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ORIGINAL PAPER

Analysis of Critical Thinking Ability in Solving Linear Inequalities with One Variable Reviewed from a Mathematical Disposition

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Abstract
This study aims to describe students' critical thinking skills in solving linear inequality problems with one variable in terms of mathematical disposition. This type of research is quantitative-qualitative research. The subjects in this study were three students selected from 31 students in class VIII-4 of SMP Negeri 4 Ambon, with categories of high, medium, and low mathematical disposition. The results of the study showed that subject JA, with a high mathematical disposition, could fulfil every indicator of critical thinking. Subject JFT, with a medium mathematical disposition category, showed that he could fulfil the critical thinking indicator on some questions and could not fulfil the critical thinking indicator on other questions. Meanwhile, subject JK, with a low mathematical disposition category, could only fulfil two indicators of critical thinking. Based on the percentage of the results of filling out the mathematical disposition questionnaire, the high mathematical disposition category is 41.94%, the moderate disposition category is 48.39%, and the low disposition category is 9.68%, which means that the largest percentage of mathematical disposition of class VIII-4 students is in the moderate mathematical disposition category.

Keywords:
Mathematical Disposition
Critical Thinking Ability
Linear Inequalities of One Variable

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INTRODUCTION

21st-century learning follows the development of technological currents that provide the breadth of learning for humans. The development of technology in the 21st century has penetrated all fields, one of which is the field of education. As a result of technological developments, there has been a change in the way of viewing 21st-century education in a more substantive way, which means that 21st-century education is not only a concept of how to teach but also changes the way of viewing the concept of education itself (Surani, 2019, p. 457). With the development of technology in 21st-century learning, it is important to develop skills that can help students face the challenges of life.

Development of skills in 21st-century learning that can help students face increasingly complex life challenges, namely creative thinking skills, critical thinking, problem-solving, and collaboration (Septicasari & Rendy, 2018, p. 108). In the context of current mathematics learning, critical thinking skills play an important role in solving various problems that require deep understanding and skills in applying concepts and procedures appropriately.

One of the mathematical materials that requires students' critical thinking skills is the material on linear inequality of one variable. This material teaches students to understand the concept of inequality and apply mathematical rules to solve problems. Although this material is basic in algebra, many students have difficulty solving problems of linear inequality of one variable. Therefore, critical thinking has a major role in developing problem-solving skills and a deep understanding of mathematical material (Permata and Yusi, 2023: 2)

In 21st-century mathematics learning, mathematical disposition, namely attitudes, beliefs, and thinking habits towards mathematics, has a very important role in influencing students' level of success in critical thinking. Positive mathematical dispositions, such as self-confidence and perseverance, can improve students' ability to think critically when solving mathematical problems. In addition, good mathematical dispositions also include flexibility and openness of thinking, allowing one to see perspectives and approaches in understanding mathematical concepts (Wirawan et al., 2023). Therefore, understanding how students' mathematical dispositions affect their abilities, especially in the context of procedural and logical material, such as linear inequality material in one variable.

This study was conducted at SMP Negeri 4 Ambon, where students showed sufficient basic mathematical abilities but still had difficulty in solving problems on the material of linear inequality of one variable. In the context of 21st-century learning, it is very important to analyse how mathematical disposition relates to students' critical thinking skills in solving problems. This study aims to provide a deeper understanding of the influence of mathematical disposition on students' critical thinking skills in the material of linear inequality of one variable.

METHOD

The type of research used is a mixed-methods quantitative-qualitative. In this study, initial data were collected by providing questionnaire sheets to measure the level of mathematical disposition of students, which would then be classified quantitatively. Then, to see critical thinking skills, students were given sheets containing story questions about linear inequality problems with one variable, which would later be described qualitatively.

The subjects in this study were three students with high, medium, and low mathematical disposition categories taken from 32 students in class VIII-4 of SMP Negeri 4 Ambon. This study used two types of data: quantitative and qualitative data. To obtain the required data, the instruments used were mathematical disposition questionnaires, critical thinking test sheets for solving linear inequality problems with one variable, and interview guidelines. The results of students' work in solving linear inequality problems with one variable will then be analysed using the data triangulation technique developed by Miles and Huberman (Sugiyono, 2017). The triangulation technique contains three steps to analyse data comprehensively regarding the subject being studied, not to test hypotheses or theories. The triangulation steps include: 1) Data reduction, 2) Data presentation, and 3) Concluding.

RESULTS & DISCUSSION

Based on the completion of the mathematical disposition questionnaire that has been carried out, the presentation of the results of completing the questionnaire in positions can be seen in the Table 1.

Table 1. Percentage of Results of Completing the Disposition Questionnaire M

No.	Value Interval	Category	Amount	Percentage
1	$x \geq 74$	High	13	41,94%
2	$60 \leq x < 74$	Medium	15	48,39%
3	$x < 60$	Low	3	9,68%

Based on Table 1, it can be seen that the mathematical disposition ability in class VIII-4 is mostly in the medium mathematical disposition category, namely with a percentage of 48.39%, with a total of 15 students. Then, in the high category, there are 13 students with a percentage of 41.94%, and in the low category, there are three students with a percentage of 9.68%.

Furthermore, based on the results of the critical thinking ability test and the percentage of the results of filling out the mathematical disposition questionnaire, three students were selected to be interviewed, namely, one student in the high category, one student in the medium category, and one student in the low category. The following is a list of research subjects interviewed:

Table 2. List of Research Subjects

Student Code	Mathematical Disposition Categories	Interview Subject Code
JA	High	JA
JFT	Medium	JFT
JK	Low	JK

From Table 2, 3 research subjects will be analysed, namely JA with a high mathematical disposition category, JFT with a medium mathematical disposition category, and JK with a low mathematical disposition category. The following is an analysis of the results and interviews of the three subjects seen from the critical thinking indicators in completing the application of linear inequality of one variable.

1. JA Subject (High Mathematical Disposition Category)

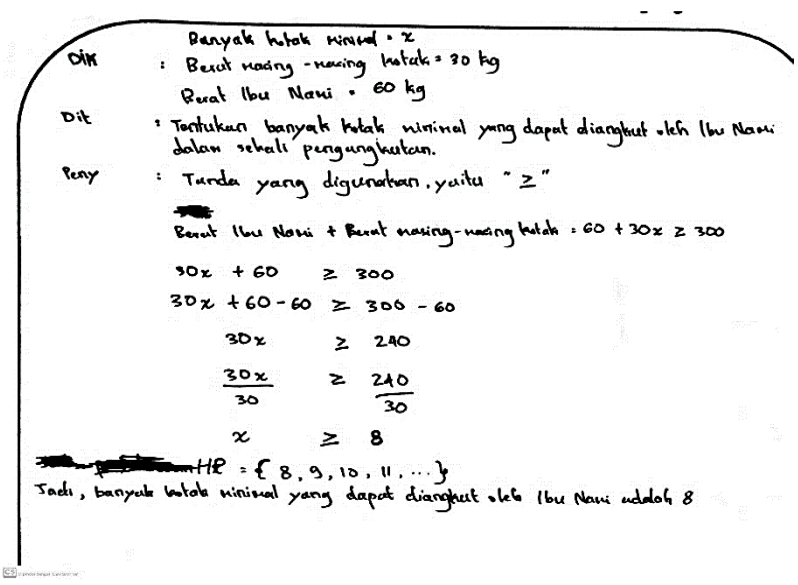

Figure 1. Results of Work Number 1 Subject JA

Based on the results of the subject JA's work, the researcher conducted an interview related to the critical thinking indicators. The following is an excerpt from the interview with subject JA:

P101	:	After reading the question, what is known and what is asked in the question?
JA101	:	The weight of each box is 30 kg. Nami's mother weighs 60 kg. I asked to determine the minimum number of boxes that Ms Nami can transport in one transport.
P102	:	From what is known, that is all there is to it; nothing else is known.
JA102	:	Yes. The carrying capacity of the box car is less than 300 kg.
P103	:	How do you model the problem in the question into a linear inequality of one variable? Please explain.
JA103	:	Okay. First, I assume the number of boxes is at least x. Because the carrying capacity of the box car is less than 300 kg, the sign used is more than or equal to (≥). Then I added the weight of Mrs Nami and the weight of each box that was previously assumed to be 30x+60, so the form of inequality that I got was 30x+60 ≥300.
P104	:	After modelling the problem in the form of an inequality, how do you solve it?
JA104	:	I solved the inequality by subtracting both sides 60, so it turned out like this (the subject pointed to the results of his work), so I got 30x≥240. Then I divided both sides by 30, 30x/30=x,240/30=8, so I got x≥8.
P05	:	Besides solving it by subtracting 60 from both sides, is there any other way?
JA05	:	There is.
P06	:	Can you explain?
JA06	:	60 is moved to the left side so that 30x≥300-60 gets 30x≥240, and then it's the same. Namely, both sides are divided by 30.
P107	:	Okay. Is x≥8 the final answer to question number 1?
JA107	:	Not yet. Because the question is about the minimum number of boxes, then from the solution set of x≥8, the smallest number is 8.
P108	:	From the answers you gave, what can you conclude?
JA108	:	So, the minimum number of boxes that Mrs. Nami can transport in one shipment is eight boxes.

Based on the results of the work and interviews of subject JA that have been explained previously, subject JA meets all indicators of critical thinking skills in each question, where subject JA can determine what is known and asked from the question even though in questions 1 and 2 subject JA has not completely written it in the work results but can complete it well during the interview process. In the analysis indicator, subject JA can model the problem from the question in the form of a linear inequality of one variable.

In the evaluation indicator, subject JA can apply strategies such as assuming the weight of each box with the symbol x (question number 1) and calculating the area of the rectangle that will be used to find the maximum width of the land (question number 2). Then, in this indicator, subject JA can also carry out the calculation steps correctly and precisely. Furthermore, subject JA fulfils the evaluation and explanation indicators, where they can explain the conclusions that will be given and correctly provide these conclusions. This is in line with what Hayudiyani et al. (2017) said, namely that students with high abilities can understand the meaning of the question (interpretation) well, understand the concept used (analysis) in working on the question, complete the solution of the question (evaluation) so that they can conclude (inference). When viewed from a mathematical disposition, Susilo et al. (2020) also argue that students with high positive mathematical dispositions have very good abilities in analysing problems and good abilities in providing explanations, evaluating, and choosing strategies, and mathematical dispositions can also show that there is a tendency for increased achievement in each indicator of critical thinking skills.

2. JFT Subject (Medium Mathematical Disposition Category)

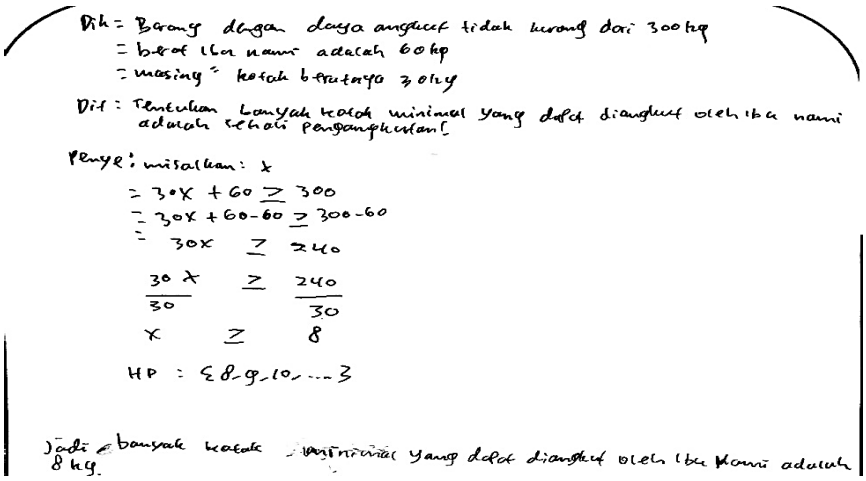

Figure 2. Results of Work Number 1 Subject JFT

Based on the results of the JFT subject's work, the researcher conducted an interview related to critical thinking indicators. The following is an excerpt from an interview with the JFT subject:

P101	:	After reading the question, what is known and what is asked in the question?
JFT101	:	The carrying capacity is not less than 300 kg, Mrs. Nami's weight is 60 kg, and each box weighs 30 kg. I asked to determine the minimum number of boxes that Mrs. Nami could transport in one shipment.
P102	:	The carrying capacity is not less than 300 kg; what is the carrying capacity? Box car? Mrs Nami? Or boxes?
JFT102	:	The carrying capacity of a box car.
P103	:	How do you model the problem in the question into a linear inequality of one variable? Try to explain.
JFT103	:	First, I assume x for each box. Then I add Mrs Nami's weight and the weight of each box that has been assumed before, so it becomes 30x+60 (explaining while showing the results of his work), the carrying capacity of the box car is less than 300 kg, so the sign used is more than or equal to (≥). The model or form of the inequality is 30x+60≥300.
P104	:	After modelling the problem into an inequality, how do you solve it?
JFT104	:	I solved it by subtracting 60 from both sides, so it becomes like this (the subject points to the results of his work), which gets 30x≥240. Then divide both sides again by 30 to get x≥8.
P105	:	Besides solving it by subtracting both sides 60, is there another way?
JFT105	:	There is, but I understand it better this way.
P106	:	Can you explain a little?
JFT106	:	(The subject is silent.)
P105	:	Okay, let us continue then. Is x≥8 the final answer to question number 1?
JFT105	:	No. The solution set of x≥8 is 8,9, 10, etc., so the smallest number is 8.
P106	:	Based on the answer you gave, what can you conclude?
JFT106	:	So, the minimum number of boxes that Mrs Nami can transport in one transport is eight boxes, not kg (pointing to the results of the subject's work, which shows an error).

Based on the results of the work and the results of the JFT subject interviews that have been explained previously, the JFT subject meets several indicators of critical thinking skills in each question. The JFT subject can meet the interpretation indicator in both questions; this can be seen from the JFT subject being able to determine, write, and explain what is known and asked completely in the results of his work and during the interview process. In the analysis indicator, the JA subject can correctly model the problem from the question in the form of a linear inequality of one variable. However, the JFK subject has not been able to meet the evaluation indicator, whereas, in question number 2, the JFK subject cannot complete the calculation process. This results in the JFK subject also not being able to meet the evaluation, explanation, and inference indicators in question number 2. This is in line with research from Ristanti (2017), where, based on the results of the study conducted, students with a moderate level of mathematical disposition, most of them have met the indicators of critical thinking skills, namely being able to prove the truth of a statement. However, they have not met the indicators of being able to organise information systematically and accurately, and being able to argue in depth correctly, and have not been able to do unsystematic and inaccurate calculations in the question.

3. JK Subject (Low Mathematical Disposition Category)

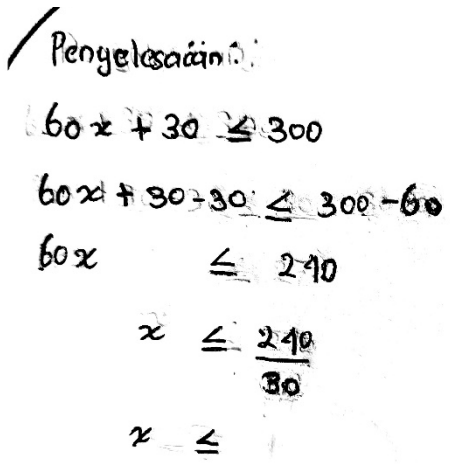

Figure 3. Results of Work Number 1 Subject JK

Based on the results of the subject JK's work, the researcher conducted an interview related to critical thinking indicators. The following is an excerpt from an interview with subject JK:

P101	:	After reading the question, what is known and what is asked in the question?
JK101	:	The carrying capacity of the box car is not less than 300 kg, Mrs. Nami's weight is 60 kg, and each box weighs 30 kg. I asked to determine the minimum number of boxes that Mrs. Nami could transport in one shipment.
P102	:	You know what is known and asked in the question, but why don't you write it down in the work results?
JK102	:	Forgot, Mom (laughs while scratching her neck).
P103	:	Okay. How do you model the problem in the question into a linear inequality of one variable? Try to explain.
JK103	:	Because Mrs. Nami's weight is 60 kg and each box weighs 30 kg, the model I got is $60x+30 \leq 300$.
P104	:	Where do the ≤ and 300 signs come from?
JK104	:	Get it from the car's carrying capacity of not less than 300 kg.
P105	:	Are you sure you did not make a mistake in modelling?
JK105	:	(The subject is silent and does not respond.)

P106 : Okay, let us continue. After modelling the problem into an inequality, how do you solve it?
JK106 : I solved it by subtracting 30 from the left side and subtracting 60 from the right side, like this (showing the result of his work). He got $60x \geq 240$. Then $\geq 240/30$, $x \geq 8$.

P107 : Why from $60x \geq 240$ to $\geq 240/30$? How did you calculate it?

JK0107 : It is the same as dividing by 60 and 30, so dividing the left side by 60 gets $60x/60=x$, and dividing the right side gets $24/30=8$.

P108 : Why do different numbers divide both sides?
JK108 : (No answer while scratching his neck)
JK109 : Is there another way besides the way you used to solve this problem?
JK09 : None.
P110 : Okay, let us continue then. Is $x \geq 8$ the final answer to question number 1?
JK110 : (no answer)
P111 : Based on the answer you gave, can you conclude?
JK111 : So, the minimum number of boxes that Mrs. Nami can transport in one transport is eight boxes.

Based on the results of the work and interview results, JK can only fulfil one indicator of critical thinking ability, namely the interpretation indicator, overall. Subject JK can write and explain what is known and what is asked for each question. However, in the analysis, evaluation, explanation, and inference indicators, subject JK has not been able to fulfill these four indicators. This can be seen from the fact that subject JK is able to do mathematical calculations correctly and systematically; then, subject JK cannot choose the strategy to be used in solving the given questions. This also results in subject JK not being able to model the question into a one-variable linear inequality form; this also results in the conclusion that cannot be given, even though in question number 1, subject JK was able to provide a conclusion. This is in line with research from Yasin et al. (2023), namely, subjects with a low category of mathematical disposition are only able to fulfil the indicators of mathematical critical thinking ability correctly in 2 indicators, one of which is the interpretation indicator, while for other critical thinking ability indicators, such as the analysis indicator and the inference indicator, the subject is unable to fulfil it properly and correctly.

CONCLUSION

Based on the results and discussion, it can be concluded that critical thinking on the linear inequality material of one variable of class VIII students of SMP Negeri 4 Ambon which is reviewed from the mathematical disposition is as follows: (1) Subject JA with a high mathematical disposition category can work on the questions given and fulfill the four indicators of critical thinking, namely interpretation, analysis, evaluation, explanation, and inference on questions number 1 and 2; (2) Subject JFT with a medium mathematical disposition category in working on the questions given, can fulfill the four indicators of critical thinking, namely interpretation, analysis, evaluation, explanation on question number 1, but on question number 2 subject JFT only fulfills the indicators of critical thinking, namely interpretation and analysis; (3) Subject JK with a low mathematical disposition category in working on the questions given only fulfills the indicators of critical thinking, namely interpretation and inference

on question number 1 and on question number 2 only fulfills the indicator of critical thinking, namely interpretation.

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