International Journal of Religion
2024
Volume: 5| Number 10 | pp. 1935 – 1951
ISSN: 2633-352X (Print) | ISSN: 2633-3538 (Online)
ijor.co.uk
DOI: https://doi.org/10.61707/7grmnb30

A Critical Thinking Profile Based on Sex Differences: A Case Study on High School Students in Palu City, Indonesia

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Abstract

This study aims to describe students' critical thinking in solving derivative problems in terms of gender. The subjects in this study were male students, S1 and female students, S2 who had high mathematical abilities. This type of research is a descriptiv research with a qualitative approach. The research instrument consists of the main instrument (researchers themselves) and supporting instruments including the provision of written assignments and interviews. The results of this study indicate that S1 and S2 in solving derivative problems according to the criteria for critical thinking starting from the indicators of focus, reason, inference, situation, clarity and overview. However, S1 and S2 have different thinking activities, S1 completed the task with a more concise completion in a more logical way of thinking, while S2 completed the task with a longer completion with his verbal abilities with precision. and careful thinking. This shows that even though S1 and S2 have equal mathematical abilities, there are differences in thinking activities in solving problems. These findings are supported by written answer data and interview results. This research provides important insights into the influence of gender on critical thinking in mathematics contexts, which can be used as a basis for developing more effective and inclusive teaching strategies.

Keywords: *Critical Thinking, Derivatives of Algebraic Functions, Genders.*

INTRODUCTION

One of the objectives of learning mathematics (Indonesia) based on Permendiknas Number 22 of 2016 is to solve mathematical problems which include the ability to understand problems, develop models of solving mathematics, solve mathematical models and provide appropriate solutions. In line with these learning objectives, the National Council of Mathematics Teachers (NCTM) states that there are five standards of mathematical ability that students must possess, one of which is problem solving ability. Based on the learning objectives and previous mathematical ability standards, it can be concluded that problem solving activities are an important part of learning mathematics. In addition, one of the most important aspects of education in the world is thinking skills in problem solving (Radulović & Stančić, 2017). The problems themselves are considered a basis that provides the opportunity for a person to highlight his creative and critical potential, given that our daily life is nothing but an endless series of many and complex problems and situations that require the employment of higher mental skills, as it is always difficult to solve all problems in the same way or ways (Al-massarweh, et.al., 2024). Good problem solving can be done if someone has the ability to think critically. This is in line with previous research (Pascarella, et.al., 2014; Pascarella & Terenzini, 2005; Mahmuzah, 2015; Saputra, et.al., 2019; Wahidin & Romli, 2020;) states that students who have the ability to think critically good will solve the problem properly and effectively.

The demands of 21st century learning encourage teachers to deliver learning, one of which fulfills higher-order thinking competencies including critical thinking (Zivkovil, 2016). Critical thinking is one of the most important skills in the 21st century for everyone (Changwong, 2018; Lamb, 2017; Cheng, May, & Wan, 2017; Chen, Tolmie, & Wang, 2017; Vieira & Tenreiro-Vieira, 2016; Moeti, et.al, 2016; Alismail & Mcguire, 2015; Atabaki, Keshtiaray & Yarmohammadian, 2015; Bell & Loon, 2015; Brown; 2015; Beers, 2011; Binkley, et.al., 2010; Ramdani, 2022 ; Basri, et.al., 2019; Purnami, et.al., 2021). Critical thinking denotes the capacity to impartially analyze information, think logically and coherently, and render reasoned judgments (Irwanto, et.al., 2024).

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Critical thinking is students' ability to find information, facts and events through logical thinking (Choiriyah, Mayuni & Dhieni, 2023). Critical thinking is characterized by thinking activities that comprehensively explore existing problems, ideas, and concrete evidence (Rhodes, 2010). Cowden & Santiago (2016) further explains that critical thinking skills originate from constructivist learning theory with a focus on enhancing students' learning experiences in the process of their thinking activities.

Researchers formulate several definitions of critical thinking. Critical thinking is logical thinking and focuses on making decisions about what to believe or do (Ennis, 2011). Critical thinking is a person's ability to understand concepts, synthesize, and evaluate information (Dekker, 2020; Florea & Hurjui, 2015). Critical thinking is a goal-directed thinking with involvement in decision making, interpretation, or problem solving (Halpern, 1998). Critical thinking is a skill that students can develop in parallel (Abrami, et.al., 2008; Monteiro, et.al., 2020). Critical thinking is a skillful and responsible thinking activity that facilitates good judgment because it is based on criteria and sensitive to context (Lipman, 2003). In addition, critical thinking is also defined as the ability to absorb and filter existing phenomena (Facione, 1990).

Furthermore, some experts also provide different opinions on indicators of measuring critical thinking skills. The five dimensions of critical thinking are verbal reasoning, argument analysis, thinking as hypothesis testing, likelihood and uncertainty, and decision making and problems (Halpern, 2012). There are six components of critical thinking according to Facione (1990), namely Interpretation, Analysis, Evaluation, Inference, Explanation, and Self-Regulation. The components of critical thinking skills as FRISCO: focus, reason, inference, situation, clarity and overview (Ennis, 1991).

Critical thinking skills train students to think with focus, namely being able to determine the information contained in a problem accompanied by the right reasons and being able to determine the right strategy in solving a problem. Students' strategies in solving problems vary, one of which is the difference in their gender. In critical thinking skills male students showed more ability in inference and interpretation skills than female students (Kumar & James, 2015). This is supported by research related to mathematics, which states that the thinking abilities of male students in mathematics and the academic field are different from female students (Pargulski & Reynolds, 2017; Rasyid, Budiarto & Lukito, 2018). National Council of Teachers of Mathematics (NCTM), namely "Several researchers have found that boys tend to use newer problem-solving strategies, while girls are more likely to use newer problem-solving strategies (Ganley & Lubienski, 2016). Following the procedures taught in school.

The results of several studies conclude that male students and female students tend to differ in problem solving strategies (Ganley & Lubienski's paper, 2016). Male students tend to use unusual problem-solving strategies, namely unique strategies that are not tied to routine procedures, while female students tend to follow more problem-solving procedures taught at school. In addition, the results of Bitara's research (2021) concluded that male students in planning solutions are more targeted, meaning that they can solve problems with shorter procedures, think of exam strategies that rely on logical thinking skills and mental calculation skills. In contrast, female students tend to think of longer and more convoluted solving strategies.

Mathematics and critical thinking cannot be separated from one another (Innabi & Sheikh, 2007; Aizikovitsh & Amit, 2011). In learning mathematics we need a higher order thinking activity, one of which is critical thinking. One of the mathematical materials that requires critical thinking skills and is related to everyday life problems is the material for the derivative of algebraic functions, namely the application of derivatives in determining the maximum and minimum values of a function. Derivative material is important material, because the knowledge is useful for students in real life, but some students sometimes experience difficulties in solving problems in applying derivatives because of their low or lack of students' critical thinking skills. Students' weaknesses in solving problems are the main cause of students' difficulties in derivative learning (Hashemi, et.al, 2019). This provides an understanding that students' difficulties in derivative learning are caused by the weak ability of students to solve problems and one of the factors that influence it is the competence of students' critical thinking skills (Mashami & Gunawan, 2018). Based on the description of the problems above, in this study the components of critical thinking skills were used based on FRISCO indicators, because they were

considered more suitable to the problems that had been described. Therefore, the purpose of this study was to describe the critical thinking profile of high school students in Palu City based on gender differences.

Methodology Section

This section discusses the research design that was undertaken in answering the problems. It also presents the respondents involved in the study, the different instruments used in gathering data, and the statistical tools to analyze and interpret the gathered dataDr. Robert Arasa, 2020).

Research Goal

This study describes the critical thinking of students with high mathematical abilities in solving derivative problems based on gender differences. In this research, we reveal students' critical thinking by first asking the subject to complete the task of understanding derivatives. in focus group discussions. Based on this data, we explore students' discourse in completing derivative assignments and then analyze it in more detail and depth. Therefore, this study examines how the critical thinking profile of students with high mathematical abilities in solving derivative problems in terms of gender differences.

Sample and Data Collection

The subjects of this research were Model Madani High School students with high mathematical abilities, men and women. The determination of the subject is based on the high mathematics ability category obtained from the even semester exam scores for mathematics subjects. The criteria for students who have high mathematical abilities are if the student's score is ≥ average $(\bar{x}) + standard\ Deviation\ (SD)$. The calculation results show: SD = 3.43; Average $(\bar{x})$ = 83.56 ; so 83.56 + 3.43=86.99 ≈ 87. Based on these calculations, a list of students who meet the categories is obtained, in Table 1.

After obtaining the results of these calculations, CJC was chosen as the male subject with high mathematical abilities and AAS as the female subject with high mathematical abilities. The selection of the subject was based on the considerations of the mathematics subject teacher in the class with the consideration that the student had good communication and was willing to work together from the beginning to the end of the research.

Using a 5% margin of error, the computed sample size (n) was approximately equal to 121.25 which was rounded to 121. Hence, 121 mathematics teachers were considered as actual sample size of this study.

Moreover, to ensure that all mathematics teachers from the three schools divisions were given fair chances of becoming part of this study, proportionate stratified random sampling method was used.

Table 1 summarizes the total number of junior high school teachers from the three schools divisions involved in the study.

Table 1. List of Students Who Meet the High Mathematical Ability Category.

Number	Initials	Student Scores
1.	AAS	88
2.	CJC	91
3.	MJ	90
4.	NDCS	88
5.	PJB	89
6.	ZGA	88

Instrumentation and Data Collection Procedure

The supporting data collection tools are 1) human instruments which function to determine research focus, determine research location and time, select research subjects, carry out data collection, prepare research instruments, and analyze data, 2) written assignments containing problems related to derivative applications about problems the maximum and minimum values of a function, which are compiled based on critical thinking indicators based on Ennis. The task is diagnostic, meaning that the researcher wants to know the description of students' critical thinking through the problems given. 3) Semi-structured interviews consist of several questions that have been designed as reference materials or guidelines during the interview. These questions

can be changed at any time or adapted to the circumstances during the interview. The purpose of conducting interviews is to clarify some information obtained through the task previously given. 4) Voice recorder and video recorder to record student activities when solving problems, so that all information is recorded properly.

Data Analysis

The data analyzed in this research are interview transcripts, subject test results, and field notes. We followed the three stages of qualitative data analysis by Miles et al. (2014), namely: 1). Data condensation refers to the process of selecting, simplifying, abstracting, and/or transforming data that approaches the entirety of written field notes, interview transcripts, documents, and other empirical material related to critical thinking.

Data condensation is carried out during the research, during research in the field, until the report is prepared. Thus, the data obtained by researchers through problem solving tasks and interviews is condensed by selecting and focusing the data on things that suit the critical thinking process. 2). Data presentation, gathering organized and compressed information that allows conclusions and actions to be drawn. Data presentation aims to simplify complex information into simple data so that it is easier to understand. At this stage, after the data is arranged sequentially, the researcher processes the data and then presents it in sentence form. The data presented in this research are data regarding descriptions of students' critical thinking in solving problems of maximum and minimum function values and condensed interview results. 3). Drawing Conclusions The researcher analyzed the data and described the data about students' critical thinking as conclusions from data that had been processed and were final so that the data could be understood and clear according to the research objectives.

RESULTS

The results obtained in this study are a description of the critical thinking of male students (S1) and female students (S2) in solving derivative problems based on Ennis' critical thinking indicators.

Exposure of data Subject 1

In this section, S1 data will be presented in solving derivative problems (M1) through the results of answers and interviews based on critical thinking indicators.

Focus

S1's written answer in mentioning the information known, asked and the completeness of other information on M1, is as fol

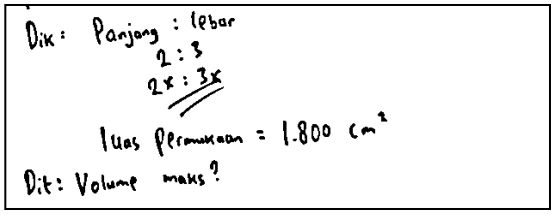


Figure 1. S1 Written Answer in Mentioning Information that Known, Asked and Completeness of Other Information on M1

Based on the picture above, it can be seen that S1 wrote that what is known in the problem is the ratio of length and width, each of which is 2:3, the surface area is 1800 cm2. Then write down that what is being asked is the maximum volume of a block-shaped aquarium without a lid.

The following are the results of the S1 interview in mentioning the information that is known and asked about the problems that have been condensed.

PM1-03 : "From that problem, what do you understand or what is known?"
SIM1-04 : "It is known that the width appeal length is 2 to 3 or can be concluded to be 2x to 3x"

PM1-05 : "From these questions, what are the questions?"

S1M1-06 : "Asked for maximum volume"

PM1-07 : "Is there any more information?"

S1M1-08 : "(pause and look back at the problem) The surface area is 1800 cm2 and the aquariumhas no cover."

After reviewing the answers and interview data, it can be concluded that on the focus indicator, S1 first identifies what is known (SIM1-04), then identifies what is being asked (S1M1-06), and finally identifies the completeness of other information. required for troubleshooting (S1M1-08).

Reason

The written answer of S1 in stating the reason for each step of the work and the reason for the conclusion of the answer on M1, is shown as follows.

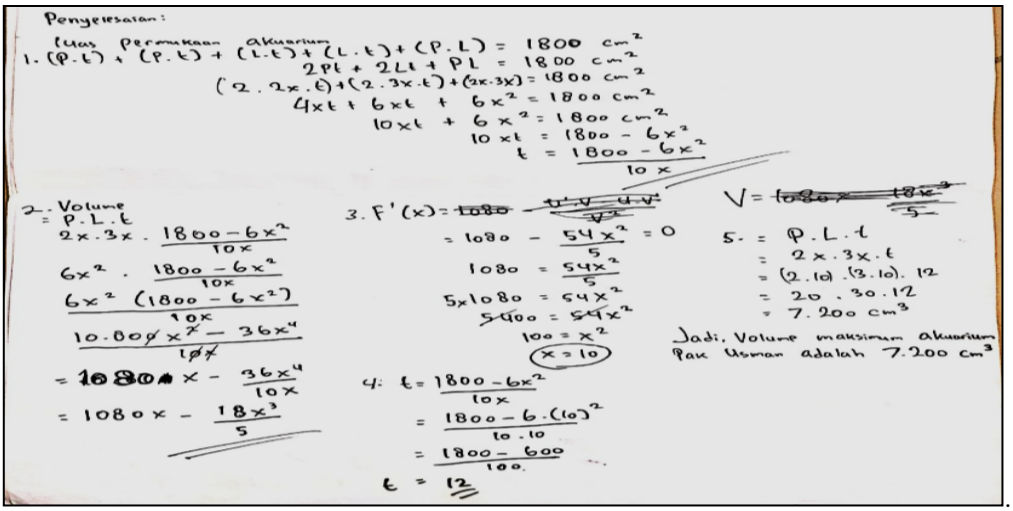


Figure 2. S1 Written Answers in Stating the Reasons for Each Step of Work and Reasons for the Conclusion of the Answers on M1

Based on the picture above, it can be seen that S1 wrote step by step to get the answer to the question. The first step is to formulate the surface area of the beam without cover and get the t (height) equation, then in the second step formulate the volume of the beam, then in the third step use the stationary conditions in the previous beam equation and get the value x = 10, then in the fourth step substitute x = 10 to the t (height) equation, and the last step is to substitute the value of x into the volume equation and conclude the final result.

The following is a transcript of the S1 interview in stating the reason for each step of the work and the reason for the conclusion of the answer.

PM1-13 : *"In step 1 you wrote, why did you use the surface area formula?"*

S1M1-14 : *"Because what is known in the problem is the surface area of the aquarium".*

PM1-19 : *"In step two, please explain how you can get* $1080x - \frac{18x^3}{5}$*?"*

S1M1-22 : *"Oh yes, because the volume of the formula is length times width times height thenfrom the equation of the surface area of the aquarium we get the height, so just put in the formula length times width times height, so the length is 2x times 3x the height obtained earlier* $\frac{1800-6x^2}{10x}$*. Then multiply it and the result is* $1080x - \frac{18x^3}{5}$*."*

PM1-27 : *"In step three, you decrease by* $1080x - \frac{18x^3}{5}$*. What is the reason?"*

S1M1-28 : *"(think for a moment)... Because the condition to know the maximum volume is* $f'(x) = 0$*."*

PM1-38 : "In step 4 (pointing to the answer paper), why did you replace x with 10?"

S1M1-41 : *"So in step 4, because we already know the equation of height, and to find out the height, I replace the x with 10."*

PM1-44 : *"In step 5, you substitute x=10 for length times width times height and the result is 7,200 cm3 and you conclude that is the maximum volume. What is your reason or why you can be sure that it is the maximum?"*

S1M1-45 : *"Because the maximum value is obtained from the derivative condition or* $f'(x) = 0$*, then when I lower I get x it is 10, I just enter the number 10 replacing x from the previous equations containing* x*."*

After analyzing the data from the answers and interviews, it can be concluded that in stating the reasons for each step of M1's work, S1 first looked for the height equation using previously known information, namely the formula for the surface area of the aquarium (S1M1-14), then obtained the equation for the volume of the aquarium by substituting the ratio length and width, then substituting t from the t equation obtained (S1M1-22) then provides an explanation that the volume equation is derived then equated to 0 on the grounds that this is the maximum volume requirement (S1M1-28) to get the value x, then the value of x is obtained is substituted into the height equation to get the height value of the aquarium (S1M1-41), finally substituting the x and t values into the aquarium volume formula and concluding that this is the maximum volume (S1M1-45).

Inference

The following is a transcript of the S1 interview in mentioning or writing down the conclusions drawn in the work step and the conclusions taken in the final answer.

PM1-50 : *"In step 1, why did you conclude to use the surface area formula of the aquarium?"*

S1M1-51 : *"Because what is known here is the surface area of the aquarium so that it is eee,I use it to know the length, height and width"*

PM1-54 : *"Why does the formula go this way? (while pointing to the surface area formula that the subject writes). Can you explain? Or can you describe why it can be like that formula?"*

S1M1-55 : *"Eee, if in that block there are six sides, but because this is an aquarium so there is no one on it, actually let me not write in this matter if the aquarium is without a lid, it could also be because logically the aquarium is without a lid. Then it's sis, so the length times height plus length times height means twice the length times the height, then added width times height plus width times height, so twice the width times the height, continue to add length times width because the aquarium above it does not exist, so only one, length times width."*

PM1-56 : *"Why in step three* $x^2 = 100$ *or* $100 = x^2$*, do you get x=10?"*

S1M1-57 : *"Because both segments are rooted so that √100=10 and* $\sqrt{x^2} = x$*."*

PM1-60 : *"So what about your reasoning regarding the conclusions you used in the final answer?"*

S1M1-61 : *"So sis, with all the steps I did, starting from step 1 to step 5, it can all be done as long as you know exactly what to do first, so if it is wrong from the beginning, it must be wrong to continue to the bottom, so this maximum volume is 7.200 cm³, and I believe it is the maximum, no more, Because I have used stationary conditions, so there is no need for me to hesitate anymore"*

After analyzing the interview data, it can be concluded that in mentioning or writing the conclusions drawn at each step of the process and the conclusions drawn in the final answer, S1 draws conclusions using the surface area formula first compared to using the volume formula (S1M1-51), then draws conclusions regarding the formula for the surface area of the beam without cover used (S1M1-55), then makes a decision using the value x = 10 with reasons he believes (mentally calculating the root of 100 is 10) (S1M1-57), until the final conclusion that S1 is sure 7,200 cm3 is the maximum volume of the aquarium due to the stationary conditions it uses (S1M1-61).

Situation

The following is a transcript of the S1 interview in applying/using the initial knowledge possessed and using

the information provided in the questions.

PM1-62	:	"*Of the many steps or formulas you applied to your answer, what knowledge or skills do you need to answer this question?"*
S1M1-65	:	"*Understand, about the formula for the surface area of the beam, know the volume formula, know how to derive the function or called the derivative, know how to factor, then how to substitute."*
PM1-68	:	"*Have you used all the information on this question in your work?"*
S1M1-71	:	"*Already, it is evident from these steps kak (while showing the answer paper). I use the comparison of length and width in the formula of the surface area of the aquarium and volume, the value of the surface area I also use there, and analyze the problem of the surface area formula if there is no lid."*

After analyzing the interview data, it can be concluded that S1 uses/applies previous knowledge (S1M1-65) and uses all the information provided in the questions (S1M1-71)**.**

Clarity

The following is a transcript of the S1 interview in stating the language/terms contained in the problem or work accurately and clearly**.**

PM1-72	:	"*Next do you understand the meaning of a block-shaped aquarium without a lid?"*
S1M1-75	:	"*Eee, so it's block-shaped, but the base that isn't on it (the cover) is not there"*
PM1-76	:	"*Do you understand the point of the question?"*
S1M2-77	:	"*Got it, sis, we mean we find the largest volume from the aquarium."*
PM1-78	:	"*Do you understand the meaning of the ratio of length and width which is 2 to 3?"*
S1M1-79	:	"*If what I understand means that the length size is smaller than the size of the width"*

After reviewing the results of the interviews, it can be concluded that S1 correctly mentions the language/terms contained in the questions or works (S1M1-75, S1M1-77, S1M1-79).

Overview

The written answer of S1 in stating the reason for each step of the work and the reason for the conclusion of the answer on M1, is shown as follows.

PM1-80	:	"*From every step you take, are you sure there is nothing wrong? How do you check?"*
S1M1-83	:	"*Eee, I just test the x value, sis. I get x = 10, if I replace x in the surface area formula, right 2pt + 2lt + pl = (2×20×12)+(2×30×12)+(20×30)=1800, now 1800 is in accordance with the surface area of the aquarium that is known, then it is certain that the value of x that I am looking for, so usually the way I can double-check my answer sis."*

After reviewing the results of the interviews, it can be concluded that the S1 in re-examining the answers in a short way, namely just looking at each step that has been taken (S1M1-83).

Exposure of data Subject 2

This section will present data S1 in solving derivatife problem (M1) through the results of answers and interviews based on critical thinking indicators.

Focus

S1's written answer in mentioning the information known, asked and the completeness of other information on M1, is shown as follows.

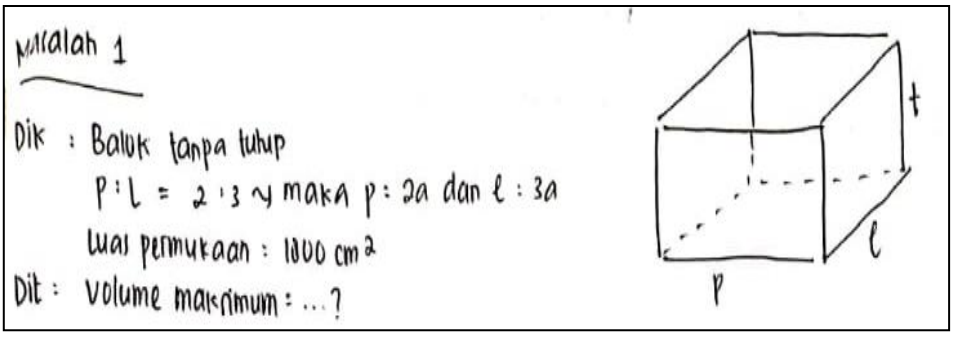


Figure 3. S2 written answers in stating information Known, Asked and Complete Other Information on M1

Based on the picture above, it can be seen that S2 wrote down the information known to be a beam without cover which has a ratio of length and width of 2:3 and a surface area of 1800 cm2. Then write down the information being asked is the maximum volume of the aquarium.

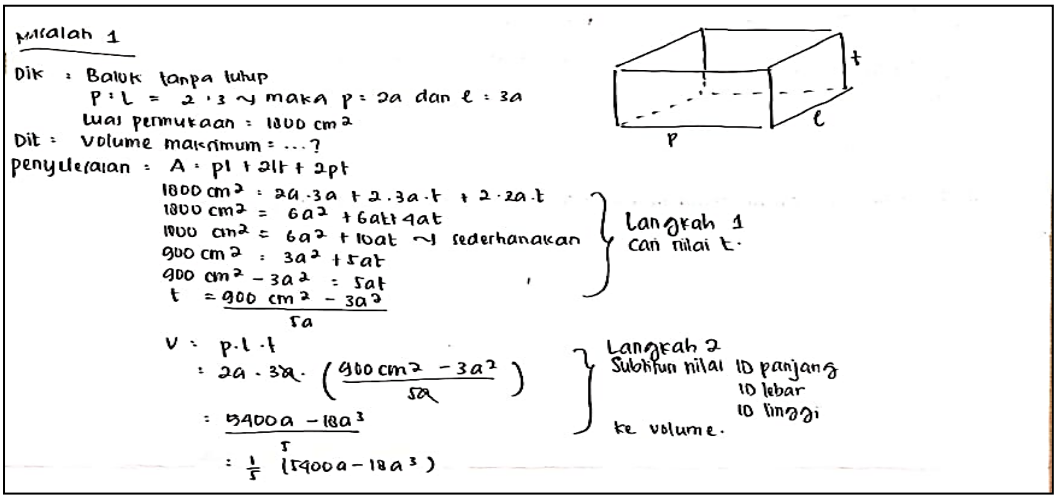
More in-depth information related to the results of S2 written answers was obtained through interviews. The following is a transcript of the S2 interview in mentioning the information known, asked and other complete information needed to solve the problem

PM1-03	:	"*Okay. From that problem, what do you understand or what do you know?*"
S2M1-04	:	"*The ratio of length and width is 2 to 3 and the surface area of the aquarium is 1800 cm² and the aquarium is in the form of a block without a lid*"
PM1-05	:	"*From that question, what is asked?*"
S2M1-06	:	"*Maximum volume*"

After reviewing the answers and interview data, it can be concluded that on the focus indicator, Masters first identifies what is known (S2M1-04) then identifies what is being asked (S2M1-06).

Reason

The written answer of S2 in stating the reason for each step of the work and the reason for the conclusion of the answer on M1, is shown as follows



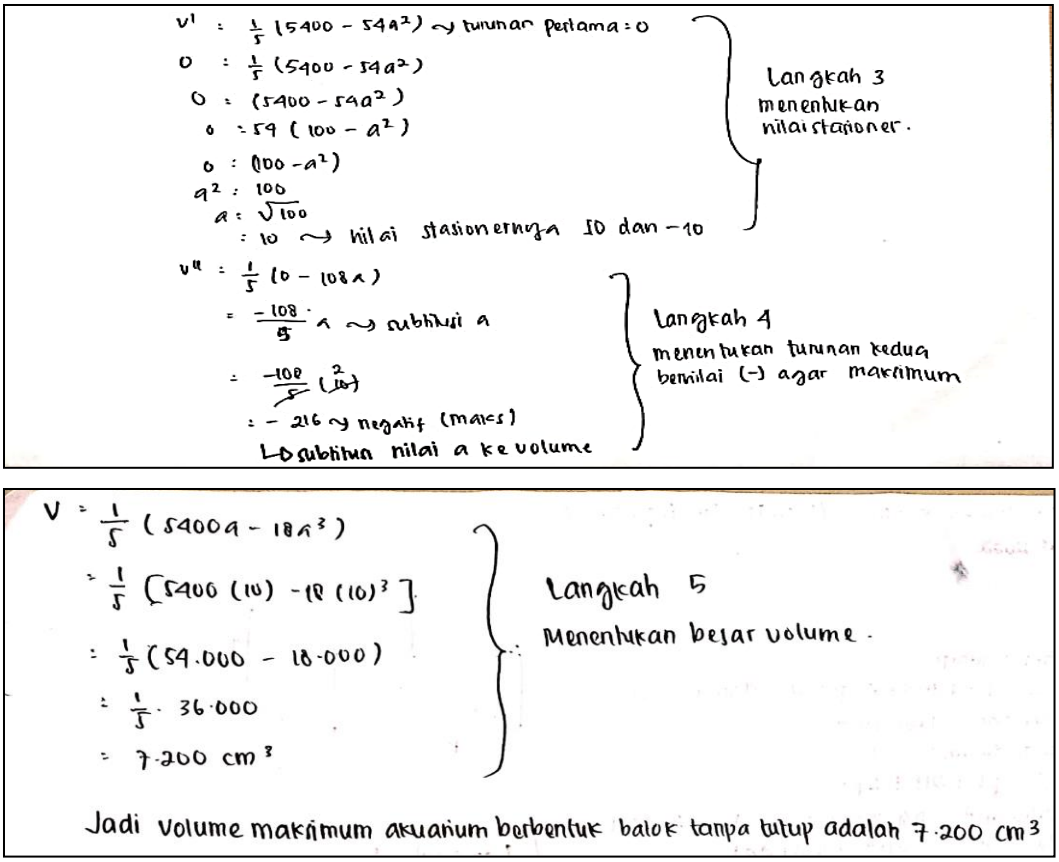


Figure 4. S2 Written Answers in Stating the Reasons for Each Step of Work and Reasons for the Conclusion of th Based on the picture above, it can be seen that S2 wrote down the completion stages in detail starting from the first step, namely finding the value of t (height) through the formula for the surface area of the beam without cover, then in the second step formulating the equation for the volume of the beam, then in the third step determining the value a = 10, then In the fourth step, test the value of a = 10 for the second derivative of the volume function and in the fifth step, determine the value of the volume of the beam by substituting the value of a = 10 into the volume formula.

The following is a transcript of the S2 interview in stating the reason for each step of the work and the reason for the conclusion of the answer.

PM1-13 : "*In step 1 you wrote, why did you use the surface area formula first?*"

S2M1-14 : "*Because the first known is the surface area, after that can later be obtained the equation t, well this equation t will be used in the next step to know the values of length, width and height*"

PM1-21 : "*In the second step, please explain how you can get* $\frac{1}{5}(5400a - 18a^3)$*?*"

S2M1-22 : "*We substitute the length and height values according to the previous one, so p is 2a, l is 3a and t is* $\frac{900\ cm^2 - 3a^2}{5a}$*.*"

PM1-27 : "*In step three, you lower V to V'. So why derive or why use the child in this third step?*"

S2M1-28 : "*Because the condition to find the maximum and minimum values must first be found the derivative and equal to 0.*"

PM1-33 : "*In step four, you replace a with positive 10 in the second derivative V.Why do you use the second derivative in this step? Can you explain?*"

S2M1-34	:	"*10 is the stationary value. The reason I substitute 10 to V" is because I want to make sure that if the result is negative later then it must be the maximum, as I have learned in the module, and vice versa, if the derivative value of both is positive, it means it is minimum. That's also a strong reason I took positive 10 in step three.*"
PM1-37	:	"*In step five, you immediately replace a equal to 10.*"
S2M1-38	:	"*Yes, not in V', but in V only.*"
PM1-41	:	"*Then here you conclude that the maximum volume is* $7200\ cm^3$. *Why can you be sure it's the maximum?*"
S2M1-42	:	"*From step 4, the second derivative is negative, so it is definitely the maximum volume.*"

e After analyzing the data from the answers and interviews, it can be concluded that in stating the reasons for each step of M1's work, S2 first looks for the height equation using previously known information, namely the aquarium surface area formula (S2M1-14). Then the aquarium volume equation is obtained by substituting the ratio of length and width, then substituting t from the t equation obtained (S2M2-22) then provides an explanation that the volume equation is derived then equated to 0 with the reason being the maximum or minimum volume requirements for the purpose of determining stationary values or value (S2M1-28), finally substituting the value of a into the aquarium volume formula and concluding that this is the maximum volume (S1M1-42).

Inference

The following is a transcript of the master's interview in mentioning or writing the conclusions drawn in the processing steps and the conclusions drawn in the final answer

PM1-45	:	"*So in the first step, why did you draw the conclusion to use the aquarium surface area formula? Why not the volume formula first?*"
S2M1-46	:	"*Because we want to find this out first sis, eee, the height equation is so that it can easily be substituted into the volume equation and in that problem the surface area is known, so that formula is used first, except that the volume was known first.*"
PM1-47	:	"*Why can the surface area formula be like that? Can you explain?*"
S2M1-48	:	"*(while explaining through pictures) The surface area is the formula for a beam without a lid, the length times the width plus 2 times the width time the height plus 2 times the length times the height, so we substitute the p and l values and the surface area value, so p is equals 2a, l is 3a.*"
PM1-49	:	"*OK, here I see in your third step that a is 10 and -10. Why did you take +10?*"
S2M1-50	:	"*Actually this is only positive 10, but in yesterday's module I noticed the reading method was different from the way I read it, so there are two a, namely +10 and -10, but only +10 is taken because in size it is impossible to use the one negative, so use +10.*"
PM1-51	:	"*Then what about your reasons regarding the conclusions you used in the final answer?*"
S2M1-52	:	"*Again, the reason for the maximum volume is because I have used the conditions for determining the stationary value, namely f'(x)=0 and I will test it again if it is proven that the value is maximum, by means of that value I substitute it into the second derivative V, kak and the result is negative, it means he is the maximum.*"

After reviewing the interview data, it can be concluded that in mentioning or writing the conclusions drawn at each step of the process and the conclusions drawn in the final answer, S2 first uses information known to the problem and draws conclusions using the surface area formula first. first compared using the volume formula (S2M1-46), then draw conclusions regarding the surface area formula of the beam without cover used (S2M1-48), then make a decision using the value a = +10 with clear reasons (S2M1-50) came to the final conclusion that S2 believed 7,200 cm3 was the maximum volume of his tank due to the stationary conditions he was using (S2M1-52).

Situation

The following is a postgraduate interview transcript in applying/using prior knowledge and using t

PM1-53 : "*Of the many steps or formulas that you applied to your answer, state what knowledge or skills do you need to answer this question?"*

S2M1-54 : "*Erm, analyze the problem, continue to record what things are known in the problem, continue to understand the conditions for determining the maximum volume."*

PM1-57 : "*Have you used all of the information on this question in your work?"*

S2M1-58 : "*For example, the known surface area of an aquarium is the surface area of an aquarium, which is 1,800 cm2, so when I write down the surface area formula, I input 1,800 and I get the equation* $t = \frac{900-3a^2}{5a}$*. Then from the ratio of length and width I put it in the volume formula, which is length times width times height so that the formula is 2a times 3a times the equation t earlier."*

After analyzing the data from the interviews, it can be concluded that the Masters used/applied their prior knowledge (S2M1-54) and used all the information provided in the questions (S2M1-58). Clarity

The following is a master's interview transcript in stating the language/terms contained in the problem or work precisely and clearly.

PM1-72 : "*Next do you understand the meaning of a block-shaped aquarium without a lid?"*
S1M1-75 : "*Eee, so it's block-shaped, but the base that isn't on it (the cover) is not there"*
PM1-76 : "*Do you understand the point of the question?"*
S1M2-77 : "*Got it, sis, we mean we find the largest volume from the aquarium."*
PM1-78 : "*Do you understand the meaning of the ratio of length and width which is 2 to 3?"*
S1M1-79 : "*If what I understand means that the length size is smaller than the size of the width"*

Overview

The following is a postgraduate interview transcript in examining/tracing back the completion that has been carried out

PM1-73 : "*How do you check your steps again?"*

S2M1-74 : "*Read again from the beginning, check the addition, multiplication, move the segments."*

After reviewing the results of the interviews, it can be concluded that Masters in re-checking answers by reading them again from the beginning, checking the calculations that have been done (S2M1-74).

DISCUSSION

The presentation and credibility of the data that has been described previously shows that there is consistency in the data of the two research subjects in solving Problem 1 (M1) and Problem 2 (M2). Therefore, in this section only the data of the two subjects, namely male subjects and female subjects, are both highly capable of completing M1 based on critical thinking indicators.

S1 and S2 in Solving M1 based on Critical Thinking Indicators

Focus

Focus is a sub-skill of critical thinking (Ennis, 1991; 1996; 2011; Nilson, Fatherstone, & Mcmurray, 2014). The series of thinking activities that the S1 goes through on the focus indicators begins with identifying what is known, then identifies what is being asked, until finally identifying the completeness of other information needed for problem solving, while the series of thinking activities that the S2 goes through on the focus indicators begins by identifying things that is known thoroughly or identify the completeness of other information then identify what is being asked. This shows that in mentioning/writing down what is known, what is asked and completeness of other information on M1, S1 starts from identifying what is known, then identifying what is being asked. To get answers to the questions asked, S1 then identifies other information to get relevance. This shows that male students have clearly stated all elements that are known, asked or other information related to the problem, this is in line with (Susilowati, 2016; Mashami & Gunawan, 2018) who

argues that in understanding male students' problems men collect written facts in questions by mentioning things that are known and asked.

The relationship between what was asked and the available information was finally declared sufficient by S1 to then complete M1. Furthermore, S2 begins by identifying things that are known thoroughly, without having to ask S2 again about other information contained in M1, this is in line with the opinion (Cahyono, 2017; Mashami & Gunawan, 2018) concluding that female students are able to identify facts given in the questions clearly, logically and in detail and completely. After that, S2 identified what was asked from M1. To get answers to the questions asked, S2 linked the known information with the things being asked, until finally S2 stated that the information provided was sufficient to complete M1. This shows S1 and S2 in mentioning/writing things that are asked, known and completeness of other information to provide complete and precise statements, so that they meet the focus indicators.

REASON

Reason is a sub-skill of critical thinking (Ennis, 1991; 1996; 2011; Nilson, Fatherstone, & Mcmurray, 2014). Reason is included in inductive and deductive reasoning (Atabaki, Keshtiaray & Yarmohammadian, 2015). The results of the study show that in stating the reasons for each step of the work and the reasons for concluding the final answer, S1 and S2 provide reasons for each step of the work in line with the information previously mentioned or linking the relationship between previous information and mentioning the work steps. The process carried out by S1 is shorter and confident in concluding answers without having to use other alternative evidence. In contrast to S2, which takes a longer path, namely believing in the conclusion of the maximum volume of the aquarium by substituting the stationary value with the second derivative of the volume equation, if the value is negative, then the volume is maximum, and vice versa, when S2 finds that the value of the second derivative is negative, S2 also believes that it is true. and proven is the maximum volume. This shows that the two subjects fulfill the sub-skills of reason.

The difference in thinking activities that S1 and S2 go through in drawing conclusions about the maximum volume in M1 shows that even though both are at the same level of mathematical ability, S1 who is a male student has a shorter completion than S2 who is a female student. This difference is in line with previous studies (Setyawati, et.al., 2020; Gulacar, et.al., 2013; Ramdani, et.al., 2021) that compared to men who are so sure about the solutions given without proving other alternatives , the time needed by women is longer because women provide more complicated and lengthy explanations to prove the answers presented. Inference

Inference is a sub-skill of critical thinking (Ennis, 1991; 1996; 2011; Facione, 1990; Nilson, Fatherstone, & Mcmurray, 2014; Watson & Glaser, 2002). Inference is identifying and storing the important parts needed to draw conclusions (Ennis, 2011; Facione, 1990; Atabaki, Keshtiaray & Yarmohammadian, 2015). The results of the study show that S1 and S2 state/write conclusions on the work steps and conclusions in the final answer in accordance with the information previously mentioned. In using the formula for the surface area of a block without a cover, S1 and S2 use the correct formula, it's just that the reasons they convey are slightly different, namely S1 reveals that without information on the problem if the block is without cover, the meaning of the problem can still be known and the surface area formula is obtained, while S2 explains the obtained formula through a sketch of a beam image. Then in determining the value of $\sqrt{100}$, S1 directly determines the stationary value used is +10, while S2 explains first the result is ± 10 then what is used is +10 not -10, because in size, the value used is positive, not negative, until concluding the final answer with the same reason as stated in the previous reason indicator.

What has been explained previously illustrates that female students are more careful and thorough in explaining the reasons for their work as is the opinion (Krutetskii, 1976; Lestari, et.al., 2021; Kaliky & Juhaevah, 2018) that women are more careful than men -man. The unique thing about the findings is that they are inversely proportional to the findings of Ramdani, et.al. (2021) which states that male students are more agile and careful in solving problems and solving problems than female students. However, in essence the results of the findings above show that the two subjects fulfill the sub-skills of inference.

Situation

Situation is a sub-skill of critical thinking (Ennis, 1991; 1996; 2011; Nilson, Fatherstone, & Mcmurray, 2014). The series of thinking activities that S1 goes through on situation indicators in mentioning the knowledge and skills needed in answering questions includes knowing the formula for surface area and volume of a block, knowing the procedure for the first derivative of a function, factoring and substitution skills and the availability of information known to questions that has been used in work S1. The series of thinking activities that the Masters goes through on this indicator includes analyzing the problem, understanding the requirements for determining the maximum volume and the availability of information known to the questions that have been used in Masters work.

This description shows that one of the unique findings in this research is that S1 and S2 apply initial knowledge of previous material and use known information in the process. There was no significant difference between the statements of the two subjects because the statements submitted were in accordance with the process. Thus, the findings above indicate that the two subjects fulfilled the situation sub-skill.

Clarity

Clarity is a sub-skill of critical thinking (Ennis, 1991; 1996; 2011; Nilson, Fatherstone, & Mcmurray, 2014). The results of the study show that S1 and S2 in mentioning the language or terms contained in the questions are generally conveyed clearly, it's just that there is a slight difference in explaining the ratio of the length and width of the aquarium, where S2 conveys using language that is less simple and seems convoluted. in contrast to S1, whose delivery is logical and clear, as Bitara (2021) argues that male students rely on their ability to think logically and mentally with numeracy skills, on the other hand female students tend to think the solution takes longer so that the completion is longer and more complicated. In addition, male students showed more logical explanations based on questions based on concepts compared to female students who explained the solution was so long (Ramdani, et.al., 2021). Thus, the findings above indicate that both subjects fulfilled the Clarity sub-skill.

Overview

Overview is a sub-skill of critical thinking (Ennis, 1991; 1996; 2011; Nilson, Fatherstone, & Mcmurray, 2014). The findings in this study indicate that women are more thorough than men, as stated by (Lestari, et.al., 2021; Kaliky & Juhaevah, 2018) at the stage of examining the process and results, female students are superior in accuracy, also supported by the opinion of Krutetskii (1976) that women are superior to men in terms of accuracy, thoroughness, thoroughness, and thoroughness of thinking-checking, female students use a step-by-step recount strategy which she does sequentially, in accordance with the opinion of Arifin, Rahman & Asdar (2015) that female students are able to check answers confidently and carefully. Thus, the findings above indicate that both subjects fulfill the Overview sub-skills.

CONCLUSION

Based on the results and discussion that has been described, the conclusions regarding this research are as follows.

Profile of Critical Thinking Male Students with High Mathematics Ability

Based on the results of written test answers and interviews with male students with high mathematical abilities, namely S1, it was concluded that S1 fulfilled all indicators of critical thinking starting from the focus indicators, namely S1 mentioning/writing information known from problems, questions asked from questions, and completeness of information required to complete the questions explained in full, on the reason S1 indicator states the reasons for each step of the work and the reason for the conclusion of the final answer, on the inferences the S1 indicator gives conclusions on the work process accompanied by conclusions on the final answer, on the situation indicator S1 applies prior knowledge of the material first and all information relevant to the problem, the S1 clarity indicator mentions the language or terms contained in the problem, until the S1 overview indicator reviews the solutions that have been made. This shows that S1 fulfills all of FRISCO's critical thinking indicators.

Profile of Critical Thinking Female Students with High Mathematics Ability

Based on the results of the written test answers and the results of interviews with students with high mathematical abilities, namely Masters, it can be concluded that Masters meets the critical thinking indicators starting from the focus indicators, namely Masters mentions/writes information known from the questions, what is asked from the questions, as well as the completeness of the information needed to finish it. the problem is explained in full, on the reason S2 indicator states the reasons for each step of the work and the reasons for the conclusion of the final answer, on the inferences the S2 indicator provides conclusions on the work process accompanied by conclusions on the final answer, on the situation indicator S2 applies prior knowledge of the previous material and all the information according to the problem, the clarity of indicator S2 mentions the language or terms contained in the problem, until the overview indicator S2 re-examines the solutions that have been made. This shows that S2 fulfills all of FRISCO's critical thinking indicators.

Differences in S1 and S2 Thinking Activities in Solving Derivative Problems

S1 and S2 in solving derivative questions have the correct answer and are accompanied by supporting reasons. However, there are several differences in thinking activity between the two, namely S1 who are male students with high mathematical abilities have a shorter completion compared to S2 completion which are female students with high mathematical abilities, S1 uses a more logical way of thinking. thinking than S2 who is more proficient in verbal skills. In addition, S1 prefers other strategies in rechecking answers compared to S2 which uses a strategy of checking answers from beginning to end, checking answers with full thoroughness and careful thought. This shows that even though S1 and S2 have equal mathematical abilities, there are some differences between the two in solving derivative questions whose data are obtained from answers to written assignments and interview results.

Recommendations

Based on the results of the description of students' critical thinking in solving derivative problems, the researcher suggests the following things.

There is a need for further research regarding the description of students' critical thinking and what factors influence it, especially in developing research centered on the thinking characteristics of male and female students so that it can become a foundation for teachers through planned learning.

Teachers are expected to consider learning plans that pay attention to differences or characteristics of students' thinking by developing questions that direct students to think critically, because as important as critical thinking is, this can help students get used to working on questions that require critical thinking. think and help students get used to dealing with these questions.

Limitations

This research has limitations, among others, the first is that the subjects selected are male students and female students who attend schools in the city of Palu and have high mathematical abilities in terms of the previous semester's report card scores. Second, this study focuses on the description of students' critical thinking through the problem of derivatives of algebraic functions, but does not rule out the possibility that the descriptions obtained can also describe creative thinking or metacognition of research subjects.

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REFERENCES

Abrami P.C., Bernard R.M., Borokhovski, E, et al. (2008). Instructional interventions affecting critical thinking skills and dispositions: a stage 1 meta-analysis. Review Educational Research, 78(4). 1102-1134. https://doi.org/10.3102/0034654308326084

Aizikovitsh, E. & Amit, M. (2011). Developing the skills of critical and creative thinking by probability teaching. Procedia Social and Behavioral Sciences, 15, 1087-1091. https://doi.org/10.1016/ j.sbspro.2011.03.243

Alismail, H. A., & Mcguire, P. (2015). 21 st century standards and curriculum : current research and practice. Journal of Education and Practice, 6(6), 150–155.

Al-massarweh, S. S., Khudairat, M. A., Freihat, R. H., & Jabali, S. M. (2024). The Impact of a Sterinberg Theory-Based Training Program on Secondary School Students' Development of Critical and Creative Thinking Skills. International Journal of Religion, 5(6), 438-456.

Arifin S., Rahman, A. & Asdar. (2015). Profil Pemecahan Masalah Matematika Siswa Ditijau dari Gaya Kognitif dan Efikasi Diri pada Siswa Kelas VIII Unggulan SMPN 1 Watampone. Jurnal Daya Matematis, 3(1): 20-29. https://doi.org/10.26858/jds.v3i1.1313

Atabaki, A.M.S., Keshtiaray, N., & Yarmohammadin, M.H. (2015). Scutiny of Critical Thinking Concept. International Education Studies, 8(3), 93-102. http://dx.doi.org/10.5539/ies.v8n3p93

Basri, H., Purwanto, As'ari, A.R., & Sisworo. (2019). Investigating Critical Thinking Skill of Junior High School in Solving Mathematical Problem. International Journal of Instruction, 12(3), 745-758. https://doi.org/10.29333/iji.2019.12345a

Beers, S. Z. (2011). 21 st century skills : Preparing students for THEIR future. STEM. Retrieved from http://cosee.umaine.edu/files/coseeos/21st_century_skills.pdf

Bell, R., & Loon, M. (2015). Reprint : The impact of critical thinking disposition on learning using business simulations. The International Journal of Management Education, 13(2), 119–127. https://doi.org/10.1016/j.ijme.2015.10.003

Bitara, T. ., & Rizal, M. . (2021). Analisis learning trajectory siswa kelas SMA dalam memecahkan masalah berdasarkan perbedaan kemampuan matematis. Aksioma, 10(2), 100-112. https://doi.org/10.22487/aksioma.v10i2.1371

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., & Ripley, M. (2010). Draft white paper 1 defining 21st century skills.The University of Melbourn. Retrieved from http://cms.education.gov.il/NR/rdonlyres/19B97225-84B1-4259-B423-4698E1E8171A/ 115804/defining21stcenturyskills.pdf

Brown, B. (2015). Twenty first century skills: A bermuda college perspective. Voices in Education, 1, 58–64.

Cahyono, B. (2017). Analisis Ketrampilan Berfikir Kritis dalam Memecahkan Masalah Ditinjau Perbedaan Gender. AKSIOMA: Jurnal Matematika dan Pendidikan Matematika, 8(1): 50-64. https://doi.org/10.26877/aks.v8i1.1510

Changwong, K. (2018). Critical thinking skill development: Analysis of a new learning management model for Thai high schools. Journal of International Studies 11(2), 37– 48. https://doi.org/10.14254/ 20718330.2018/11-2/3

Chen, P., Tolmie, A. K., & Wang, H. (2017). Growing the critical thinking of schoolchildren in Taiwan using the Analects of Confucius. International Journal of Educational Research, 84, 43-54. https://doi.org/10.1016/j.ijer.2017.02.002

Cheng, M. H., May, & Wan, Z. H. (2017). Exploring the effects of classroom learning environment on critical thinking skills and disposition : A study of Hong Kong 12 th graders in Liberal Studies. Thinking Skills and Creativity, 24, 152-163. https://doi.org/10.1016/j.tsc.2017.03.001

Choiriyah, Mayuni, I. & Dhieni, N., (2022). The effectiveness of multimedia learning for distance education toward early childhood critical thinking during the covid-19 pandemic. European Journal of Educational Research, 11(3), 1553-1568. https://doi.org/10.12973/eu-jer.11.3.1555

Cowden, C. D., & Santiago, M. F. (2016). Interdisciplinary explorations: Promoting critical thinking via problem-based learning in an advanced biochemistry class. Journal of Chemical Education, 93(3), 464-469. https://doi.org/10.1021/acs.jchemed.5b00378

Dekker, T. J. (2020). Teaching critical thinking through engagement with multiplicity. Thinking Skills and Creativity, 37, 1-9. https://doi.org/10.1016/j.tsc.2020.100701

Ennis, R. H. (2011). The nature of critical thinking: An outline of critical thinking dispositions and abilities. University of Illinois, 2(4).

Ennis, R. H. (1991). Critical Thinking: A Streamlined Conception. University of Illnois.

Ennis, R. H. (1996). Critical Thinking Dispositions : Their Nature and Assessability. 18(2 & 3): 165–182. https://doi.org/10.22329/il.v18i2.2378

Ennis, R. H. (2011). The nature of critical thinking: An outline of critical thinking dispositions. University of Illinois

Facione, P. A. (1990). Critical thinking : A statement of expert consensus for purposes of educational assessment and instruction executive summary (The Complete American Philosophical Association Delphi Research Report). California: The California Academic Press.

Florea, N. M., & Hurjui, E. (2015). Critical thinking in elementary school children. Procedia Social and Behavioral Sciences, 180, 565-572. https://doi.org/10.1016/j.sbspro.2015.02.161

Ganley, C. & Lubienski, S. (2016). Current Research on Gender Difference in Math. National Council of Teachers of Mathematics. https://www.nctm.org-/Publications/Teaching-Children-Mathematics/Blog/Current-Research-on-Ge-nder-Differences-in-Math/

Gulacar, O., Bowman, C. R., & Feakes, D. A. (2013). Observational Investigation of Student Problem Solving: The Role and Importance of Habits. Science Education International, 24(2), 344-360

Halpern, D. F. (1998). Teaching critical thinking for transfer across domains. American Psychologist, 53(4), 449–455.
Halpern, D. F. (2012). Halpern critical thinking assessment: Test manual. Austria: Schuhfried GmbH.
Hashemi, N., Kashefi, H., & Abu, M. S. (2019). Generalization Strategies in the Problem Solving of Derivative and Integral. International Journal on Emerging Mathematics Education, 3(1), 77. https://doi.org/10.12928/ijeme.v3i1.11425.
Innabi, H. & Sheikh, O.E. (2007). The Change in Mathematics Teachers' Perceptions of Critical Thinking after 15 Years of Educational Reform in Jordan. Educational Studies in Mathematics 64, 45–68. https://doi.org/10.1007/s10649-005-9017-x
Irwanto, I., Suryani, E., & Cahyani, T. S. (2024). Improving Students' Critical Thinking Skills Using Guided Inquiry with Problem-Solving Process. International Journal of Religion, 5(6), 243-251.
Kaliky, S. & Juhaevah, F. (2018). Analisis Kemampuan Berpikir Kritis Siswa Kelas X SMA dalam Menyelesaikan Masalah Identitas Trigonometri Ditinjau dari Gender. Jurnal Matematika dan Pembelajaran, 6(2): 111-126. http://dx.doi.org/10.33477/mp.v6i2.663
Krutetskii, V.A., (1976). The Phsicology of Mathematical Abilities in Schoolchildren. Chicago : Univ. of Chicago Press, United States.
Kumar, R. R., & James, R. (2015). Evaluation of critical thinking in higher education in Oman. International Journal of Higher Education, 4(3), 33–43.
Lamb, S. (2017). Key skills for the 21st century: An evidence-based review. Melbourne Australia: State of New South Wales
Lambert, V., & Lambert, C. (2012). Editorial: Qualitative descriptive research: An acceptable design. Pacific Rim International Journal of Nursing Research, 16(4), 255-256.
Lestari, W., Kusmayadi, T.A., & Nurhasanah, F. (2021). Kemampuan Pemecahan Masalah Matematika Ditinjau dari Perbedaan Gender. AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 10(2): 1141-1150. https://doi.org/10.24127/ajpm.v10i2.3661
Lipman, M. (2003). Thinking in education second edition. Australia: Cambridge University Press.
Mahmuzah, R. (2015). Peningkatan Kemampuan Berpikir Kritis Matematis Siswa SMP Melalui Pendekatan Problem Posing. Jurnal Peluang, 4(1): 64-72. https://jurnal.usk.ac.id/peluang/article/view/5860
Mashami, R,A. & Gunawan, G. (2018). The Influence of Sub-Microscopic Media Animation on Students' Critical Thinking Skills Based on Gender. Journal of Physics: Conference series, 1108. https://doi.org/10.1088/1742-6596/1108/1/012106
Miles, M. B., Huberman, A. M., & Saldana, J. (2014). Qualitative Data Analysis: A Methods Sourcebook Third Edition. Sage Publications.
Moeti, B., Killion Mgawi, R., & Smitta Moalosi, W. T. (2016). Critical thinking among post-graduate diploma in education students in higher education: Reality or fuss? Journal of Education and Learning, 6(2), 13-24. https://doi.org/10.5539/jel.v6n2p13
Monteiro, S., Sherbino, J., Sibbald, M., & Norman, G. (2018). Critical thinking, biases and dual processing: The enduring myth of generalisable skills. Medical Education, 54(1), 66-73. https://doi.org/10.1111/medu.13872
National Council of Teachers of Mathematics (NCTM)
Nilson, C., Fatherstone, C.M. & Mcmurray, A.M. (2014). Developing children's critical thinking through creative arts exposure: An application of ennis's super-streamlined critical thinking framework. The International Journal of Arts Education, 8(3), 31-45. http://dx.doi.org/10.18848/2326-9944/CGP/v08i03/31-45
Permendiknas No. 22 Tahun 2016 tentang Tujuan Pembelajaran Matematika
Pargulski, J.R., & Reynolds, M.R. (2017). Sex differences in achievement: distributions matter. Personality and Individual Differences 104, 272-278. https://doi.org/10.1016/j.paid.2016.08.016
Pascarella, E. T., Martin, G. L., Hanson, J. M., Trolian, T. L., Gillig, B., & Blaich, C. (2014). Effects of diversity experiences on critical thinking skills over 4 years of college. Journal of College Student Development, 55(1), 86–92. https://doi.org/10.1353/csd.2014.0009
Pascarella, E. T., & Terenzini, P. T. (2005). How college affects students: A third decade of research (Vol. 2). Jossey-Bass, An Imprint of Wiley.
Purnami, W., Sarwanto, S., Suranto, S., Suyanti, R., & Mocerino, M. (2021). Investigation of Science Technology Ecocultural Society (STEcS) Model to Enhance Eco Critical Thinking Skills. Journal of Innovation in Educational and Cultural Research, 2(2), 77-85.
Radulović, L. & Stančić, M. (2017). What is Needed to Develop Critical Thinking in Schools ?. Center for Educational Policy Studies Journal, 7(3), 9-25. https://doi.org/10.26529/cepsj.283
Ramdani, D., Susilo, H., Suhadi., & Sueb. (2022). The effectiveness of collaborative learning on critical thinking, creative thingking, and metacognitive skill ability: Meta-analysis on biological learning. European Journal of Educational Research, 11(3), 1607-1628. https://doi.org/10.12973/eu-jer.11.3.1607
Ramdani, A., Jufri, A.W., Gunawan, G., Fahrurozi, M. & Yustiqfar, M. (2021). Analysis of student's critical thinking skils in terms of gender using science teaching materials based on the 5E learning cycle integrated with local wisdom. Indonesian Journal of Science Education, 10(2), 187-199. http://dx.doi.org/10.15294/jpii.v10i2.29956
Rasyid, M.A., Budiarto, M.T. & Lukito, A. (2018). Junior high school students' reflective thinking on fraction problem solving: In case of gender differences. Journal of Physics: Conference series, 947. https://doi,org/10.1088/1742-6596/947/1/012041

Rhodes, T. (2010). Assessing outcomes and improving achievement: Tips and tools for using rubrics. Association of American Colleges and Universities.

Saputra, M. D., Joyoatmojo, S., Wardani, D. K., & Sangka, K. B. (2019). Developing CriticalThinking Skills through the Collaboration of Jigsaw Model with Problem-Based Learning Model. International Journal of Instruction, 12(1), 1077-1094

Setyawati, D. U., Rika, B., Febrilia, A., & Nissa, I. C. (2020). Profil Kemampuan Berpikir Kritis Mahasiswa dalam Menyelesaikan Soal Pemecahan Masalah Matematika Ditinjau dari Jenis Kelamin. Jurnal Didaktik Matematika 7(1): 90–104. https://doi.org/10.24815/jdm.v7i1.15709.

Sugiyono. (2013). Metode Penelitian Kuantitatif, Kualitatif dan R&D. Bandung: ALFABETA

Suhartini & Martyanti, A. (2017). Improving Critical Thinking Skills in Ethnomatematics-Based Geometry Learning. Gangtang Journal, 2(2): 105-112. https://doi.org/10.31629/jg.v2i2.198

Susilowati, J.P.A. (2016). Profil Penalaran Siswa SMP dalam Pemecahan Masalah Matematika Ditinjau dari Perbedaan Gender. Jurnal Review Pembelajaran Matematika, 1(2): 132-148. https://doi.org/10.15642/jrpm.2016.1.2.132-148

Vieira, R. M., & Tenreiro-Vieira, C. (2016). Fostering scientific literacy and critical thinking in elementary science education. International Journal of Science and Mathematics Education, 14(4), 659-680

Wahidin, D., & Romli, L. A. M. (2020). Students Critical Thinking Development in National Sciences and Mathematics Competition in Indonesia: A Descriptive Study. Jurnal Pendidikan IPA Indonesia, 9(1), 106-116.

Watson, G., & Glaser, E. (2002). Watson-Glaser critical thinking appraisal-UK edition practice test. Londan: Pearson

ŽivkoviĿ, S. (2016). A model of critical thinking as an important attribute for success in the 21st century. Procedia-social and behavioral sciences, 232, 102-108. https://doi.org/10.1016/j.sbspro. 2016.10.0.