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# Students' Critical Thinking Skills on Algebraic Problems Through Mathematical Resilience

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***ABSTRAK***

*Matematika memiliki peranan penting dalam menjalankan kehidupan sehari-hari maupun dalam ilmu-ilmu lainnya karena matematika dapat melibatkan banyak hal. Penelitian ini bertujuan untuk menganalisis kemampuan berpikir kritis siswa melalui resiliensi matematis. Penelitian ini menggunakan metode deskriptif kualitatif. Jumlah subjek penelitian ini adalah 473 siswa SMA dari 6 sekolah yang berbeda, dimana proses pemilihan subjek menggunakan Winstep. Instrumen penelitian adalah angket, tes dan wawancara. Analisis dalam penelitian ini dilihat dari dua aspek yaitu sekolah dan gender. Untuk mengetahui respon siswa terhadap angket yang telah dibagikan, peneliti menggunakan Model Rasch yang kemudian diekspor ke dalam file excel. Setelah itu, data dianalisis menggunakan software Winstep. Hasil penelitian menunjukkan bahwa resiliensi matematis tidak berpengaruh terhadap keterampilan berpikir kritis. Terbukti dalam penelitian ini bahwa siswa dengan resiliensi matematis tinggi ternyata memiliki kemampuan berpikir kritis yang rendah, siswa dengan resiliensi matematis sedang memiliki kemampuan berpikir kritis yang tinggi, dan siswa yang resiliensi matematisnya rendah memiliki kemampuan berpikir kritis sedang.*

**ABSTRACT**

Mathematics has an important role in carrying out everyday life and in other sciences because mathematics can involve many things. This study aims to analyze students' critical thinking skills through mathematical resilience. This study used a descriptive qualitative method. The number of subjects of this study were 473 Senior High School students from 6 different schools, in which the process of selecting the subject used Winstep. The research instruments were questionnaires, test and interviews. The analysis in this study is seen from two aspects, namely school and gender. To find out the students' responses to the questionnaire that had been distributed, the researcher used the Rasch Model which was then exported into an excel file. After that, the data were analyzed using Winstep software. The result of this research was that mathematical resilience had no effect on critical thinking skills. It was proven in this study that students with high mathematical resilience turned out to have low critical thinking skills, students with medium mathematical resilience had high critical thinking skills, and students with low mathematical resilience had medium critical thinking skills.

## 1. INTRODUCTION

Mathematics has an important role in carrying out everyday life and in other sciences because mathematics can involve many things (Aliyah et al., 2019; Faradillah & Febriani, 2021; Ningtyas et al., 2019). Students consider mathematics to be a subject that is not easy to learn and a difficult science because mathematics involves too many complex formulas and calculations so that students find it difficult to understand concepts in mathematics and this assumption is likely to affect students' mastery of learning mathematics because they think mathematics is not based on needs it's self-imposed (Bakhri et al., 2019; Ghany & Wahyudin, 2021). Therefore students must have strong soft skills and be interested in mathematics so that students will struggle hard and never give up in completing difficult mathematical tasks and the soft skill in question is mathematical resilience (Hendriana et al., 2019). Mathematical resilience is the attitude or positive response of students in facing difficulties or obstacles in learning mathematics so that students will find new strategies to overcome them (Amelia et al., 2020; Ishak et al., 2020; Rokhmah et al., 2019). Mathematical resilience is an important aspect to support student success in learning

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mathematics (Muntazhimah & Ulfah, 2020). Students who have good mathematical resilience will be tough and can overcome various obstacles in learning mathematics and are also able to solve difficult problems in mathematics (Ruqoyyah et al., 2020). The factors that cause low mathematical resilience are lack of confidence in one's own abilities, pessimism in learning and less ability to establish good relationships with the surrounding environment (Fitri et al., 2019). If students are open to alternative ideas and see that ideas or suggestions from other people can have the potential to increase understanding of something, as well as provide an opportunity to see more practical ways for the future and this allows students' intellectual abilities to improve further (Lee & Johnston-Wilder, 2017).

One of the intellectual abilities that is very important for everyone and a fundamental part of human maturity is critical thinking (Harum et al., 2020). The ability to think critically is the ability to think logically, reflectively and productively which is applied in assessing conditions for making appropriate judgments and decisions (Asmar & Delyana, 2020). Critical thinkers use their intellect and intellect to be able to analyze, assess and improve their thinking on every event they find (Sari et al., 2019). Students who have the ability to think critically not only receive the information obtained but critically, students can choose important information that can be used to draw the right conclusions (Yumiati & Kusumah, 2019). So in short, the ability to think critically can be defined as a mental process in understanding the world using pre-existing knowledge (Rosidin et al., 2019). This critical thinking ability can make students accustomed to being rational in determining the best alternative choices for themselves (Firdaus et al., 2019). In addition, critical thinking skills can build students' way of thinking, so they can draw conclusions to find the right solution in solving a problem, especially when studying mathematics (Apriliana et al., 2019). Students are said to have critical thinking skills if students are able to understand concepts and can apply these concepts to solve a problem (Dewi et al., 2017). One of the factors that can hinder the ability to think critically is that students lack a sense of notification, which can cause students to be underdeveloped and make it difficult for students to search and investigate systematically, logically, critically, analyze and also formulate findings (Dwijayanti et al., 2020). In order to be able to assess and see students 'mathematical critical thinking skills is by looking at the student learning process to find out students' critical thinking processes in solving problems (Farib et al., 2019). In learning mathematics, if critical thinking skills are applied, it will not only produce students who think critically in solving a problem, but the effect can strengthen students' memory (Ismail et al., 2019).

Critical thinking skills are needed to solve problems in problems, one of which is solving problems with algebraic problems (Cahyono et al., 2019). Algebra is studied by students from elementary to high school, it can be said that algebra is considered the basis for learning mathematics, if students do not learn or understand algebra properly it will make students difficult to learn the next material because mathematics has a hierarchical nature (Wulandari et al., 2020). Therefore, students must understand the concept of algebraic material so that students will have the ability to obtain, manage and use information to solve mathematical problems in everyday life (Pramuditya et al., 2021). Based on the relevant research, it was found that students' mathematical critical thinking skills can be influenced by AQ (Adversity Quotient) (Hidayat & Sari, 2019). Other studies say that using the scientific approach can affect students' mathematical critical thinking skills (Ucisaputri et al., 2020). Other studies say that students' mathematical critical thinking skills are better when using the scientific approach than conventional approaches, but in mathematical resilience students have no difference when using the two approaches (Rohaeti & Koswara, 2018). Then, in another study, it is found that students' critical thinking skills have several significant differences which are influenced by cognitive style and gender, and there are also differences in the process of students who have high critical thinking skill in solving algebraic problems (Cahyono et al., 2019). There is a gap in these 4 studies in which no one has discussed the ability to think critically in solving algebraic problems through mathematical resilience. The purpose of this study is to analyze students' critical thinking in solving algebraic problems through mathematical resilience.

## 2. METHOD

This research used descriptive qualitative research. This research was conducted online through Google Form and Zoom. The subjects of this study were students from 6 schools. The instruments used by the researcher were questionnaires, tests, and interviews. The questionnaire is used to determine students' mathematical resilience and this questionnaire has been validated by two mathematics lecturers and one mathematics teacher. The result of the validation is that the questionnaire is suitable for use through one revision because there is a change in the word structure so that students understand the meaning of the sentence in the questionnaire. This questionnaire has a scale of 1 to 7 consisting of strongly disagree, disagree, somewhat disagree, neutral, somewhat agree, agree, and strongly agree. In this questionnaire

there are four indicators that have been adapted from previous research, including value, struggle, growth and resilience with a total of 35 statements in the questionnaire.

The analysis in this study is seen from two aspects, namely school and gender. To find out the students' responses to the questionnaire that had been distributed, the researcher used the Rasch Model which was then exported into an excel file. After that, the data were analyzed using Win step software. Rasch analysis is a probabilistic model that uses a model of analysis and this analysis was developed by a mathematician from Denmark, namely George Rasch, and this Rasch analysis can be called the Rasch model (Robinson et al., 2019). Rasch Model can also be interpreted as a logistic that provides for all items and subjects where items to estimate difficulty and person to estimate the ability used to scale items and subjects that match the same latent properties (Cascella & Giberti, 2020). Using the Rasch model allows the creation of a wright map that can help illustrate how the student's skill level corresponds to the difficulty level of the question (Jacob et al., 2019). A very incapable person and an item that is very difficult to place at the bottom and a very capable person and an item that is very easy to place at the top (Colledani et al., 2020).

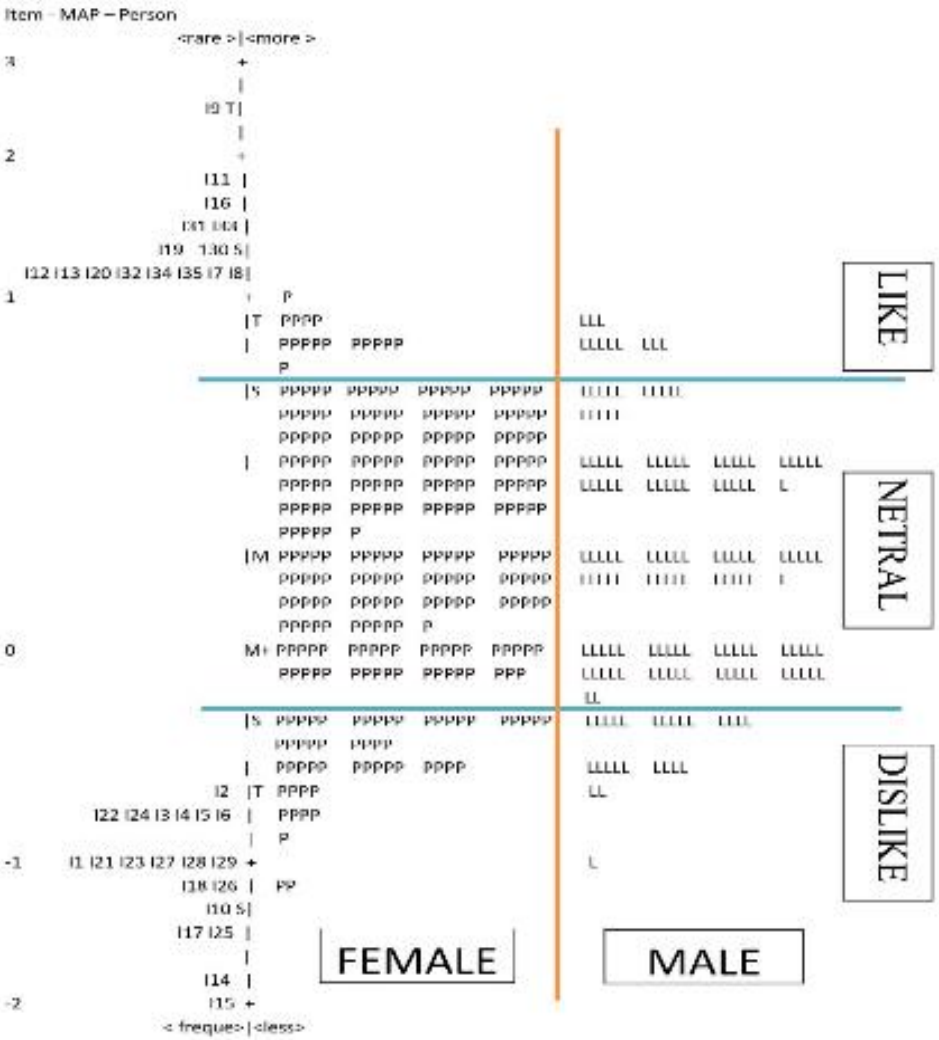


**Figure 1.** Win Step Mathematical Resilience Map Based on Gender

Based on Figure 1, it can be seen that there are 27 students who have high mathematical resilience, 373 students have medium mathematical resilience, and 80 students have low mathematical resilience. It can also be seen that there are more female students who have high mathematical resilience than male students, namely 16 and 11, respectively. In this research, the researcher took 1 subject from each category. There were 3 subjects that were randomly selected. The subject who had high mathematical resilience was named as HS, the subject who had medium mathematical resilience was named as MS, and the subject who had low mathematical resilience was named as LS. The taken subjects can be described in Table 1.

**Table 1**. Subjects Selected Based on Mathematical Resilience Categories

| Category | Gender | Code |
|---|---|---|
| High | Male | HS |
| Medium | Female | MS |
| Low | Male | LS |

## 3. RESULT AND DISCUSSION

### Result

The test instrument used by the researcher aims to measure and determine students' critical thinking skills. This test instrument is guided by (Facione, 2020) and this instrument has been validated by two lecturers in the field of mathematics and one mathematics teacher. The result of the validation is that the questionnaire is suitable for use through several revisions because there are changes in the questions so that it can meet the indicators of critical thinking skills. After conducting the test, the researcher conducted an interview. Interviewing in this study is interviewing the subject in order to see the process of student work in doing critical tests. After the interview, the researcher performed a data analysis that was carried out after the data interview. Subjects that have been selected using the Win step application obtained 3 subjects and these subjects take the next test, namely the mathematical critical thinking ability test. There are several indicators, including interpretation, analysis, evaluation and inference. At the interpretation stage, the subject is expected to understand or interpret the meaning / meaning of the problem. At the analysis stage the subject is expected to identify and conclude the relationship between statements, questions, concepts, descriptions etc. At the evaluation stage the subject is expected to be able to assess the credibility of the statement / representation and assess it reasonably from concluding the relationship to the statement, question, description etc. At the inference, the subject is expected to be able to identify what is needed in drawing logical conclusions. After being analyzed, the results of the HS, MS, and LS mathematical critical thinking skills are obtained as in Table 2.

**Table 2**. Score Results from the Subject of Mathematical Critical Thinking Skills

| Code | Interpretation | Analysis | Evaluation | Inference | Score |
|---|---|---|---|---|---|
| HS | The score obtained on the interpretation indicator is 0 because students did not write down what was known and asked about the question | The score obtained on the analysis indicator was 0 because the students did not do the questions | The score obtained on the evaluation indicator is 3 because students only work on one question using the right strategy but make mistakes when doing calculations | The score obtained on the conclusion indicator is 4 because students work on one problem by making appropriate conclusions and in accordance with the context | 7 |
| MS | The score obtained on the interpretation indicator was 3 because the students did not write down correctly and completely | The score obtained on the analysis indicator is 2 because the students make a mathematical model but it is not correct | The score obtained on the evaluation indicator is 7 because in one of the questions the student made a mistake in the calculation | The score obtained in the conclusion indicator is 6 because in one of the students' questions it was not correct to write the conclusion even though it was in accordance with the context | 18 |
| LS | The score obtained on | The score obtained on the | The score obtained on the | The score obtained on the | 8 |

| Code | Interpretation | Analysis | Evaluation | Inference | Score |
|---|---|---|---|---|---|
| | the interpretation indicator is 8 because writing is known and asked correctly and completely | analysis indicator is 0 because students do not make mathematical models of the questions given | evaluation indicator is 0 because students do not use strategies in solving questions | conclusion indicator is 0 because students do not make conclusions | |

The three selected subjects were given questions related to solving algebraic questions that were in accordance with the indicators of critical thinking and in interviews. The results of this study are described in accordance with the indicators of critical thinking skills which are as follows. The first indicator is interpretation. This indicator consists of two questions. One of the questions is presented in Figure 2.

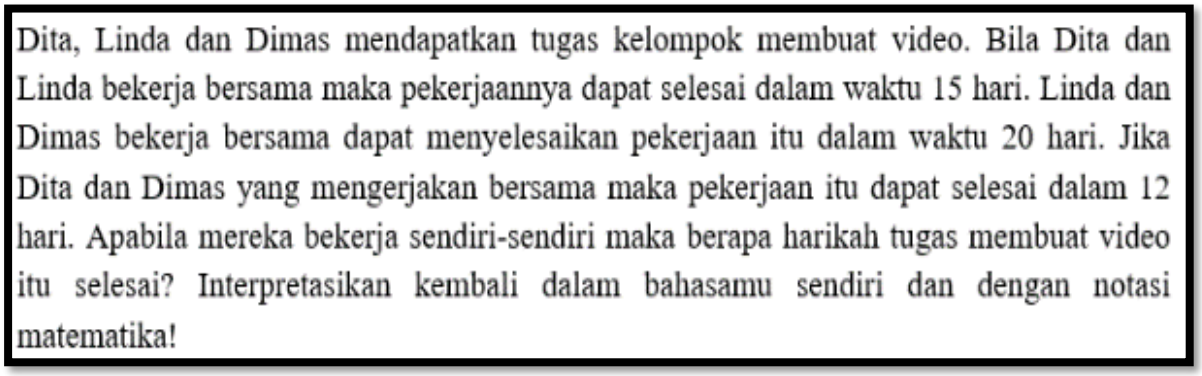
Dita, Linda dan Dimas mendapatkan tugas kelompok membuat video. Bila Dita dan Linda bekerja bersama maka pekerjaannya dapat selesai dalam waktu 15 hari. Linda dan Dimas bekerja bersama dapat menyelesaikan pekerjaan itu dalam waktu 20 hari. Jika Dita dan Dimas yang mengerjakan bersama maka pekerjaan itu dapat selesai dalam 12 hari. Apabila mereka bekerja sendiri-sendiri maka berapa harikah tugas membuat video itu selesai? Interpretasikan kembali dalam bahasamu sendiri dan dengan notasi matematika!

**Figure 2.** Problem Interpretation

Interpretation is the ability of students to know, understand or express the meaning or meaning of the data that has been presented in a problem. This interpretation is intended so that students are able to write down information on a problem. HS could not solve the problem because HS was too focused on other indicators so that HS made time to run out of work. However, when conducting interviews, HS can convey the information contained in the matter. Even so, it was said that HS could not achieve these indicators because HS did not provide a written answer. Next is the subject of MS. MS can solve the problem in writing, but in solving the problem, MS does not fulfill the purpose in the interpretation indicator, MS does not provide information on the problem in its own language but with a mathematical model. During the interview, MS provided the information contained in the problem by assuming it into mathematical symbols. In this case, MS also cannot meet the interpretation indicators. Then the LS subject can write down the information contained in the problem correctly and precisely. Even when interviewed, LS was able to explain the information contained in the question. In this case the LS can meet the interpretation indicators. The second indicator is analysis. This indicator consists of two questions. One of the questions about this indicator is as shown in Figure 3.

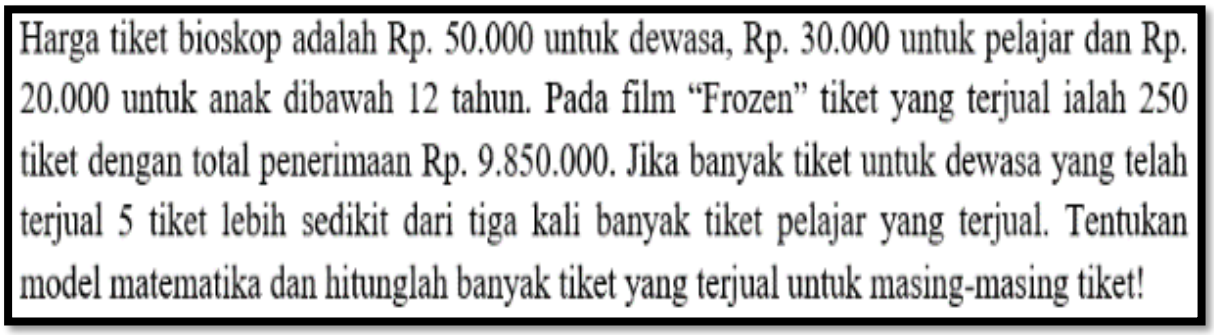
Harga tiket bioskop adalah Rp. 50.000 untuk dewasa, Rp. 30.000 untuk pelajar dan Rp. 20.000 untuk anak dibawah 12 tahun. Pada film "Frozen" tiket yang terjual ialah 250 tiket dengan total penerimaan Rp. 9.850.000. Jika banyak tiket untuk dewasa yang telah terjual 5 tiket lebih sedikit dari tiga kali banyak tiket pelajar yang terjual. Tentukan model matematika dan hitunglah banyak tiket yang terjual untuk masing-masing tiket!

**Figure 3.** Problem Analysis

Analysis is the ability of students to identify the relationship between statements, questions or concepts in the data or problems that have been given and students can create and explain mathematical models appropriately. HS subject could not solve the problem. When interviewed, HS said that HS did not understand the sentence in the question, namely "If the number of tickets for adults that have sold 5 tickets is less than three times the number of student tickets sold". Next is the subject of MS. MS can work on analytical indicator questions but there is an error when MS is working on it, namely when making mathematical models. MS only assumes that with only two variables, there should be 3 variables. When interviewed, MS said that he did not see the keyword student in the question, what MS saw was only the keywords for adults and children under the age of 12. It can be seen from the interview that MS is doing something reckless. Then LS can only interpret the problem but cannot convert it into mathematical form. During the interview, LS said that he had forgotten what the mathematical model was, therefore he could only interpret the problem. The third indicator is evaluation. This indicator consists of two questions. One of the questions about this indicator is as presented in Figure 4.

Bu Irene membeli 3 jus jeruk , 2 jus apel dan 2 jus cherry seharga Rp. 42.000. Bu Vira membeli 2 jus jeruk, 2 jus apel dan 4 jus cherry seharga Rp. 51.000. Bu Windi membeli 3 jus jeruk, 3 jus apel dan 3 jus cherry seharga Rp. 54.000. Berapakah harga 1 kotak jus jeruk, jus apel dan jus cherry dan strategi apakah yang Anda akan gunakan untuk menyelesaikan permasalahan tersebut? Jelaskan.

**Figure 4.** Problem Evaluation

It was only HS and MS that answered this question. Figure 5 shows the answers by HS and MS.

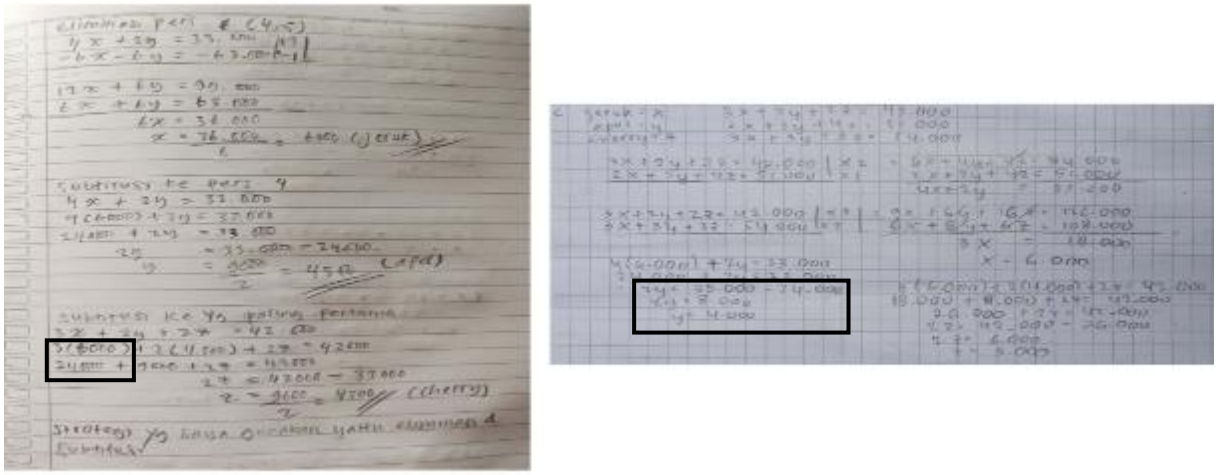

**Figure 5.** HS' and MS' Answer

Evaluation is the ability of students to find and prove the errors contained in the problems given and then students look for solutions or solutions to these problems. In this indicator students are expected to be able to solve the problem with the right calculations. It can be seen in the picture that HS can work on the problem, but an error occurred during the calculation process. During the interview, HS confidently explained the calculation process and HS did not feel that there was an error in the calculation process. Next is the subject of MS. MS also miscalculated while working on the problem. Even in the interview, MS was not aware of any errors in the calculation process and he was quite sure that the calculations carried out were correct. The two subjects were actually quite able to find and prove the problem when working on the problem, but they were not careful in the calculations. While LS cannot work on the problem. During the

interview, LS again said that he had forgotten the material related to this question. The fourth indicator is inference. This indicator consists of two questions. One of the questions about this indicator is shown in Figure 6.

Siska membeli 2 pulpen, 2 pensil dan 4 buku dengan harga Rp. 43.000. Riska membeli 3 pulpen, 1 pensil dan 2 buku dengan harga Rp. 28.500. Fitri membeli 3 pulpen, 3 pensil dan 2 buku seharga Rp. 36.500. Setelah Siska, Riska, dan Fitri bertemu di taman, mereka menghitung harga satuan dari pulpen, pensil, dan buku. Sehingga diketahui bahwa harga satu pulpen adalah Rp 3.000, satu pensil adalah Rp 4.000, dan satu buku adalah Rp 7.000. Benarkah kesimpulan harga satuan masing-masing benda yang dibeli oleh mereka? Jelaskan.

**Figure 6.** Problem Inference

In this indicator, it was only HS and MS that answered the question, while LS did not. Figure 7 is present the results of HS' and MS' answers.

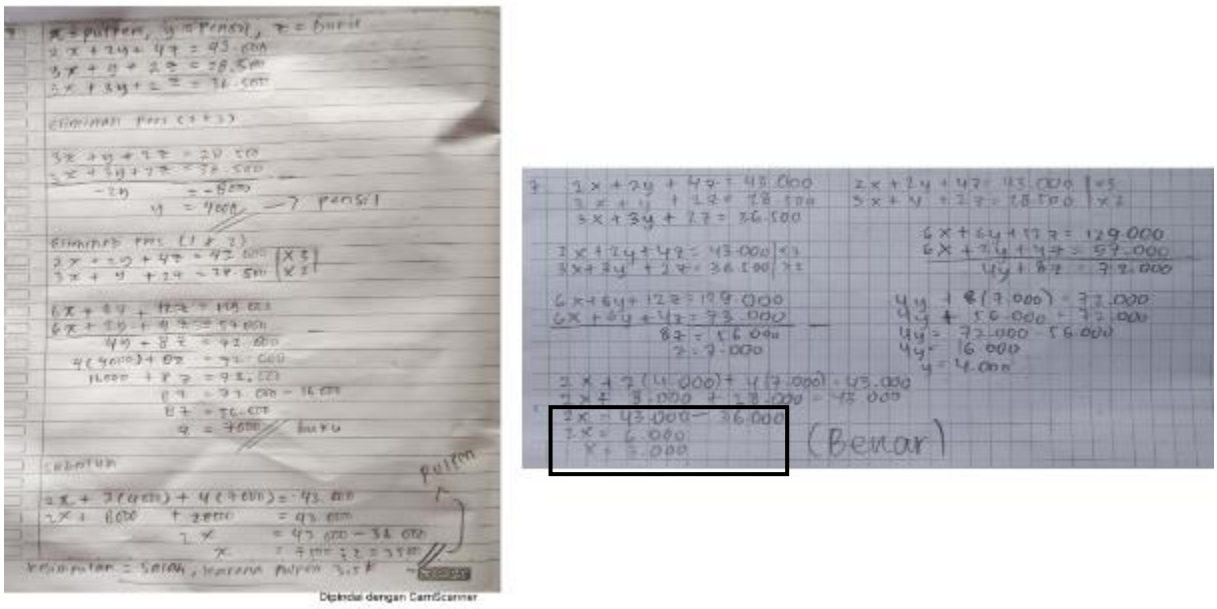


**Figure 7.** HS' and MS' answer

Inference is the ability of students to make conclusions according to the context of the given problem. It can be seen that HS can conclude correctly and precisely. There is no difference between written answers and during the interview. When interviewed, HS has confidence that can make the subject feel confident in explaining the conclusions obtained and the explanation is correct and in accordance with the context of the question. While MS could not conclude the answer correctly. MS miscalculated again during the calculation process and MS concluded that the conclusion on the question was correct, even though the actual price of the pen was 3,500. During the interview, the researcher told MS about his mistake and that he was wrong in calculating. This makes MS able to solve the problem but cannot draw conclusions correctly because of an error in the calculation even though it is in accordance with the context of the question. Next subject LS. LS does not work on this indicator question. During the interview, LS still said that LS forgot the material. Therefore, for HS researchers who have high mathematical resilience, they can only complete analytical indicators, then HS has moderate mathematical critical thinking skills. MS who has moderate mathematical resilience can complete all critical thinking indicators, then MS has high mathematical critical thinking skills. LS which has low mathematical resilience only completes the interpretation indicator, so LS has low critical thinking skills.

**Discussion**

Based on the research results that have been obtained on the first indicator, namely interpretation, students who have high critical thinking skills can solve the problem but with a mathematical model instead of using their own language and students have errors when converting existing information into mathematical form. In this case, students cannot code verbally into symbolic in the sense that students have not been able to change the problem into an appropriate mathematical model (Wardah et al., 2021). Students who have moderate critical thinking skills can write down information about questions well. In line with previous research that students who think critically are being able to identify and mention the information that is known in the questions clearly, namely students can reread the appropriate information on the questions and students are also able to express questions in the questions (Pujiasih, 2018). Students who have low critical thinking skills cannot solve the interpretation problem because time runs out. This often happens to students in solving math problems. This is in line with previous research that students are not good at managing time when working on math problems (Kosasih & Pujiastuti, 2020).

The second indicator is analysis. Students who have high critical thinking skills have carelessness in reading questions. This carelessness has an impact on errors in determining known information and this is caused by students who are limited in reading comprehension skills so that it results in students ignoring relevant keywords in story problems (Pradini, 2019). Students who have moderate critical thinking skills cannot convert it into a mathematical model. In this case, the student can be said to have made a transformation error. Transformation errors can cause students to be unable to describe and also change information from questions into mathematical forms or models (Pranitasari & Ratu, 2020). Then students who have low critical thinking skills do not understand the questions. Errors in understanding the questions can occur because students do not understand the keywords in the questions so that students do not know the important information that is stated and asked in the questions (Suratih & Pujiastuti, 2020).

The third indicator is evaluation. Students who have high and low critical thinking skills both have errors in calculations. However, there are operational technical obstacles experienced by students, namely students are not careful when carrying out addition, subtraction or multiplication operations on numbers that exist during the calculation process (Maarif et al., 2020). Student inaccuracy can be caused by students being reluctant to re-check their work from the start (Haryadi & Nurmaningsih, 2019). Meanwhile, students who have the ability to think critically are forgetting the material. The problem of forgetting has often happened, students understand the learning when in class, but after several meetings to learn new materials, students forget the old materials (Ario & Asra, 2019).

The last indicator is inference. Students who have high critical thinking skills are not careful when working on the problem. Errors like this are because students are not careful in the process, even though students must be full of accuracy when solving math problems in the form of stories (Mafruhah & Muchyidin, 2020). So even though students have written the appropriate conclusions, the final results written are not correct because previously there was an error in the calculation process (Islamiyah et al., 2018). Students who have the ability to think critically are again experiencing forgetfulness. The inability of students in terms of remembering or relating old or previous knowledge to the problems that have been given at this time, this can be called forgetting (Indrawati et al., 2019). Meanwhile, students who have low critical thinking skills work on the problem correctly. It can be said that HS has the ability to think critically mathematically where the subject can draw conclusions to decide the correct or appropriate solution in solving mathematical problems (Apriliana et al., 2019).

The findings in this study indicate that students' critical thinking skills are still not optimal. This is in line with other studies which say that students' critical thinking skills are also not optimal even though when learning has used the discovery learning model, because the emergence of students' critical thinking processes is different on each critical thinking indicator when students solve the problem (Farib et al., 2019). This low critical thinking ability can be due to the lack of precise models in learning. In line with previous research that low critical thinking skills can also be caused by learning that is still dominated by teachers which can cause students to lack critical thinking skills (Nuryanti et al., 2018). In addition, teachers do not train students in developing critical thinking skills. This is in line with previous research that when students are given different questions than usual, students become confused in understanding the problem this is due to the lack of teachers in training students' abilities in working on various questions in the form of stories (Indrawati et al., 2019). Therefore, teachers are expected to be able to train students' critical thinking skills by using appropriate mathematical models.

From the results and discussions that have been described, it is not enough just to have confidence in learning and mastering mathematics, but an attitude of struggle and unyielding in finding ways to overcome difficulties and obstacles is also needed in learning mathematics. In line with other studies that students' self-confidence does not have a significant effect on learning achievement (Kunhertanti & Santosa, 2018). Based on these findings, this can be the cause that students who have good mathematical resilience

do not necessarily have good mathematical abilities. So that further researchers can find out about mathematical resilience factors, using critical thinking indicators with different experts, and with different levels or materials.

## 4. CONCLUSION

In this study, it was found that high mathematical resilience has low critical thinking skills, medium mathematical resilience has high critical thinking skills, and low mathematical resilience has medium critical thinking skills. So mathematical resilience has no effect on critical thinking skills. However, it should be noted that research results may vary according to the instruments used. The limitation in this study is in data collection because the informants sometimes do not fill out the questionnaire in actual circumstances and also the data collection that is done boldly makes it difficult for researchers because of the network. Thus, the researcher provides suggestions for further research to be carried out. This is because there is no influence between critical thinking skills and mathematical resilience. Further researchers can use indicators of critical thinking skills based on other experts, for example, Ennis and others, and other researchers that conduct critical thinking research with different materials or with different school levels and find out the factors that influence students' mathematical resilience.

## 5. REFERENCES

Aliyah, I. M., Yuhana, Y., & Santosa, C. A. H. F. (2019). Kemampuan Koneksi Matematis Siswa Ditinjau dari Kemampuan Awal dan Gender. *Jurnal Didaktik Matematika*, *6*(2), 161–178. https://doi.org/10.24815/jdm.v6i2.14104.

Amelia, R., Kadarisma, G., Fitriani, N., & Ahmadi, Y. (2020). The effect of online mathematics learning on junior high school mathematic resilience during COVID-19 pandemic. *Journal of Physics: Conference Series*, *1657*(1). https://doi.org/10.1088/1742-6596/1657/1/012011.

Apriliana, L. P., Handayani, I., & Awalludin, S. A. (2019). The Effect of a Problem Centered Learning on Student's Mathematical Critical Thinking. *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, *4*(2), 124–133. https://doi.org/10.23917/jramathedu.v4i2.8386.

Ario, M., & Asra, A. (2019). Pengembangan Video Pembelajaran Materi Integral Pada Pembelajaran Flipped Classroom. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *8*(1), 20–31. https://doi.org/10.24127/ajpm.v8i1.1709.

Asmar, A., & Delyana, H. (2020). Hubungan Kemandirian Belajar Terhadap Kemampuan Berpikir Kritis Melalui Penggunaan Software Geogebra. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *9*(2), 221. https://doi.org/10.24127/ajpm.v9i2.2758.

Bakhri, S., Sari, A. F., & Ernawati, A. (2019). Kualitas Pembelajaran Kontekstual Siswa IPS Materi Program Linier yang Memiliki Kecemasan Belajar Matematika. *Kreano, Jurnal Matematika Kreatif-Inovatif*, *10*(2), 186–192. https://doi.org/10.15294/kreano.v10i2.19061.

Cahyono, B., Kartono, Waluyo, B., & Mulyono. (2019). Analysis critical thinking skills in solving problems algebra in terms of cognitive style and gender. *Journal of Physics: Conference Series*, *1321*(2), 0–7. https://doi.org/10.1088/1742-6596/1321/2/022115

Cascella, C., & Giberti, C. (2020). Beyond text comprehension: exploring items' characteristics and their effect on foreign students' disadvantage in mathematics. *International Journal of Mathematical Education in Science and Technology*, *0*(0), 1–21. https://doi.org/10.1080/0020739X.2020.1836408.

Colledani, D., Anselmi, P., & Robusto, E. (2020). Rasch Models in the Analysis of Repgrid Data. *Journal of Constructivist Psychology*, *0*(0), 1–21. https://doi.org/10.1080/10720537.2020.1852461.

Dewi, N. P. S. R., Wibawa, I. M. C., & Devi, N. L. P. L. (2017). Kemampuan Berpikir Kritis Dan Keterampilan Proses Dalam Pembelajaran Siklus Belajar 7E Berbasis Kearifan Lokal. *JPI (Jurnal Pendidikan Indonesia)*, *6*(1), 125–133. https://doi.org/10.23887/jpi-undiksha.v6i1.9476.

Dwijayanti, I., Nugroho, A. A., & Pratiwi, Y. I. (2020). Meta-Analysis: the effect of Problem Approach and Inquiry Approach Toward Students' Mathematical Critical Thinking Skill Over the Past 4 Years. *Al-Jabar : Jurnal Pendidikan Matematika*, *11*(1), 101–106. https://doi.org/10.24042/ajpm.v11i1.4944.

Faradillah, A., & Febriani, L. (2021). Mathematical Trauma Students' Junior High School Based on Grade and Gender. *Infinity Journal*, *10*(1), 53. https://doi.org/10.22460/infinity.v10i1.p53-68.

Farib, P. M., Ikhsan, M., & Subianto, M. (2019). Proses Berpikir Kritis Matematis Siswa Sekolah Menengah Pertama Melalui Discovery Learning. *Jurnal Riset Pendidikan Matematika*, *6*(1), 99–117. https://doi.org/10.21831/jrpm.v6i1.21396.

Firdaus, A., Nisa, L. C., & Nadhifah, N. (2019). Kemampuan Berpikir Kritis Siswa pada Materi Barisan dan Deret Berdasarkan Gaya Berpikir. *Kreano, Jurnal Matematika Kreatif-Inovatif*, *10*(1), 68–77. https://doi.org/10.15294/kreano.v10i1.17822.

Fitri, S., Syahputra, E., & Syahputra, H. (2019). Blended Learning Rotation Model Of Cognitive Conflict Strategy To Improve Mathematical Resilience In High School Students. *International Journal of Scientific and Technology Research*, *8*(12), 80–87. https://www.ijstr.org/final-print/dec2019/Blended-Learning-Rotation-Model-Of-Cognitive-Conflict-Strategy-To-Improve-Mathematical-Resilience-In-High-School-Students.pdf.

Ghany, W. A., & Wahyudin, W. (2021). The Implementation of Supportive Classroom Environment in VII-Grade Mathematics Learning. *JTAM (Jurnal Teori Dan Aplikasi Matematika)*, *5*(1), 225–235. https://doi.org/10.31764/jtam.v5i1.3919.

Harum, C. L., Yusrizal, Syukri, M., & Nurmaliah, C. (2020). Pengaruh Model Pembelajaran Generatif Berbasis Phet Terhadap Keterampilan Berpikir Kritis Dan Motivasi Belajar Siswa Pada Materi Gelombang. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, *8*(2), 164–174. https://doi.org/10.24815/jpsi.v8i2.15776.

Haryadi, R., & Nurmaningsih, N. (2019). Analisis Kesalahan Mahasiswa dalam Menyelesaikan Soal Persamaan Garis Lurus. *Jurnal Elemen*, *5*(1), 1–11. https://doi.org/10.29408/jel.v5i1.703.

Hendriana, H., Sumarmo, U., Carli, C., Ristiana, M. G., & Putra, H. D. (2019). Enhancing students mathematical creative skill and resilience by using problem posing approach. *Journal of Physics: Conference Series*, *1318*(1). https://doi.org/10.1088/1742-6596/1318/1/012065.

Hidayat, W., & Sari, V. T. A. (2019). Kemampuan Berpikir Kritis Matematis dan Adversity Quotient Siswa SMP. *Jurnal Elemen*, *5*(2), 242. https://doi.org/10.29408/jel.v5i2.1454.

Indrawati, K. A. D., Muzaki, A., & Febrilia, B. R. A. (2019). Profil Berpikir Siswa dalam Menyelesaikan Soal Sistem Persamaan Linear. *Jurnal Didaktik Matematika*, *6*(1), 69–84. https://doi.org/10.24815/jdm.v6i1.12200.

Ishak, N. H. F. B., Yusoff, N. F. B. M., & Madihie, A. (2020). Resilience in mathematics, academic resilience, or mathematical resilience?: An overview. *Universal Journal of Educational Research*, *8*(5 A), 34–39. https://doi.org/10.13189/ujer.2020.081905.

Islamiyah, A. C., Prayitno, S., & Amrullah, A. (2018). Analisis Kesalahan Siswa SMP pada Penyelesaian Masalah Sistem Persamaan Linear Dua Variabel. *Jurnal Didaktik Matematika*, *5*(1), 66–76. https://doi.org/10.24815/jdm.v5i1.10035.

Ismail, S. N., Muhammad, S., Kanesan, A. G., & Ali, R. M. (2019). The influence of teachers' perception and readiness towards the implementation of Critical Thinking Skills (CTS) practice in mathematics. *International Journal of Instruction*, *12*(2), 337–352. https://doi.org/10.29333/iji.2019.12222a.

Jacob, E. R., Duffield, C., & Jacob, A. M. (2019). Validation of data using RASCH analysis in a tool measuring changes in critical thinking in nursing students. *Nurse Education Today*, *76*(November 2018), 196–199. https://doi.org/10.1016/j.nedt.2019.02.012.

Kosasih, F., & Pujiastuti, H. (2020). Analisis Kesalahan Siswa Sekolah Menengah Kejuruan dalam Mengerjakan Soal Cerita Sistem Persamaan Linear Dua Variabel. *MAJU : Jurnal Ilmiah Pendidikan Matematika*, *7*(2), 164–173. https://ejournal.stkipbbm.ac.id/index.php/mtk/article/view/516.

Kunhertanti, K., & Santosa, R. H. (2018). The Influence of Students' Self Confidence on Mathematics Learning Achievement. *Journal of Physics: Conference Series*, *1097*(1). https://doi.org/10.1088/1742-6596/1097/1/012126.

Lee, C., & Johnston-Wilder, S. (2017). The Construct of Mathematical Resilience. In *Understanding Emotions in Mathematical Thinking and Learning*. Elsevier Inc. https://doi.org/10.1016/B978-0-12-802218-4.00010-8.

Maarif, S., Setiarini, R. N., & Nurafni, N. (2020). Hambatan Epistimologis Siswa dalam Menyelesaikan Masalah Sistem Persamaan Linear Dua Variabel. *Jurnal Didaktik Matematika*, *7*(1), 72–89. https://doi.org/10.24815/jdm.v7i1.15234.

Mafruhah, L., & Muchyidin, A. (2020). Analisis kesalahan siswa dalam menyelesaikan soal cerita matematika berdasarkan kriteria Watson. *Pythagoras: Jurnal Pendidikan Matematika*, *15*(1), 24–35. https://doi.org/10.21831/pg.v15i1.26534.

Muntazhimah, M., & Ulfah, S. (2020). Mathematics Resilience of Pre-Service Mathematics Teacher. *International Journal of Scientific and Technology Research*, *9*(1), 1442–1445. https://www.ijstr.org/final-print/jan2020/Mathematics-Resilience-Of-Pre-service-Mathematics-Teacher.pdf.

Ningtyas, D. Y., Fuad, Y., & Lukito, A. (2019). Kemampuan Representasi Mahasiswa Pendidikan Matematika dalam Menyelesaikan Soal Kalkulus. *Kreano, Jurnal Matematika Kreatif-Inovatif*, *10*(1), 27–36. https://doi.org/10.15294/kreano.v10i1.17334.

Nuryanti, L., Zubaidah, S., & Diantoro, M. (2018). Analisis Kemampuan Berpikir Kritis Siswa SMP. *Jurnal Pendidikan: Teori, Penelitian Dan Pengembangan*, *3*(2), 155–158. http://journal.um.ac.id/index.php/jptpp/article/view/10490.

Pradini, W. (2019). Analisis Kesalahan Siswa dalam Menyelesaikan Soal Cerita Persamaan Linear Dua Variabel. *PYTHAGORAS: Jurnal Pendidikan Matematika*, *14*(1), 33–45. https://doi.org/10.21831/pg.v14i1.21481.

Pramuditya, S. A., Noto, M. S., & Handayani, V. D. (2021). Desain Didaktis Konteks Fabel Berbasis Pemahaman Matematis Siswa pada Materi Aljabar. *Jurnal Elemen*, *7*(1), 68–83. https://doi.org/10.29408/jel.v7i1.2730.

Pranitasari, D., & Ratu, N. (2020). Analisis Kesalahan Siswa dalam Menyelesaikan Soal Matematika PISA pada Konten Change and Relationship. *AKSIOMA : Jurnal Matematika Dan Pendidikan Matematika*, *9*(4), 1235–1248. https://doi.org/10.24127/ajpm.v9i4.2685.

Pujiasih, F. (2018). Profil Kemampuan Berpikir Kritis Matematis Siswa dalam Pemecahan Masalah Soal SPLDV Ditinjau dari Kemampuan Matematika. *Jurnal Karya Pendidikan Matematika*, *5*(2), 9–19. https://doi.org/10.26714/jkpm.5.2.2018.9-19.

Robinson, M., Johnson, A. M., Walton, D. M., & MacDermid, J. C. (2019). A comparison of the polytomous Rasch analysis output of RUMM2030 and R (ltm/eRm/TAM/lordif). *BMC Medical Research Methodology*, *19*(1), 1–12. https://doi.org/10.1186/s12874-019-0680-5.

Rohaeti, E. E., & Koswara, D. (2018). Mathematical critical thinking and resiliency : Experiment of grade-7 students using scientific approah. *Jurnal Riset Pendidikan Matematika*, *5*(2), 223–232. https://doi.org/10.21831/jrpm.v5i2.17322..

Rokhmah, K. N., Retnawati, H., & Solekhah, P. (2019). Mathematical resilience: Is that affecting the students' mathematics achievement? *Journal of Physics: Conference Series*, *1320*(1). https://doi.org/10.1088/1742-6596/1320/1/012036.

Rosidin, U., Kadaritna, N., & Hasnunidah, N. (2019). Can argument-driven inquiry models have impact on critical thinking skills for students with differentpersonality types? *Cakrawala Pendidikan*, *38*(3), 511–526. https://doi.org/10.21831/cp.v38i3.24725.

Ruqoyyah, S., Murni, S., & Fasha, L. H. (2020). Microsoft Excel VBA on mathematical resilience of primary school teacher education students. *Journal of Physics: Conference Series*, *1657*(1). https://doi.org/10.1088/1742-6596/1657/1/012010.

Sari, T. P., Dawud, & Andajani, K. (2019). Hubungan Kemampuan Berpikir Kritis dengan Kemampuan Menulis Teks Editorial Siswa Kelas XII. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *4*(1), 51–55. http://journal.um.ac.id/index.php/jptpp/article/view/11853.

Suratih, S., & Pujiastuti, H. (2020). Analisis kesalahan siswa dalam menyelesaikan soal cerita program linear berdasarkan Newman's error analysis. *Pythagoras: Jurnal Pendidikan Matematika*, *15*(2), 111–123. https://doi.org/10.21831/pg.v15i2.30990.

Ucisaputri, N., Nurhayati, N., & Pagiling, S. L. (2020). Pengaruh Pendekatan Saintifik terhadap Kemampuan Berpikir Kritis Matematis pada Siswa SMP Negeri 2 Marauke. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *9*(3), 789–798. https://doi.org/10.24127/ajpm.v9i3.2919.

Wardah, S., Utomo, D. P., & Putri, O. R. U. (2021). An Analysis of Errors on Mathematical Symbol as a Metaphor in Linear Programming. *Jurnal Didaktik Matematika*, *8*(1), 45–58. https://doi.org/10.24815/jdm.v8i1.18304.

Wulandari, S., Hajidin, H., & Duskri, M. (2020). Pengembangan Soal Higher Order Thinking Skills (HOTS) pada Materi Aljabar di Sekolah Menengah Pertama. *Jurnal Didaktik Matematika*, *7*(2), 200–220. https://doi.org/10.24815/jdm.v7i2.17774.

Yumiati, Y., & Kusumah, Y. S. (2019). Interaction between Students' Learning and Early Mathematical Skills to Increase Mathematical Critical Thinking Skill. *Al-Jabar: Jurnal Pendidikan Matematika*, *10*(1), 125–134. https://doi.org/10.24042/ajpm.v10i1.3712.