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Junior High School Students Creative Thinking Ability In Solving Open Ended Problems On Straight-Line Equations From Gender

Afni Molita[1], Masriyah[2]
[1](*Student of the Mathematics Education Study Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, Indonesia)*
[2](*Lecturer in the Mathematics Education Study Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, Indonesia)*

* Corresponding Author. E-mail: afni.19002@mhs.unesa.ac.id

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Abstrak

Guru pada umumnya tidak menyajikan latihan kepada siswa untuk berpikir kreatif karena setiap latihan yang diberikan hanya berorientasi pada hasil tanpa melihat bagaimana proses yang dijalankan oleh siswa. Oleh sebab itu diperlukan pendekatan pembelajaran yang tepat untuk meningkatkan kemampuan berpikir kreatif siswa. Pendekatan yang dapat digunakan guna meningkatkan kemampuan berpikir kreatif siswa dalam pembelajaran yakni dengan memberikan soal open ended. Tujuan penelitian ini adalah memperoleh deskripsi tentang (1) kemampuan berpikir kreatif matematis siswa laki-laki dalam menyelesaikan soal open ended materi persamaan garis lurus dan (2) kemampuan berpikir kreatif matematis siswa perempuan dalam menyelesaikan soal open ended materi persamaan garis lurus. Metode penelitian ini adalah deskriptif kualitatif. Data dikumpulkan dengan menggunakan metode tes dan metode wawancara. Tes tertulis pada penelitian ini berupa Tes Kemampuan Matematika (TKM) yang diadaptasi dari soal UN SMP yang telah tervalidasi dengan pemilihan soal yang mencakup materi kelas VII dan VIII semester gasal. Selain itu tes tertulis dalam penelitian ini juga berupa Tes Penyelesaian Masalah (TPM) berisi soal open ended persamaan garis lurus. Sedangkan metode wawancara dilakukan setelah siswa yang terpilih menjadi subjek penelitian mengerjakan tes. Data yang terkumpul kemudian dianalisis secara kualitatif. Hasil penelitian menunjukkan bahwa siswa perempuan hanya mampu memenuhi indikator kemampuan berpikir kreatif fluency. Namun, siswa perempuan tidak memenuhi indikator flexibility dan novelty. Dengan demikian, siswa perempuan termasuk kategori kurang kreatif berdasarkan tingkat kemampuan berpikir kreatif matematis siswa menurut Siswono. Sementara itu, siswa laki-laki memenuhi indikator kemampuan berpikir kreatif matematis fluency dan novelty. Dengan demikian, siswa laki-laki termasuk kategori kreatif berdasarkan tingkat kemampuan berpikir kreatif matematis menurut Siswono.

Kata Kunci: *Kemampuan Berpikir Kreatif, Siswa SMP, Soal Open Ended, Persamaan Garis Lurus, Jenis Kelamin*

Abstract

Teachers generally do not present exercises for students to think creatively because each exercise given is only result-oriented regardless of how the process is carried out by students. Therefore we need the right learning approach to improve students' creative thinking skills. An approach that can be used to improve students' creative thinking skills in learning is by providing open-ended questions. The purpose of this study was to obtain a description of (1) the mathematical creative thinking abilities of male students in solving open-ended questions on straight-line equations and (2) the mathematical creative thinking abilities of female students in solving open ended questions on straight line equations. This research method is descriptive qualitative. Data was collected using test methods and interview methods. The written test in this study was in the form of a Mathematical Ability Test (TKM) which was adapted from validated SMP National Exam questions with a selection of questions covering material for grades VII and VIII in odd semesters. Apart from that, the written test in this study was also a Problem-Solving Test (TPM) containing open-ended questions on straight-line equations. While the interview method was carried out after the students who were selected as research subjects took tests. The data collected was then analyzed qualitatively. The results showed that female students were only able to meet the fluency creative thinking ability indicators. However, female students did not meet the flexibility and novelty indicators. Thus, female students are included in the less creative category based on the level of students' mathematical creative thinking ability according to Siswono. Meanwhile, male students met the fluency and novelty mathematical creative thinking ability indicators. Thus, male students are included in the creative category based on the level of ability to think creatively mathematically according to Siswono.

Keywords: *Creative Thinking Ability, Middle School Students, Open Ended Questions, Straight Line Equations, Gender*

Introduction

The ability to think creatively is an ability that is needed in the 21st century. This is because the development of technology and information cannot be separated from the ability to think creatively. The development of technology and information today is the fruit of the ability to think creatively (Khasawneh et al., 2021). The

development of information-communication technology, social media, limited natural resources, and uncertain changes require the ability to think creatively (Schoevers et al., 2022). The ability to think creatively encourages humans to live better in increasingly limited environmental conditions. The complexity of social problems is a challenge that requires the ability to think creatively to deal with them. This requires the ability to think creatively in dealing with and overcoming social problems that occur. Creative thinking is also one of the abilities currently desired in the world of work (Ciani et al., 2023). This is in line with the Career Center Maine Department of Labor USA (2004) which explains that the ability to think creatively is also one of the abilities desired by the world of work. The survey results on the skills needed in the world of the workplace the ability to think creatively among the top four skills important in business. Thus, the ability to think creatively is very important for every individual (Maskur et al., 2020).

Creative thinking is a mental activity that is used by someone to develop new ideas or ideas (Rizqi et al., 2021). Ideas in the sense here are ideas in solving or solving problems correctly and according to their requests. Creative thinking is seen as the ability to think logically and intuitively (Lusiana & Andari, 2022). This is in line with Harriman's opinion (2017) that creative thinking is a thought that tries to create new ideas. (Kharisma Isrozia Kusumawardhany et al., 2022) also explain that creative thinking is the ability to develop ideas that are unusual, quality, and appropriate to the task. Based on some of these opinions, it can be seen that creative thinking is a process that develops unusual ideas and generates new thoughts. Creative thinking does not only occur in certain fields, such as art, literature, or science but is also found in various fields of life including mathematics (Leikin & Elgrably, 2020). Creative thinking in mathematics refers to the notion of creative thinking in general. The ability to think creatively in mathematics or often called the ability to think mathematically is the ability to think that aims to create or find new ideas that are different, unusual, or original which bring definite and precise results. This is in line with the opinion of (Xu & Qi, 2022) who defines the ability to think creatively mathematically as the ability to find solutions to mathematical problems easily and flexibly. Meanwhile, (Musa & Maat, 2021) explains that mathematical creative thinking refers to the ability to generate various new solutions to open-ended mathematical problems. Based on some of these opinions, it can be seen that the ability to think creatively mathematically is the ability to generate new ideas in finding varied and valid solutions to a mathematical problem (Widyastuti & Jusra, 2022).

The definition of creative thinking ability in mathematics above shows that learning mathematics plays a role in growing and emphasizing creative thinking abilities. This is in line with Ministerial Regulation Number 22 of 2006 so that students through learning mathematics can have the ability to think creatively (Schoevers et al., 2018). However, the facts show that students' mathematical creative thinking abilities are low. Based on the results of the Trend International Mathematics and Science Study (TIMMS) it is stated that the level of student's creative thinking skills in Indonesia is low because only 2% of Indonesian students can work on high and advanced category questions that require the ability to think creatively in solving them (Damayanti & Sumardi, 2018). The low ability of students' creative thinking was also found in research (Sahliawati & Nurlaelah, 2020) which stated that students' ability to think creatively in terms of originality, fluency, flexibility, and sensitivity at the State Madrasah Tsanawiyah (MTsN) Cikembar, Sukabumi Regency was classified as low. Research conducted by (Retnawati, 2019)also found that students' creative thinking abilities in terms of fluency, flexibility, originality, and detail at Madrasah Aliyah Negeri (MAN) 1 Pontianak were also low. These facts show that students' creative thinking abilities in Indonesia are still relatively low and need to be improved, especially in learning.

The low level of student's creative thinking skills in Indonesia is caused by learning, including learning mathematics, which does not provide opportunities for students to find answers or ways that are different from what educators have taught. This is because learning mathematics in class still emphasizes students' understanding without involving creative thinking skills. Students are not allowed to get answers or ways that are different from what the teacher has taught (Retnawati, 2019). Teachers often do not let students construct their own opinions or understanding of mathematical concepts. Teachers generally do not present exercises for students to think creatively because

each exercise given is only result-oriented regardless of how the process is carried out by students. While students themselves are not familiar with exercises or questions that require creative thinking to answer them. If students' thinking space is limited, students thinking skills do not develop (Monrat et al., 2022). One of the causes of this is that the teacher has not taken the right learning approach to improve students' creative thinking skills.

One approach that can be used to improve students' creative thinking skills in learning is by providing open-ended questions. This is in line with the opinion of Getlezs and Jackson who argued that one of the efforts to improve the ability to think creatively mathematically in learning is to provide open-ended problems or open-ended problems (Harmini et al., 2020). An approach using open-ended problems or questions has developed in Japan (Sproesser et al., 2022). The use of investigations, namely a kind of open-ended method, developed in England. Open-ended questions are questions that have more than one way or method of solving or the solution has a non-single answer. Line (Suherman & Vidákovich, 2022) explains that the notion of an open-ended problem can be formulated as a mathematical problem or problem formulated in such a way that it has several or even many correct solutions and there are many ways to reach that solution. The main goal is not to get answers but more emphasis on how to arrive at an answer. (Yunita et al., 2020) explain that the teacher's job is to develop students' creative thinking abilities, among others by giving assignments more often or asking open-ended questions. Open-ended questions in mathematics can be found in various materials, one of which is straight-line equations. In straight-line equations, there are infinitely many lines that pass through 1 point, making it possible to create an open-ended problem that has many answers or ways of solving it. This can encourage students' creativity in solving open-ended questions because it can produce multiple answers and multiple ways according to students' creative thinking abilities. In addition to the type of problem approach used, gender is one of the factors that influence the level of student's creative thinking abilities.

Gender which is one of the factors that influence the level of students' creative thinking ability is reinforced by the statements of several experts. (Suherman & Vidákovich, 2022) explain that women are vulnerable to problems related to abstracts, so women are considered weak and incapable of learning mathematics. However, this is contrary to the opinion of (Khasawneh et al., 2021) which states that the learning achievements of male and female students are equally good. (Schoevers et al., 2022) that girls are good at thinking in terms of accuracy and thoroughness, in contrast to male students who tend to be less precise and tend to get things done quickly. This shows that the creative thinking of male and female students is different, as well as the level of creative thinking. This statement is also reinforced by the opinion of (Maskur et al., 2020) which states that gender differences are no longer only related to biological problems but then develop into differences in abilities between men and women. So, the gender difference in this study is a difference in the level of mathematical creative thinking ability that exists in male and female students. Based on this background, the purpose of this study was to determine the mathematical creative thinking skills of junior high school students in solving open-ended questions on straight-line equations material in terms of gender.

Method

This research uses qualitative research with descriptive type. The subjects of this study were class VIIIG junior high school students at SMPN 1 Bangkalan, Jl. Trunojoyo No. 2, RW. 01, Pejagalan, Kec. Bangkalan, Kab. Bangkalan, Madura. This research was conducted on April 14, 17 and 18, 2023. The subjects of this study consisted of 1 female student and 1 male student with equivalent mathematical abilities.

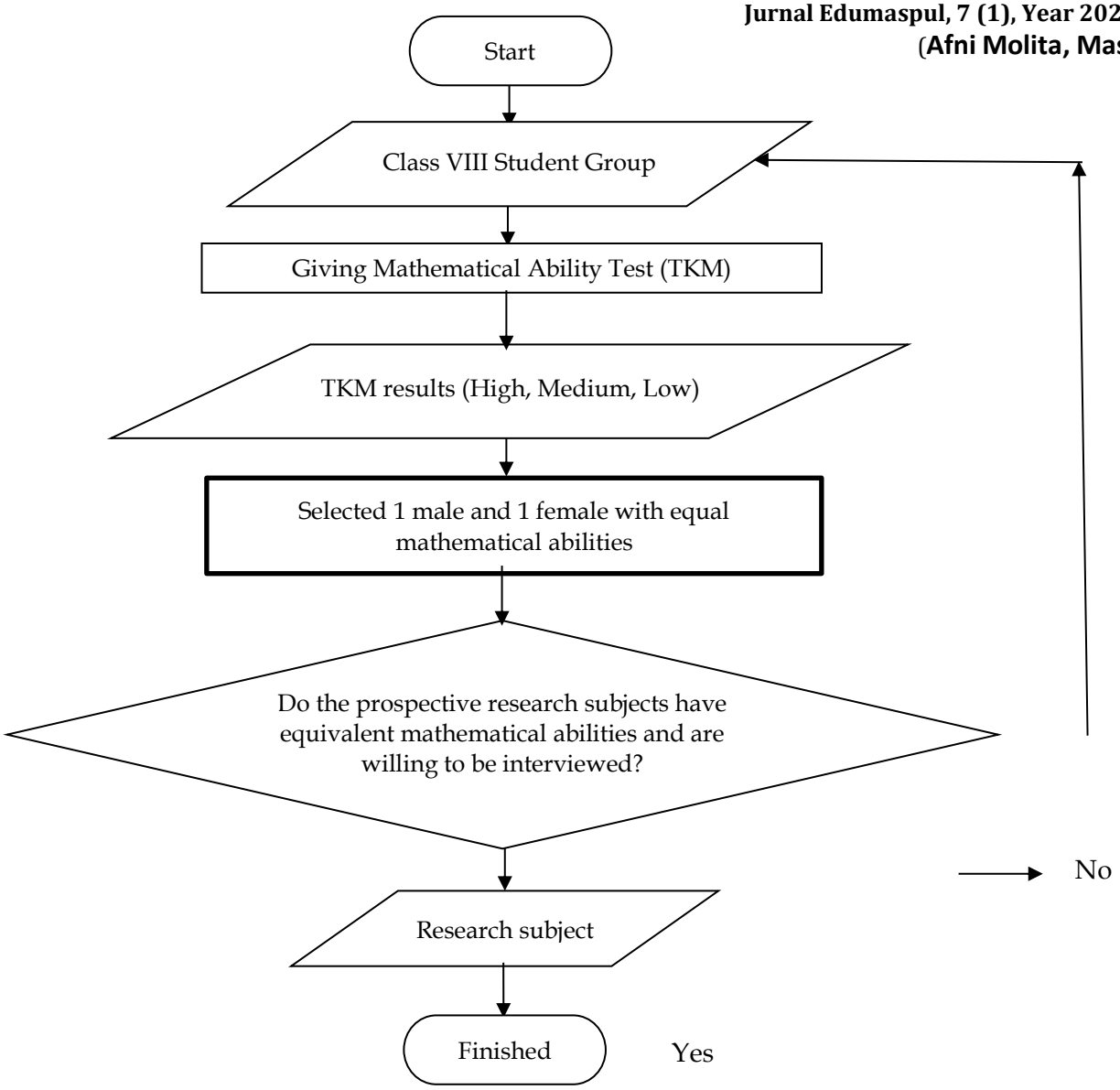
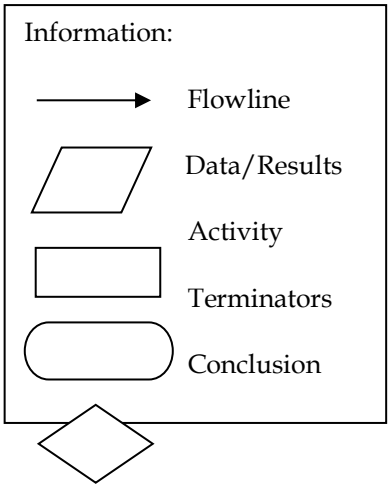


Figure 1. Research Subjects



The subject of this study was taken based on the results of the Mathematics Ability Test (TKM) given to the Grade VIII students and based on the teacher's recommendations for communicative students. The selected subjects were then given an open-ended question test. After working on the test questions, the subject was then interviewed to

find out more about his mathematical creative thinking abilities.

The data collection method was carried out using the test method (the written test in this study was also in the form of a Problem-Solving Test (TPM) containing open-ended straight line equation questions as much as 1 description item which contained aspects of fluency, flexibility, and novelty) and interviews (Mathematics Ability Test and Problem-solving). The data analysis method used is the research technique according to Miles and Huberman, namely data reduction, data display, and conclusion drawing/verification.

Results and Discussion

Results

This research uses the Mathematical Ability Test (TKM) that the researchers adapted from the SMP National Examination questions that have been validated by selecting questions that cover odd semester class VII and VIII material. The Mathematics Ability Test (TKM) was administered to 27 students in class VIIIG at SMPN 1 Bangkalan. Following are the results of the total score of the Mathematical Ability Test (TKM) for each class VIIIG student at SMPN 1 Bangkalan as presented in Table 1. below.

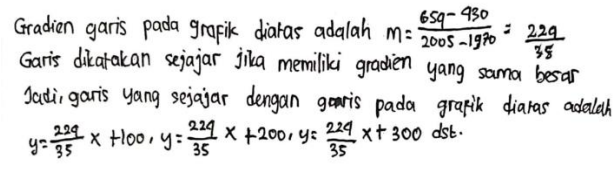
Table 1. TKM Score Results for VIIIG Students at SMPN 1 Bangkalan

No.	Student's initials	Student Gender	Total Student TKM Score
1	**SB**	**L**	**100**
2	AN	L	95
3	AK	P	100
4	sl	P	90
5	**Dr**	**P**	**100**
6	AR	L	100
7	RA	P	50
8	US	L	80
9	FG	P	50
10	sl	P	30
11	DB	P	65
12	HW	P	50
13	sy	P	30
14	NM	P	50
15	SR	P	100
16	AF	L	50
17	AM	P	95
18	WS	P	100
19	WM	L	40
20	AJ	L	90
21	DT	L	100
22	MD	L	80
23	RR	L	90
24	MP	L	90
25	MM	L	100
26	DS	L	80
27	Dr	P	80

Based on the TKM score table for each class VIII student above, 18 students with the high ability (T), 1 student with moderate ability (S), and 8 students with low ability (R) were obtained. Based on the teacher's recommendation, communicative students were selected to be the subjects of this study, namely 1 male student (SL) and 1 female student (SP) with equal high ability (T). Based on the TKM score table for class VIIIG, SB was chosen as a male subject (SL) and DR as a female subject (SP). Following are the results of the Problem Solving Test (TPM) and interviews of each research subject which were analyzed based on

indicators of mathematical creative thinking ability, namely fluency, flexibility, and novelty.

Results of TPM Male Subjects (SL)



To determine the equation of another line parallel to the line on the graph, SL can only use one solution. However, the unique method of solving used by SL includes methods that have not been taught in schools. SL first looks for the magnitude of the gradient of the line on the graph. SL uses the gradient that has been obtained to determine three other line equations that are parallel to the line on the graph using the gradient obtained to become the coefficient of the variable x which is then added a constant because SL knows that lines are said to be parallel if they have the same gradient. So, three other equations of lines that are parallel to the lines on the graph y= $\frac{224}{35}x$+100 , y= $\frac{224}{35}x$+200, dan y= $\frac{224}{35}$x+300. After completing the open-ended questions on the Problem Solving Test (TPM), then SL was interviewed directly by the researcher (PP) with the following interview results

Table 2. Transcript of SL Interview with Researcher (PP)

P/S	Interview	Code
PPU1	“Have you ever solved a problem like this before?”	(U)
SLU1	"Never"	
PPU2	“Do you understand the problem asked in the question?”	(U)
SLU2	"Yes"	
PPU3	"What is known in the problem?"	
SLU3	“Line on the graph and coordinate points crossed”	
PPU4	"What is asked in the problem?"	
SLU4	"3 equations of parallel lines"	
PPU5	"How can you provide more than one answer to the problem in the open ended question?"	(U)
SLU5	"Use the formula to find the gradient of a line to use as the gradient of another parallel line"	
PPU6	"Why is that?"	
SLU6	"Because the conditions parallel to the gradient are the same, so all you have to do is add the constants"	
PPX7	"How many solving strategies did you use to solve the open ended questions?"	(X)
	"One"	
SLX7	“What is your strategy for finding alternative answers like that?”	
PPX8	"Because what you are looking for is the equation of lines that are parallel so the	(X)
SLX8	gradient is the same, so use the formula to find the gradient of the line"	
	“Are there any other settlement strategies besides the one you used?”	
	"Maybe there is"	
PPX9	“Have your settlement strategies ever been taught in school?”	(X)
SLX9	"Don't know"	
PPV10	“What is your reason for using a settlement strategy like this?”	(V)
SLV10	“Because it's simple”	
PPV11		(V)
SLV11		

Analysis of Answers Based on Indicators of Mathematical Creative Thinking Ability

Fluency indicator

Based on SL's answer, it can be seen that SL fulfills the fluency indicator. This is because the SL is capable solve problems by giving many answers to problems in the open-ended questions given. This can be seen from SL's answer which can provide three other equations of lines parallel to the lines on the graph y= $\frac{224}{35}x$+100 ,

y= $\frac{224}{35}x$+200, dan y= $\frac{224}{35}$x+300. This was reinforced by the results of SL's interviews with researchers who said that SL had never solved a problem like that before but understood the problem being asked so that she was able to provide many answers to the problem in open-ended questions which were given by using the formula for finding the gradient of a line to be used as a gradient line. others are parallel. Because, according to SL, the conditions for parallel gradients are the same, so all you have to do is add the constants.

Flexibility Indicator

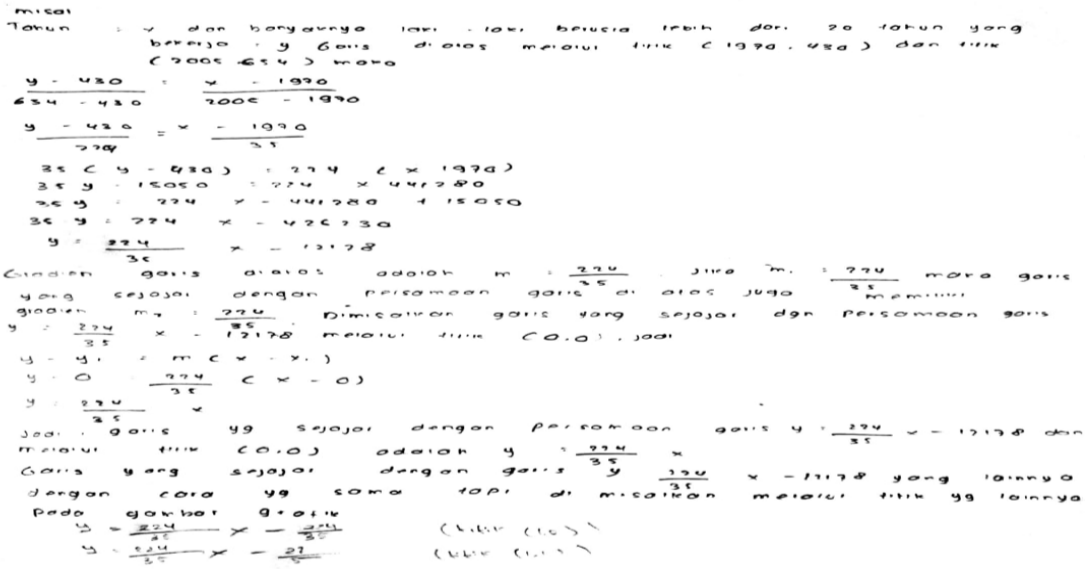
Based on SL's answer, it appears that SL does not meet the flexibility indicator. This is because SL is not able to use various ways of solving problems but only uses 1 method of solving problems in solving the given open-ended questions. SL first looks for the magnitude of the gradient of the line on the graph. SL uses the gradient that has been obtained to determine three other line equations that are parallel to the lines on the graph because SL knows that lines are said to be parallel if they have the same gradient. This was reinforced by the results of SL's interviews with researchers who stated that SL was only able to provide one solution strategy and was not sure whether there was another solution strategy than what he did that could be used in solving the open-ended questions given.

Novelty Indicator

Based on SL's answers, it can be seen that SL meets the novelty indicator. This is because can make a solution that is new and different from the way of solving that is taught in general in schools solving problems in the open-ended questions given. This can be seen from SL's answer in looking for several other lines parallel to a line, then SL only looks for the magnitude of the gradient and adds it with a constant which in other words shifts the lineup. This is because SL assumes that the terms of a line are said to be parallel if the lines have the same gradient magnitude, so SL only looks for the magnitude of the gradient of a known line which will then be the coefficient of the variable x in the equation of other parallel lines and adds it with a constant.

Thus, based on the level of students' creative thinking ability according to Siswono, SL is included in the creative category. This is because SL is only able to show fluency and novelty only in solving open-ended problems.

TPM Results of Female Subjects (SP)



To determine the equation of another line that is parallel to the line on the graph, SP can only use one solution method that has been taught at school. This SP first determines the equation of the line on the graph by substituting the two points passed by the line on the graph, namely (1970, 430) and (2005, 654) into the formula $\frac{y-y_1}{y_2-y_1}=\frac{x-x_1}{x_2-x_1}$, so that SP gets the equation line on the chart y= $\frac{224}{35}x-12178$.

From these equatins known as gradien line on the charts $\frac{224}{35}$. This information is used to find the equation of another line parallel to line k by substituting the gradient and one of the points through which another parallel line passes line on the chart suppose the point (0,0) so that another parallel line equation is obtained line on the chart that is $y = \frac{224}{35}x$. Then, SP mentions that to get the equation of a line parallel to line on the chart others use the same method but with examples of other crossed points on the graph.

After completing the open-ended questions on the Problem Solving Test (TPM), then SP was interviewed directly by the researcher (PP) with the following interview results.

Table 3. SP interview transcript with the researcher (PP)

P/S	Interview	Code
PPU1	“Have you ever solved a problem like this before?”	(U)
SPU1	"Once, but the problem is different, just the same way of solving it"	(U)
PPU2	“Do you understand the problem asked in the question?”	
SPU2	"Yes"	
PPU3	"What is known in the problem?"	
SPU3	“2 points crossed by a line”	
PPU4	"What is asked in the problem?"	
SPU4	"3 equations of parallel lines"	
PPU4	"How can you provide more than one answer to the problem in the open ended question?"	(U)
SPU5	"Matching with the formula to determine the equation of a straight line through 2 points"	
PPX5	"How many solving strategies did you use to solve the open ended questions?"	(X)
	"One"	
SPX5	“What is your strategy for finding alternative answers like that?”	
PPX6	"I see what is known and what is asked, then look for the appropriate formula and	(X)
SPX6	substitute it"	
	“Are there any other settlement strategies besides the one you used?”	
PPX7	“There must be, but I usually that's all”	(X)
SPX7	“Have your settlement strategies ever been taught in school?”	
PPV8	"Yes, she was taught by Mrs. Sari (mathematics teacher for class VIIIG)"	(V)
SPV8	“What is your reason for using a settlement strategy like this?”	
PPV9	“Because it can be used”	(V)
SPV9		

Analysis of Answers Based on Indicators of Mathematical Creative Thinking Ability

Fluency indicator

Based on SP's answers, it appears that SP meets the indicators of creative thinking fluency. This is becauseSPcapablesolve problems by giving many answers to problems in the open-ended questions given. This can be seen from SP's answer which can provide three other equations of lines that are parallel to the lines on the graph, namely using the way he did but with the example of another crossed point on the graph. This was reinforced by the results of SP's interviews with researchers who said that SP had solved similar problems so that they understood the problems asked in the questions which enabled SP to solve the open-ended questions given by matching the formula to determine the equation of a straight line through 2 points.

Flexibility Indicator

Based on SP's answers, it can be seen that SP does not meet the flexibility indicator because SP is unable to use various ways of solving problems but only uses 1 way of solving problems in solving the given open-ended questions. SP only uses a way of substituting the two points passed by the line on the graph into the formula

$\frac{y-y_1}{y_2-y_1}=\frac{x-x_1}{x_2-x_1}$, so that the equation is obtained the line on the chart. From these equations will be known gradient that line will be used to find the equation of another line parallel to line k on the graph. This was reinforced by the results of SP's interviews with researchers who said that SP was only able to provide 1 solution strategy and could not provide other resolution strategies than what he did in solving the open-ended questions given.

Novelty Indicator

Based on SP's answer, it can be seen that SP also does not meet the novelty indicator because SP is unable to make a solution that is new and different from the way of solving that is taught in general in schools solving problems in the open-ended questions given. SP only provides solutions as exemplified by the teacher in class learning when the teacher explains and gives examples of how to determine the equation of another line that is parallel to a straight line. This was confirmed by the results of SP's interview with the researcher who said that the strategy he used had been taught by a mathematics teacher in a previous class.

Thus, based on the level of students' creative thinking ability according to Siswono, SP is included in the less creative category. This is because SP is only capable shows indicators of fluency in solving open-ended problems.

Discussion

Based on the results of the data analysis that the researchers had done, the data showed that male students met the fluency and novelty mathematical creative thinking ability indicators so male students were included in the creative category based on the level of ability to think mathematically creatively according to Siswono. Meanwhile, female students were only able to meet fluency indicators and were included in the less creative category based on the level of students' mathematical creative thinking ability according to Siswono. This is reinforced by research conducted by (Sproesser et al., 2022) which shows that differences in the mathematical creative thinking abilities of male and female students lie in the novelty indicator. Female students have not been able to meet the novelty indicator, this is different from the male students who can meet the indicator. The results of this study are also in line with research conducted by (Monrat et al., 2022) which states that there are differences in the ability to think creatively between male and female students. This difference lies in the novelty indicator. Female students have not been able to show novelty indicators, while male students have been able to show these indicators. Therefore,

However, this is different from the results of research conducted by (Retnawati, 2019) which stated that the creative thinking abilities of female students were superior to male students.Similar results were also put forward by (Musa & Maat, 2021), which statedthe mathematical creative thinking abilities of female students are superior to the mathematical creative thinking abilities of male students in solving problems on sequences and series material. This is also reinforced by research conducted by (Xu & Qi, 2022), whichexamined the profile of creative thinking abilities of junior high school students in terms of the level of math anxiety and gender. Research result (Lusiana & Andari, 2022) stated that female students were superior to male students, because female students were able to fulfill all indicators of the ability to think creatively mathematically and male students were only able to fulfill the fluency and flexibility indicators..This certainly contradicts the results of this study which show that male students' creative thinking skills are superior to female students. This can be seen from the results of students' answers in solving open-ended questions on the Problem Solving Test (TPM) which show that male students are included in the creative group, while female students are included in the less creative group. Based on the level of students' creative thinking ability according to Siswono.

Based on the results of data analysis and reinforced by the results of previous studies, it can be concluded that there are differences in the ability to think creatively mathematically between male and female students.

Conclusion

Based on the results of data analysis and discussion conducted by researchers, it can be concluded that female students are only able to meet the fluency creative thinking ability indicators. However, female students did not meet the flexibility indicator because they were not able to use various ways of solving problems but only used 1 way of solving problems in solving the open-ended questions given. Female students also do not meet the novelty indicator because they are not able to make a solution that is new and different from the way of solving that is generally taught at school in solving problems in the open-ended questions given. Thus, female students are included in the less creative category based on the level of students' mathematical creative thinking

ability according to Siswono. Meanwhile, male students met the fluency and novelty mathematical creative thinking ability indicators.

This is because male students can solve problems by giving many answers to problems the open-ended questions given and can make a solution that is new and different from the way of solving that is generally taught at school in solving problems in the open-ended questions given. Thus, it can be said that there are differences in the level of mathematical creative thinking ability between male students and female students so gender can affect the level of students' mathematical creative thinking ability. Thus, male students are included in the creative category based on the level of ability to think creatively mathematically according to Siswono.

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Author Profile

Afni Molita is a student of the Mathematics Education Study Program in the Department of Mathematics at the Faculty of Mathematics and Natural Sciences at Universitas Negeri Surabaya.

Masriyah is a full-time lecturer and is the Deputy Dean for general affairs and finance at the Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya. In the last 1 year, taught 8 courses namely Assessment of Learning Processes and Results, Fundamentals of Mathematics, School Mathematics, School Mathematics and Its Teaching (School Mathematics and Its Teaching), Microteaching, Innovative Learning II, Learning Design and Evaluation (Learning Design and Evaluation)), and Mathematics Education Seminar. Has done 7 services. Has published 196 Scientific Articles in journals. Became 13 scientific seminar speakers. Obtained 1 Intellectual Property Rights.