



# Students' mathematical reflective thinking ability on statistics material with STEAM approach

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## Abstract

**Background:** The STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach in education has been gaining traction for its holistic and integrated framework that fosters critical and reflective thinking. Previous studies have shown its effectiveness in various aspects of mathematical competencies, yet there is limited research concerning its impact on students' reflective thinking skills in statistical material.

**Aim:** This study aims to analyze students' mathematical reflective thinking skills in statistical material, using the STEAM approach.

**Method:** Utilizing a qualitative research design, this study engaged six twelfth-grade students from MAN 1 Karanganyar as its subjects. Data were gathered through a combination of essay-based tests focused on data interpretation tasks and comprehensive interviews. The analysis was performed through observation, interviews, testing, and data triangulation, followed by thematic data reduction.

**Result:** The findings disclose that students exhibited varying degrees of mastery over reflective thinking in the context of tackling statistical problems. While they demonstrated competence in technical and mathematical aspects under the STEAM approach, their proficiencies were less apparent in scientific, artistic, and technological dimensions.

**Conclusion:** The study concludes that although the STEAM approach facilitates technical and mathematical skill enhancement, it may not fully equip students with comprehensive reflective thinking skills, particularly in statistical contexts. Therefore, there is a need for a more targeted pedagogical approach to bridge these gaps and cultivate well-rounded, reflective thinkers.

## INTRODUCTION

In the era of 21st-century learning transformation, technology is evolving rapidly, presenting a myriad of challenges, particularly in the context of globalization. These challenges impact various educational aspects, ranging from school curricula and assessment methods to learning outcomes and student performance (Lince, 2022; Suhandi & Robi'ah, 2022). These facets necessitate a more integrative and innovative approach in education, particularly in mathematics instruction. The 21st-century learning model, adopted in the 2013 Curriculum, demands higher-order thinking skills such as problem-solving and reflective mathematical thinking (Fitri et al., 2020; Nismawati et al., 2019). To address these challenges, various methods and approaches, including the scientific approach, have been developed to enhance students' mathematical skills (Abadi et al., 2017; Richardo, 2017; Tambunan, 2019). However, there still exists a deficiency in student mathematical skills, one of which is the ability for reflective mathematical thinking. This skill is a critical element in preparing the younger generation for the demands of the 21st century (Afifah & Retnawati, 2019; Kurniawati et al., 2019).

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The aim of reflective mathematical thinking is to delve deeper into, and scrutinize the process underlying the quest for solutions to mathematical problems (Hendriana et al., 2019). Reflective thinking skills are essential for finding solutions, fostering creative ideas, and honing skills in a systematic and conceptual manner (Hasançebi et al., 2021; Yildiz, 2020). Therefore, to improve reflective mathematical thinking abilities, specific educational approaches and cognitive processes must be applied and mastered. This demands a more inclusive teaching approach that facilitates both intellectual and emotional participation from students (Lestari, 2017).

One intriguing solution is the STEAM approach, which stands for Science, Technology, Engineering, Arts, and Mathematics. STEAM can enhance students' reflective mathematical thinking by encouraging them to engage in more complex and reflective cognitive processes (Harris & de Bruin, 2017). This means that students are required to understand data and variables from a broader perspective, encompassing not just calculations and formulas, but also interpretation and real-world application. The STEAM approach focuses on holistic and integrative learning (Liao, 2019; Pears et al., 2019), allowing students to solve problems in a wider context, make connections between seemingly unrelated information, and evaluate multiple solutions. This methodology is considered capable of harmonizing various academic disciplines (Mu'Minah & Aripin, 2019; Sa'ida, 2021).

One area of mathematics that students often find challenging is statistics (Dalimunthe, 2019; Suryana, 2015), particularly when they are expected to communicate using reflective thinking. In the context of mathematics, specifically in the subject of statistics, the STEAM approach is highly relevant as it offers interdisciplinary integration that enriches students' understanding and provides real-world context for statistics, demonstrating its application in various fields like science, technology, and arts (Dewi & Khotimah, 2020; Wibowo, 2017). This not only sharpens problem-solving skills but also makes the learning experience more engaging and contextual. For example, in traditional math lessons, students may solely focus on understanding and applying formulas. However, through the STEAM approach, students will also learn how data and statistics can impact other fields such as economics, sociology, and healthcare. This not only broadens students' horizons but also makes learning more engaging and relevant to everyday life (Dewi & Khotimah, 2020; Wibowo, 2017).

Numerous prior studies have extensively discussed the effectiveness of the STEAM approach in education. For instance, Elvianasti et al. (2019) found that the scientific approach in natural science education had a significant and effective impact. Iaskyana et al. (2022) highlighted how STEAM is relevant in the context of remote learning. Mengmeng et al. (2019) asserted that STEAM serves as a key catalyst for enhancing the quality of preschool education. Additional research has also indicated that STEAM is effective in improving various student mathematical skills, such as mathematical communication (Harahap et al., 2021), creative thinking (Lumbantobing & Azzahra, 2020; Rahmawati et al., 2023), critical thinking (Khoiriyyah et al., 2022; Retnowati, & Subanti, 2020), and mathematical reasoning (Sokolowski, 2019). Nonetheless, there remains a significant research gap concerning the analysis of the effectiveness of the STEAM approach in enhancing students' reflective mathematical thinking abilities, especially in the context of statistics.

Therefore, this research focuses on the analysis of students' reflective mathematical thinking abilities at MAN 1 Karanganyar, utilizing the STEAM approach. This focus is crucial given the relevance of reflective thinking skills in daily life and STEAM's potential to augment them. In designing this study, considerations will be given to the real-world relevance of statistical data, the competencies expected from students, and the challenges they face during the learning process. It is hoped that this research will provide new insights into how STEAM can enrich students' abilities in reflective mathematical thinking, particularly in the field of statistics.

## **METHODS**

Employing a descriptive-qualitative paradigm, this investigation unfolds in three critical stages and aims to offer an unmanipulated, factual depiction of research findings. As substantiated by prior works (Doyle et al., 2019; Sagala et al., 2019), the study focuses on scrutinizing the proficiency of MAN 1 Karanganyar students in manifesting reflective mathematical thinking within the realm of statistics, particularly employing the STEAM (Science, Technology, Engineering, Arts, and Mathematics) methodology. Conducted at MAN 1 Karanganyar, located at Jl. Monginsidi No. 4, Manggeh, Tegalgede, Kec. Karanganyar, Karanganyar Regency, the research is scheduled to span the Odd Semester of the academic year 2022/2023. There are three stages carried out in this study, namely as follows: (1) Planning Stage, the initial step in this research, namely by observing and interviewing research problems, then submitting titles for making proposals and preparing research instruments, (2) In The stage of implementation and data analysis, researchers conducted interviews, documentation, and tests as a result of data collection. The data analysis stage is a stage that cannot be missed because at this stage the researcher analyzes and processes the data that has been obtained from the previous stage, (3) Reporting stage, the researcher compiles a report based on data that has been previously analyzed.

The focal subjects of this inquiry are six senior students (Class XII) from MAN 1 Karanganyar who are currently engaged in statistics coursework. The study adopts a qualitative data framework to gather insights into students' capabilities for reflective mathematical thinking within statistical contexts, facilitated by the STEAM approach. Data for this research is primarily sourced from in-depth interviews and specially designed aptitude tests, aimed at evaluating reflective mathematical thinking in statistical domains, and is administered to the six selected Class XII participants.

### ***Research Instruments and Data Collection Techniques***

Data collection techniques in this study were tests and interviews. The participant cohort consisted of senior students (Class XII) enrolled in MAN 1 Karanganyar. During the evaluative phase, the acquisition of data was facilitated through a series of constructed-response assessments, focusing on statistical subject matter. This modality enabled students to express their solutions in an unconstrained manner, thereby providing a more nuanced lens through which their aptitude for reflective mathematical thinking could be evaluated.

Regarding the interview modality, it serves as a meticulous method of data harvesting, involving direct, face-to-face interactions with study participants coupled with subsequent debriefing sessions, thereby augmenting the accuracy and depth of the acquired data (Rukajat, 2018). In the context of this specific study, the interviews with Class XII students at MAN 1

Karanganyar were designed to scrutinize factors affecting their ability for reflective mathematical thinking in the realm of statistics via the STEAM approach. The metric utilized for evaluating reflective mathematical thinking was adapted from a composite index developed by Surbeck, Han & Moyer, and Nisak, as cited in Ramadhani & Aini (2019).

**Table 1.** Indicators of Mathematical Reflective Thinking Ability

Phase/Level	Indicator
Reacting	State what is being asked.
	State what is known.
	State the relationship between what is asked and what is known.
	Able to explain what is known enough to answer what is asked.
Elaborating/Comparing	Explain the answers to the problems that have been obtained.
	Relate the questions asked to the problems encountered before.
Contemplating	Determine the goal of the problem.
	Detect errors in answers.
	Correct and explain if there are errors in the answers.
	Draw the right conclusions.

### ***Data Analysis Techniques***

The analytical process in this study is constructed as a rigorous, systematic compilation of gathered data, designed for ease of comprehension and interpretation by various stakeholders. Citing the methodological outline posited by Sutriani & Octaviani (2019), the qualitative data analysis in this investigation is organized into three sequential stages: data reduction, data presentation, and inferential conclusion.

#### **1. Data reduction**

In this initial phase, the data undergoes a meticulous evaluation for its relevance to the study's objectives. Following the collection of data via observations, interviews, and assessments, a sorting process is initiated. Data congruent with the research questions are retained for deeper analysis, while irrelevant data are systematically excluded. This raw data is subsequently summarized and organized into coherent clusters, thereby providing a framework that highlights key points integral to the study's objectives, thereby facilitating future analytical endeavors.

#### **2. Data Presentation**

At this juncture, the investigator categorizes and delineates the data in a descriptive or narrative format, devoid of any artificial manipulations. The purpose of this activity is to achieve a systematic, coherent organization of insights and ideas that have been harvested from the field. Initial coding commences based on the various sub-themes, paving the way for more targeted analysis correlated with the central research questions.

#### **3. Inferential Conclusions**

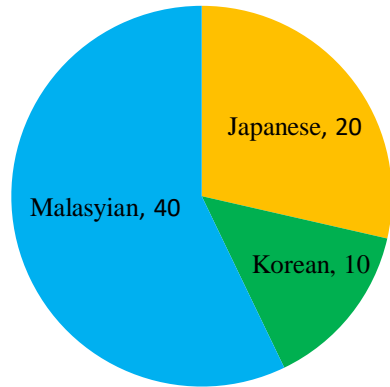
This culminating phase employs the analyzed data to extract meaning and draw conclusions pertinent to reflective mathematical thinking and the underlying influencing factors. By this stage, each coded sub-topic is examined in depth, enabling the researcher to articulate informed conclusions regarding both the capability for reflective mathematical thinking and the variables that may influence it.

In summary, the analytical framework is designed to evolve from descriptive categorization to more nuanced interpretation, all aimed at elucidating the dynamics of reflective mathematical thinking and its influencing factors. Through this systematic

methodology, the study aims to offer robust, validated conclusions that contribute to the broader academic discourse.

**Table 2.** Problem Instruments

A private company provides scholarships to 3 private schools in North Sumatra. The scholarship is in the form of studying at 3 universities abroad, namely Japanese, Korean, and Malaysian Universities. Each school can register a maximum of 50 students. University capacity in Japan is 20 people, in Korea is 10 people and in Malaysia is 40 people.



Then answer the following two questions:

1. Make a distribution table. If school A (private I) registers as many as 20 students at a Japanese University, 5 students at a Korean University, and 10 students at the University of Malaysia. School B (Private II) enrolled 20 students at the Japanese University, 10 students at the Korean University, and 15 students at the University of Malaysian. Meanwhile, school C (Private III) registered 10 students at Korean University, 35 students at Malaysian University, and 5 students at Japanese University.
2. If school C (Private III) experiences data changes, that is, 2 students move from Japanese University to Korean University. Korea University moved 3 students to a Japanese University. And 15 students did not take courses at the University of Malaysia. Make the latest distribution table!

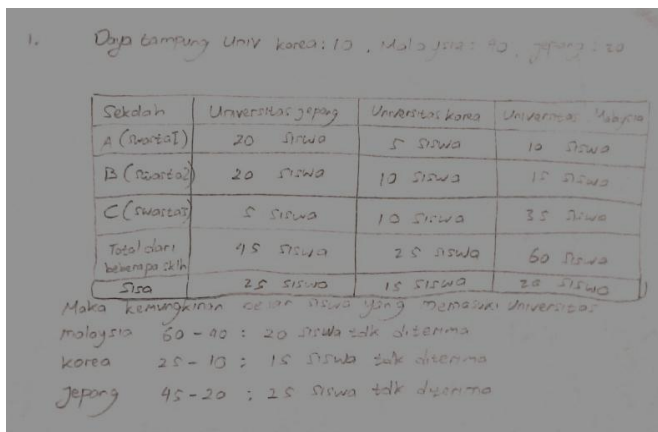
## RESULTS AND DISCUSSION

### RESULT

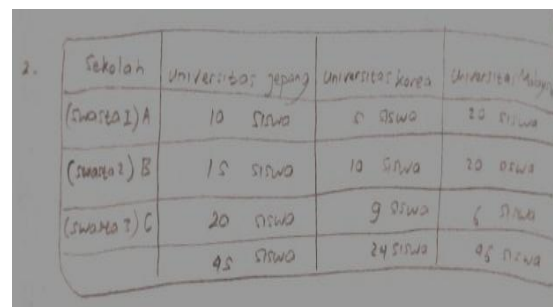
The presentation of the results of students' reflective thinking skills tests with the STEAM approach proceeds as follows.

#### Subject 1 answers:

Subject 1 looks to write down what they know about the questions, their writing skills at each university, and identify problems related to the core questions and statistics.



**Figure 1.** Answer subject 1 question 1



**Figure 2.** Answer subject 1 question 2

#### Translation :

Korean capacity: 10  
 Malaysia's capacity: 40  
 Japanese capacity: 20

School (private)	University Japanese (total student)	University Korean (total student)	University Malaysian (total student)	School (private)	University Japanese (total student)	University Korean (total student)	University Malaysian (total student)
A	20	5	10	A	10	5	20
B	20	10	15	B	15	10	20
C	5	10	35	C	20	9	6
Total from several schools	45	25	60	Total from several schools	45	24	46

Then most likely students who enter the university of Malaysia  $60-40 = 20$  students are not accepted

Then most likely students who enter Korean universities:  $20 - 10 = 15$  students are not accepted

Then most likely students who enter Japanese universities:  $45-20 = 25$  students are not accepted

Figure 1 reveals that students possess the capacity to identify and articulate both the questions posed and their underlying rationales. Conversely, Figure 2 underscores the students' inability to critically evaluate the explanations provided in question number 2, further highlighting their limitations in conjecturing plausible answers. This conclusion is drawn from an interview in which students articulated their reasoning and potential conclusions about complex questions. Specifically, these issues appear to be particularly challenging when students are required to implement mathematical strategies in data presentation within the STEAM framework. This observation is corroborated by the fact that students struggle to diagnose issues within the questions presented.

From the results of the analysis of the answers to these two questions, it can be concluded that:

1. Students are capable of addressing both the first and second questions but seem limited to mere understanding of the queries. It appears that they have some indicators to grasp what is explicitly asked but lack deeper insight.
2. Students have not yet developed the analytical tools to decipher what is being asked, differentiate between known variables and unknowns, nor have they mastered drawing accurate conclusions based on the queries. This indicates a gap in their problem-solving abilities.
3. There's an evident lack of proficiency regarding the application of the STEAM methodology, as the students could not delineate the steps for reflective thinking, particularly in making correlations between the questions posed.
4. Students have not been able to imagine the truth and conclusions in solving statistical problems, and students have not been able to determine the calculation steps correctly, which means that students do not have indicators of reflective thinking ability.

These findings were further substantiated during an interview with Subject 1, documented as follows:

Q : *“Is your typical approach to simply read and answer questions immediately?”*

A : *“No, I base my responses on my understanding of the questions posed. I try to register each question individually, understand what is known, and then proceed to answer.”*

This analytic distillation aims to contribute nuanced insights into students' reflective mathematical thinking abilities and their correlations with the STEAM methodology, thereby enhancing the academic discourse surrounding this subject matter.

**Subject 2 answers:**

Subject 2 exhibited a lack of detailed analytical engagement with the questions presented. Rather than delineating known variables or specifying the queries related to the statistical material, the student merely responded to the overtly stated question concerning the frequency distribution of the data. During the problem-solving process, the student's responses were noticeably deficient in articulating any definitive conclusions. This interpretive assessment seeks to enrich the scholarly dialogue by offering an intricate examination of Subject 2's problem-solving approach, particularly focusing on the absence of analytical depth and the inability to draw meaningful conclusions.

No	Sekolah	Jumlah Siswa			Jumlah
		U. JEP	U. Kor	U. Malay	
1	Swasta A	20	5	10	35
2	Swasta B	20	10	15	45
3	Swasta C	5	10	35	50
	Jumlah	45	25	60	130

**Figure 3.** Answer subject 2 question 1

No	Sekolah	Jumlah Siswa			Jumlah
		U. JEP	U. Kor	U. Malay	
1	Swasta A	20	5	10	35
2	Swasta B	20	10	15	45
3	Swasta C	6	9	20	35
	Jumlah	46	24	45	115

**Figure 4.** Answer subject 2 question 2

**Translate:**

No	School	Total Student			Sum
		U. Jep	U. Korea	U. Malay	
1	Swasta A	20	5	10	35
2	Swasta B	20	10	15	45
3	Swasta C	5	10	35	50
		45	25	60	130

No	School	Total Student			Sum
		U. Jep	U. Korean	U. Malay	
1	Swasta A	20	5	10	35
2	Swasta B	20	10	15	45
3	Swasta C	6	9	20	35
		45	25	60	115

Figures 3 and 4 indicate that students can discern potential answers to the questions posed. However, even within the context of a row frequency distribution table, there's a noticeable lack of reflective thinking skills in problem-solving. This conclusion is bolstered by interview outcomes with students, who expressed difficulties in operationalizing and delineating the appropriate frameworks for problem identification within the queries. Although students may engage with the STEAM methodology when grappling with technological and mathematical challenges, their learning appears to be confined to making associations between problem solutions and analogous objects particularly in areas such as science, engineering, and art.

From the analysis of the answers to these two questions, it can be concluded that:

1. Students capable of tackling questions 1 and 2 display an ability to comprehend answers presented by the frequency table. However, their responses remain anchored to the manifest content of the questions without delving into their latent aspects.

2. Students haven't demonstrated a clear understanding or capacity to form conclusions regarding the answers to the posed questions. They notably struggled to identify and resolve the underlying issues in the second question.
3. The integration of reflective thinking within the STEAM approach is found wanting. Specifically, students were able to pinpoint steps for reflective thinking through observation but failed to make any meaningful correlation between question 1 and the queries posed in question 2.
4. Students have not yet developed the ability to conceptualize and validate truth and conclusions in resolving statistical queries. This signals an absence of reflective thinking capabilities, including the skill to determine accurate computational steps.

This was reinforced by the response of Subject 2 in the interview session.

Q : "Do you find the procedures for dealing with statistical questions and problems confusing?"

A : "I'm somewhat puzzled because my focus was solely on the explicit requirements of the question. My immediate reaction was to directly answer and construct a frequency table for the statistical data."

**Subject 3 answers:**

Subject 3 exhibited a commendable degree of analytical engagement with the task at hand. Not only was he capable of transcribing the data from the questions into his own vernacular, but he also elucidated in detail his understanding of the questions. Specifically, he delineated the capacities of various tertiary institutions when questioned about statistical data matters. During the problem-solving exercise, Subject 3's responses manifestly led to coherent conclusions. This analysis endeavors to contribute to academic discourse by providing a multifaceted interpretation of Subject 3's approach to problem-solving. Noteworthy is the student's ability to convert raw data into personalized language, the depth of analytical scrutiny applied to the questions, and the subsequent capability to arrive at insightful conclusions.

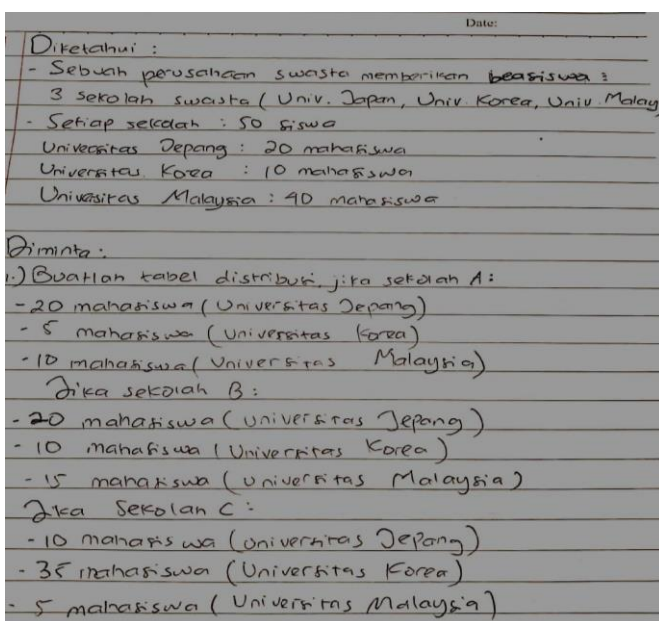


Figure 5. Answer subject 3 question 1

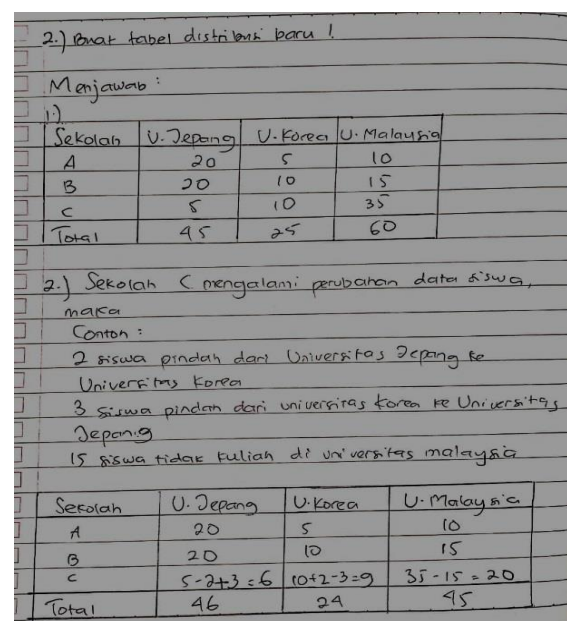


Figure 6. Answer subject 3 question 2



**Translation:**

Is known:

- A private company providing scholarships: 3 private schools (Univ.Japan, Univ.Korea, Univ.Malay)

• Each school: 50 students

Japanese University: 20 students

Korea University: 10 students

University of Malaysia: 40 students

Requested:

1) Make a distribution table if school A:

- 20 students (Japanese University)
- 5 students (Korea University)
- 10 students (University of Malaysia)

If school B:

- 20 students (Japanese University)
- 10 students (Korea University)
- 15 students (University of Malaysia)

If school C:

- 10 students (University of Japan)
- 35 students (Korea University)
- 5 students (University of Malaysia)

2) Create a new distribution table!

Answer:

School	U. Japanese	U. Korean	U. Malaysian
A	20	5	10
B	20	10	15
C	5	10	35
Total	45	25	60

2) School C has changed student data, then

Example:

2 students transferred from Japanese University to Korean University

3 students transferred from a Korean university to a Japanese university

15 students are not attending Malaysian universities

School	U. Japanese	U. Korean	U. Malaysian
A	20	5	10
B	20	10	15
C	$5-2=3+3=6$	$10+2=12-3=9$	$35-15=20$
Total	46	24	45

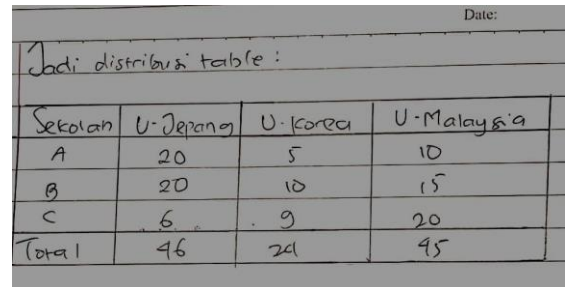


Figure 7. Answer subject 3 question 2

So, distribution table:

School	U. Japanese	U. Korean	U. Malaysian
A	20	5	10
B	20	10	15
C	6	9	20
Total	46	24	45

Figures 5 through 7 elucidate that students can sequentially identify the elements implicated in the task at hand. These students also exhibit the capacity to conceptualize fully-formed objects from diversified perspectives. Yet, post-interview evaluations revealed a certain hesitancy among the students to articulate conclusions emanating from their responses to the second question. Interestingly, students effectively harnessed the STEAM approach integrating science, technology, engineering, art, and mathematics by associating problem-solving strategies with the specific objects referenced in the questions and underlying concepts.

From the analysis of the answers to these two questions, it can be concluded that:

1. Students effectively engage with both questions but largely confine their understanding to the explicit answers provided. They elaborate upon and delineate the indicators that underscore the intended focal point of the questions.
2. Students exhibit limitations in identifying and resolving dilemmas posed in the second question. This is partly because they possess some awareness of the subject matter but lack a comprehensive grasp, which hampers their ability to draw precise conclusions and answers.

3. The STEAM approach has endowed students with some contextual thinking abilities. Students demonstrate a rudimentary level of reflective thought when considering the correlation between the first and second questions.
4. While students can conceptualize hypothetical outcomes and conclusions, they do not yet possess refined skills in reflective thinking, thus affecting their ability to identify accurate computational methodologies.

This interpretation is further corroborated by the following interview excerpt with Subject 3:

Q : *"Are you perplexed by the standard operating procedures for question formulation and textual formatting? Is everything status quo in terms of comprehension, questioning, and response?"*

A : *" No, upon perusing the questions, I documented my existing knowledge, posed further questions, and subsequently formulated conclusions. I articulated this in a detailed fashion to ensure clarity and precision during the data interpretation process. I constructed frequency tables, translated new data into those tables, and addressed questions related to the data."*

## DISCUSSION

**Table 3.** The results of data analysis can be presented in a comparison of reflective thinking skills and the STEAM approach to 3 subjects.

Reflective Thinking Indicator	STEAM components	Subject 1	Subject 2	Subject 3
Reacting	Science	Students adept in tackling statistical queries exhibit a primary understanding of the posed questions. These individuals subsequently respond by deciphering the implicit meaning of inquiries, providing detailed elaborations within the framework of the "Reacting" reflective thinking indicator.	Students lack sufficient competency in the "Reacting" reflective thinking indicator. Their limitations preclude them from fully grasping the nuanced meanings of the queries and from elaborating in detail.	Students proficient in addressing both the initial and subsequent questions demonstrate a foundational understanding, further elucidating their responses within the "Reacting" reflective thinking domain by delving into the queries' intricacies.
Elaborating/ Comparing	Technology, Engeneering ,Arts,Mathematics	Students demonstrate comparative analytical skills, adeptly elucidating the pertinent technologies and engineering strategies required for resolving statistical conundrums. Their application of the STEAM approach fosters an interdisciplinary	Students exhibit deficiencies in analytical and comparative skills, struggling to discern the appropriate technological and engineering methods for problem-solving within statistical contexts. Their limitations extend	Students possess the analytical acumen for making nuanced comparisons, adeptly identifying the relevant technological and engineering solutions needed for statistical challenges. They effectively deploy the STEAM approach, amalgamating insights from Fine

		perspective, incorporating Fine Arts and Mathematics into their problem-solving paradigm.	to the ineffective application of the STEAM approach, especially in the realms of Fine Arts and Mathematics.	Arts and Mathematics into their problem-solving techniques.
Contemplating	Technology, Engineering, Arts, Mathematics	Students manifest contemplative indicators, recognizing potential solutions and deducing conclusions from posed questions. Their learning approach, guided by Technology, Engineering, Arts, and Mathematics, facilitates a cohesive strategy for solving statistical problems.	Students lack a contemplative dimension, offering only superficial answers to questions without delving into deeper conclusions. Their utilization of the STEAM approach remains rudimentary, restricted largely to Technology and Mathematics.	Students display contemplative acumen, identifying plausible solutions and deriving conclusions from the questions at hand. Their integrated learning strategy, informed by Technology, Engineering, Arts, and Mathematics, enables a comprehensive approach to statistical problem-solving.

Based on the data table's outcomes, all three subjects display varying degrees of reflective capability within the context of the STEAM (Science, Technology, Engineering, Art, and Mathematics) framework. Subjects 1 and 3 exhibit competencies across multiple facets of reflective thinking, including reactive, comparative, and contemplative thought processes, when tackling statistical challenges. This variance underscores the significance of diverse cognitive abilities in educational settings (Seifu, 2018). Pedagogical models that emphasize reflective and investigative practices serve to sharpen both student and educator critical analysis, fostering self-assessment and iterative improvement. Conversely, Subject 2 lacks these multi-dimensional reflective skills, solely engaging with the technological aspects of the STEAM approach. This deficiency points to an underlying issue contributing to weakened capabilities in mathematical reflective thinking.

All three subjects in this study exhibited foundational elements of reflective thinking, as evidenced by their ability to engage with various components of the STEAM pedagogical model. Nonetheless, these individuals encountered barriers to effective problem-solving, primarily stemming from difficulties in understanding the questions posed and interpreting the answers required. This indicates that while they may excel in isolated facets of reflective thought, integrating these into a coherent problem-solving strategy remains a challenge.

## CONCLUSIONS

From the results of this study, it can be concluded that the three subjects were able to think reflexively. The ability to think reflectively possessed by those who have studied with the STEAM approach can be measured internally by responding to, comparing, and reflecting on indicators of reflective thinking: learning approaches in science, technology, engineering, art, and mathematics. Satisfy the ability to think femininely. Suggestions from future researchers regarding the results of this study are expected to help improve the ability to think reflectively

using the STEAM approach in implementing problem-solving exercises in statistics learning. Reflective thinking ability is an effort to support student satisfaction in learning mathematics, especially statistical data. Reflexive thinking skills are closely related to learning statistics. Reflective thinking skills are very important in the process of creative thinking and to a greater extent when studying science and mathematics.

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## AUTHOR CONTRIBUTIONS STATEMENT

All authors have contributed greatly to this article and are fully responsible for its content. Everyone who has contributed to this article is the author.

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