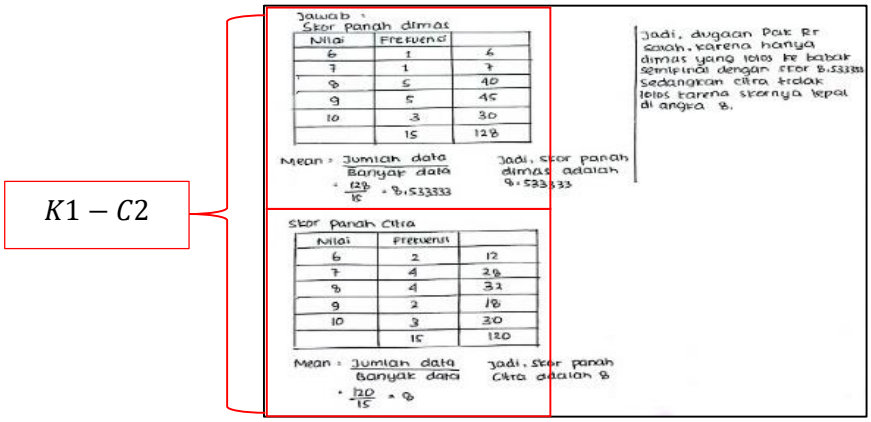
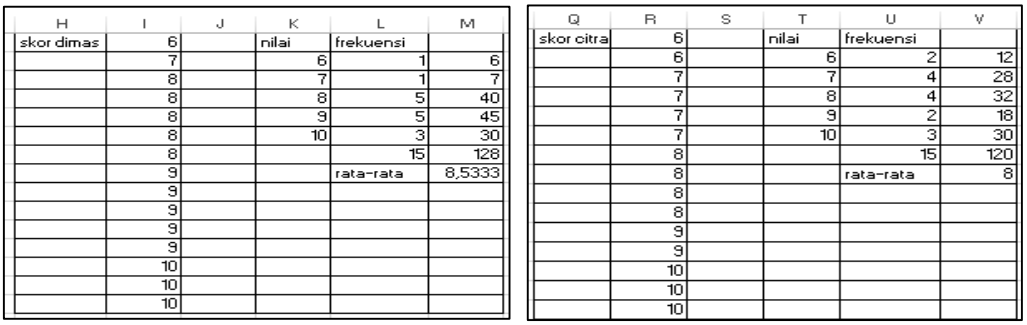


Figure 4. Written answers' K1 planning and executing stage



H	I	J	K	L	M
skor dimas	6		nilai	frekuensi	
	7		6	1	6
	8		7	1	7
	8		8	5	40
	8		9	5	45
	8		10	3	30
	8			15	128
	9			rata-rata	8,5333
	9				
	9				
	9				
	9				
	10				
	10				
	10				

Q	R	S	T	U	V
skor citra	6		nilai	frekuensi	
	6		6	2	12
	7		7	4	28
	7		8	4	32
	7		9	2	18
	7		10	3	30
	8			15	120
	8			rata-rata	8
	8				
	8				
	9				
	9				
	10				
	10				
	10				

Figure 5. The results of calculations in *Microsoft Excel* at the stage of planning and executing

The following are except of interview with ST and SR regarding the planning and executing stage in Figure 4 and 5, the researcher interviewed K1 as follows:

PK1-13 : "What is your plan or strategy for solving the problem?"
ST-05 : "Initially, entering data into *Microsoft Excel* continued to be sorted from smallest to largest. Then we look for a lot of data and continue to write it in the frequency column after that multiply the value by the frequency" **(C1, C2, C3)**
SR-03 : "After knowing the results, we add the results of the values multiplied by the frequency. Then the scores of Dimas and Citra's arrows were obtained" **(C2, C3)**
PK1-14 : "What is the average way to find out?"
K1-08 : "The total column multiplied by the value by frequency divided by the total frequency column" **(C2, C3)**

Based on the writer's answer and interview, K1 planned a strategy by finding the average score of Dimas' arrow and Citra's arrow score by presenting them in a table (ST-05). K1 implemented the chosen plan by finding the average in tabular form. K1 entered the data in *Microsoft Excel* then found the amount of data and multiplied the amount of data by the score. After that, sum the product of the score with the frequency to find the average arrow score using the formula of the total column of the product of the score with the frequency divided by the total frequency column (ST-05, SR-03, and K1-08). The subject can explain in detail the steps of the solution (ST-05, SR-03, and K1-08). From the description, it can be concluded that the planning stage planning and executing show that K1 can plan the solution strategy well. K1 did the calculation in *Microsoft Excel* according to the formula they knew.

Monitoring and Reflecting

The following is K1's interview at the monitoring and reflecting stage:

PK1-15 : "Are you sure of the finish you wrote?"
K1-09 : "Sure, sis"
PK1-16 : "How can you be sure?"
K1-10 : "We check starting from what is known and asked correctly, continue to check the answers and calculations" **(D1, D2)**
SR-09 : "Because I have also asked and discussed with ST about the conclusion" **(D1)**
PK1-17 : "For this problem, you had a difference of opinion, how do you respond?"
K1-11 : "We read and re-discuss to understand the problem so that we can get the bright spot" **(D3)**

Based on the interview, K1 reviews and checks the steps and final results found together and keeps communicating to check shared understanding (K1-10 and SR-09). K1 re-examines the steps of problem-solving from known information, and calculations to the conclusions found (K1-10). K1 accepts different opinions in the group and discusses to find a solution (K1-11). From the description, it can be concluded that the monitoring and reflecting stages showed that ST and SR asked each other and rechecked the steps and problem-solving results found. ST appreciated the results that had been obtained.

Based on the results of the study, it is shown that the subjects with high mathematics ability stage of exploring and understanding high mathematics ability students more quickly identify the information in the problem. High mathematics ability students have a broader understanding so that they can help low mathematics ability students and determine the concepts to be used. At the stage of representing and formulating, high mathematics ability students have a broader picture of the problem given and can give an opinion about the picture in the problem. High math ability students can present data in the form of tables on the answer sheet and calculations in *Microsoft Excel*. With discussion and help from high math ability students, low math ability students can have the same understanding as high math ability students. This is in accordance with the opinion of Greenberg & Nillssen (2015) that collaboration is beneficial for broadening and deepening understanding of various topics.

In the planning and implementation stage, high mathematics ability students can plan the strategies used in solving the problem and can provide ideas by compiling data, finding solutions using *Microsoft Excel*, and working on tasks that are their responsibility. This is supported by the results of research conducted by Safitri (2018) which states that students with high mathematics abilities quickly find ideas and plan solutions to solve problems. However, low math ability students do the tasks that are their responsibility, but tend to follow the suggestions of high math ability students. By discussing with each other, high mathematics ability students and low mathematics ability students can find *Microsoft Excel*-assisted solutions according to their understanding. In the monitoring and reflecting stage of high mathematics ability students and low mathematics ability students rechecked the steps and solution results found.

Conclusion

Based on the discussion presented, it can be concluded that the heterogeneous group of high mathematics ability students and low mathematics ability students communicated with each other by asking and answering each other in solving the problem. High mathematics ability students can explain the problem description, provide ideas in determining the solution strategy, and find solutions using *Microsoft Excel* so that they dominate the problem-solving process. However, low math ability students tend to be helped by the ideas of high math ability students. High math ability students organize the division of tasks. In addition, high mathematics ability students and low mathematics ability students carry out the tasks that are their responsibility.

Suggestions from researchers based on the conclusions that have been obtained are to improve students' problem-solving skills, especially students with low mathematics abilities, so it is hoped that teachers can design learning through collaborative problem-solving and consider all effective strategy for solving problems.

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