Enhancing Critical Thinking and Creativity in Mathematics: An Explanatory Sequential Investigation of Teachers' Instructional Strategies

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ABSTRACT

Improving students' performance in Mathematics remains a global priority to enhance critical and creative thinking skills. This study examined the quality of instructional strategy implementation and measured the levels of critical and creative thinking among Grade 7 students through an explanatory sequential mixed-methods approach. The quantitative phase utilized the STAR Observation Tool to assess instructional strategies and standardized tests adapted from the Grade 7 MATATAG Curriculum to evaluate students' critical and creative thinking abilities. The qualitative phase involved semi-structured interviews to explore students' perspectives on effective teaching strategies. The study was conducted among 9 Grade 7 Mathematics teachers selected through census sampling and 279 students from eight public secondary schools in Tampakan District, selected by means of cluster and simple random sampling. Results from the quantitative phase revealed that teachers' instructional strategies were implemented at a very satisfactory level, and students demonstrated a good level of critical and creative thinking. However, no significant relationship was found between instructional strategy quality and students' cognitive skill levels. In contrast, qualitative findings indicated that students found problem-solving tasks, research-based projects, inquiry-based methods, and interactive activities to be particularly effective in developing their higher-order thinking skills. These findings emphasize the importance of enhancing instructional quality and promoting innovative, student-centered teaching methods to foster critical and creative thinking in Mathematics. The study also calls for continued research to support curriculum development and improve instructional practices in diverse educational settings.

Keywords: Critical Thinking, Creativity, Instructional Strategies, Mixed Methods, MATATAG Curriculum

INTRODUCTION

In the dynamic landscape of education, the development of students' critical thinking and creativity has become a pivotal goal for educators and policymakers. These cognitive skills empower learners to navigate complex challenges, engage in innovative problem-solving, and adapt to the demands of an ever-evolving global society. The mathematics classroom, regarded as a cornerstone of intellectual growth, offers a vital context for fostering these skills. However, the extent to which students engage critically and creatively, and the influence of teachers' instructional strategies on this engagement, necessitates further exploration.

Globally, a decline in students' mathematical abilities has been evidenced by international assessments such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) (Petko et al., 2016). These assessments reveal that a significant number of students underperform in higher-order mathematical tasks, suggesting limitations in prevailing educational practices. Nationally, the Philippines faces similar challenges. According to the Department of Education, the 2022 PISA results indicated that the country achieved an average mathematics score of 355, a marginal increase from 353 in 2018, yet still ranking sixth from the bottom among 81 participating countries. Notably, only 16% of Filipino

students reached at least Level 2 proficiency, highlighting a substantial deficiency in essential mathematical competencies.

At the local level, the situation reflects these broader trends. Data from the Department of Education–South Cotabato consolidated proficiency report for the first grading period of School Year 2024–2025 showed that the average proficiency level across 18 districts was 83.34%, with 75.24% of learners attaining grades of 80 and above, classified as "satisfactory." The Tampakan District reported a slightly higher mean of 83.37%, yet only 74.63% of learners achieved grades of 80 and above. Furthermore, notable variations in performance among schools within the district emphasize the urgent need for targeted interventions to strengthen critical thinking and creativity in mathematics education.

Despite recognition of the importance of these skills, significant gaps persist in the literature. Traditional teaching methods in mathematics, which emphasize rote memorization and procedural learning, have been shown to impede the development of higher-order thinking skills (Chen et al., 2021; Serin, 2019; Yaniawati et al., 2020). There is a dearth of research focusing on instructional strategies specifically designed to cultivate critical and creative thinking, particularly within the Philippine context (Sumarni & Kadarwati, 2020). Additionally, empirical studies linking specific instructional approaches to measurable improvements in critical thinking and creativity, especially at localized levels, remain limited (Petko et al., 2016; DepEd, 2022).

In response to these identified gaps, this study seeks to examine how the quality of teachers' instructional strategies—specifically in terms of situation, task, action, and result—relates to students' critical thinking and creativity in mathematics. The findings aim to inform the development of a theory or instrument aligned with the MATATAG Curriculum, with the ultimate goal of enhancing critical thinking and creativity in mathematics classrooms.

This investigation aspires to contribute meaningfully to educational theory and practice by offering evidence-based recommendations to improve instructional methodologies, foster higher-order thinking skills, and elevate students' mathematical performance both locally and beyond.

This study is not just a response to a local problem but a significant step towards aligning teaching methodologies with the demands of the 21st century, which require critical thinking and creativity, among other skills. The study's findings will be instrumental in identifying effective strategies to enhance mathematics education quality and improve learners' performance in all districts, making it a crucial contribution to education. This systematic investigation aims to hold significant implications for educational theory and practice, as the educators can reevaluate and refine their pedagogical approaches and create more effective learning environments to improve academic performance and promote higher-order thinking skills.

METHODOLOGY

Research Design

This study employed an explanatory sequential design. It was a two-phase design where quantitative data was collected and analyzed first; then, qualitative data was collected and analyzed based on the quantitative results. The qualitative data was used to explain the quantitative data (Creswell & Creswell, 2018).

In the quantitative phase, teachers were observed by supervisors, principals, school heads, or master teachers using the adapted STAR observation tool (Classroom Observation Tool or COT) for Proficient Teachers I–III, which was based on the Department of Education's Results-Based Performance Management System (RPMS) and Philippine Professional Standards for Teachers (PPST) framework (Department of Education [DepEd], 2018).Students were administered standardized tests to measure their critical thinking and creativity. These tests were adapted and revised from the Grade 7 MATATAG Curriculum Lesson Exemplars and Worksheets (DepEd, 2022).

Descriptive statistics, such as mean and standard deviation, were used to summarize and describe the performance scores of both teachers and students (Creswell & Creswell, 2018). For inferential statistics,

Spearman's Rank-Order Correlation (Spearman's Rho) was employed to determine the strength and direction of the monotonic relationship between teacher observation scores and students' test results in critical thinking and creativity (Laerd Statistics, 2018). This non-parametric test was used because the data did not meet the assumption of normality and involved ordinal variables.

In the qualitative phase, all Math seven teachers' scores were interviewed to collect insights into their instructional strategies and observations of enhancing critical thinking and creativity. Based on the exams, high and low-performing students were also interviewed to explore their learning and perceptions of their teachers' influence on critical thinking and creativity.

The qualitative and quantitative data were integrated to explore instructional strategies that enhance critical thinking and creativity in mathematics class. The integrated data were interpreted to develop a theory or instrument that enhances critical thinking and creativity in mathematics class.

Research Locale

This study involved several secondary schools within the district of Tampakan. These schools included Danlag National High School, Datal Biao Integrated School, Maltana National High School, Liberty National High School, Lampitak National High School, Tampakan National High School, Palo 19 National High School, and Tablu National High School.

The Tampakan District is a diversified area with many large, medium, and small schools, rich and poor. Each school catered to different types of students in a geographic and culturally diverse environment. In this light, the study focused on schools with the primary objective of obtaining information on instructional strategies adopted by Mathematics teachers of Grade 7 and the effects such teaching has on critical thinking and creativity among their students. This is aligned with the guidelines presented by Upadhyay (2023) in the proper selection of research locale, which argued that the research locale selected based on the objectives of the study and the target field of information to match the output gathered from such locale and the primary purpose of the study.

Research Participants

The respondents involved all the teachers handling Grade 7 Mathematics classes and their students from all schools in the District of Tampakan. Every teacher was randomly selected from only one section.

These teachers were currently employed by the Department of Education, teaching Grade 7 Mathematics in the Tampakan District, and had at least one year of teaching experience in Mathematics. In addition, they received relevant training or professional enhancement in mathematics instructional strategies within the last year. Only those teachers who volunteered to participate in the study and provided informed consent were included.

Teachers who did not meet the following inclusion criteria for this study were excluded: Those who were not active in teaching Grade 7 Mathematics in Tampakan District, had less than one year of experience and had not received professional development in Mathematics pedagogy. Opting out of this study and withdrawing consent would also fall under the exclusion criteria.

For the student participants, only Grade 7 students enrolled in the sections selected for the study were considered. These students were a heterogeneous group, ensuring that the study captured various levels of critical thinking and creativity in Mathematics. Students who were not officially enrolled in Grade 7 Mathematics classes or belonged to sections not selected for the study were excluded.

The involvement of Grade 7 students and teachers who taught Math 7 from Tampakan District schools was vital to this study's objectives. The researchers believed that these students had no prior information or experience with the approach introduced by this study. They could participate properly in the data collection period, and their opinions and suggestions by the end of the session provided additional input that benefited the study's context and claims.

For the qualitative phase of the study, the researcher chose three students who obtained high scores in the

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assessment, another three who obtained average scores, and three who obtained low scores. This is aligned with the selection technique implemented by a study conducted by Wang et al. (2022), which also utilized a mixed-method approach wherein key informants for the qualitative phase of the study were selected based on their scores on the test. This method allows the researcher to explore the perspectives of the various students on the subject matter, classified based on their performance, for deeper and more meaningful investigation.

Research Instrument

To support the descriptive part of the research, mean and standard deviation were used to describe the students' critical thinking abilities and creativity levels in Mathematics class. Specifically, Spearman's Rank Correlation was used to measure the direction and strength of the relationship between the dependent and one or more independent variables (Taylor, 2024).

In the qualitative strand, this study utilized thematic analysis. Thematic analysis is one of the most common forms of analysis used for qualitative research. It emphasizes identifying, analyzing, and interpreting patterns of meaning within qualitative data. Data gathered from the interview were transcribed and reviewed through thorough readings. The transcripts were then coded to extract general meanings that contain coherent words or phrases. These were gathered regardless of the research question. Coded meanings related to the research question were grouped accordingly. Each interview has these clusters, and themes were extracted from these clusters (Perenara-Wilkinson,2024).

Data Gathering Procedure

The following step-by-step data-gathering procedures outline the data collection process in the study Enhancing Critical Thinking and Creativity in Mathematics: An Explanatory Sequential Investigation of Teachers' Instructional Strategies.

The development of the interview questionnaire was crucial for this study. The researcher designed a semi-structured questionnaire to collect data on the specific instructional strategies used by the teacher that students find most effective in fostering critical thinking and creativity. Semi-structured interview questionnaires, which were established based on pre-defined constructs, were often used in social science, marketing, and other research. They were ideal for exploratory research (George, 2023).

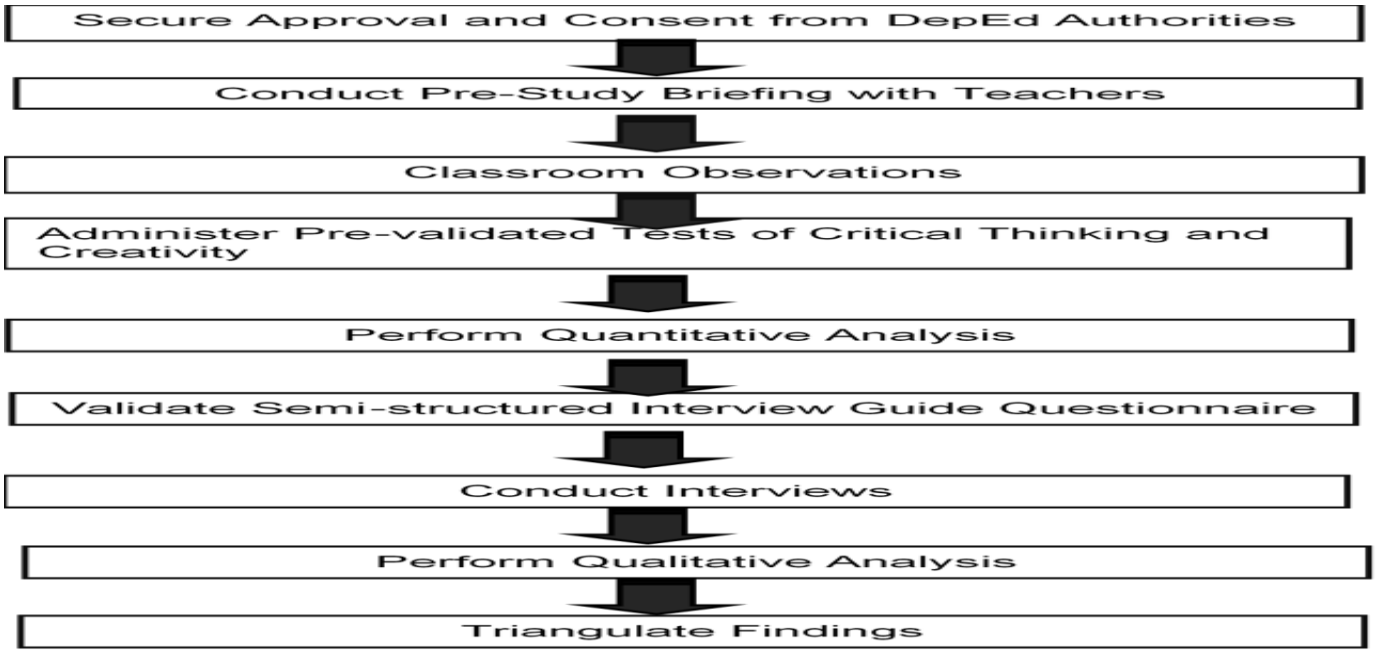

Figure 1: Diagram of the Data Gathering Procedure

The validity of the questionnaire was ensured through a comprehensive review involving multiple key stakeholders. The face and content validity of the questionnaire should be attained to ensure the reliability and

effectiveness of these questionnaires in measuring the constructs included in a specific study (Aithal & Aithal, 2020). The validation team comprised three Master Teachers from the Tampakan District. The diverse group provided comprehensive feedback on the questionnaire's content to ensure accuracy in measuring the intended constructs and alignment with the study's objectives.

Ethical Considerations

The researcher was expected to adhere to the following ethical considerations to secure the safety and privacy of all individuals and files involved in this study.

The researchers sought permission from the respondents before conducting the research. A letter of intent was sent to each school to obtain the approval of the principal and teachers who participated in the data collection. Participation was voluntary; the researchers did not coerce any respondents to answer the standardized test or interview questions. They also ensured that all respondents' personal information remained confidential and was used solely for academic purposes, adhering to established ethical standards for research involving human subjects (American Psychological Association [APA], 2020; Babbie, 2020). All procedures followed the basic principles of informed consent, confidentiality, and respect for participants' rights (Creswell & Creswell, 2018).

To ensure that the researchers follow the moral principles of the laws and code of ethics, below are the ethical considerations that are to be considered in this study:

Permission and Secrecy. Participants were adequately informed about the study's purpose, methodology, and objectives to enable them to make informed decisions regarding participation (World Medical Association, 2013). The researchers ensured that all personal information was kept confidential and was accessible only to authorized personnel.

Permission to withdraw. Participation in the study was entirely voluntary. Participants were informed that they could withdraw without facing any penalties or obligations (Babbie, 2021). If a participant decided to withdraw, their participation immediately ceased, and no further data were collected from them.

Sensitivity and respect. Interviews were conducted with the utmost respect, empathy, and cultural sensitivity. A safe and supportive environment was created, especially considering participants may have diverse or complex life circumstances. Respectful communication, active listening, and validation of participants' experiences were key practices maintained throughout the data-gathering process (Liamputtong, 2013).

Reduction of Harm. Researchers took proactive measures to minimize any potential psychological, emotional, or physical harm participants might experience during the interviews. Steps were taken to ensure the process was non-threatening and supportive (Sieber & Tolich, 2013).

Informed Consent. An Informed Consent Form (ICF) was presented to all participants, ensuring a voluntary and well-informed agreement before participation. The ICF outlined the study's purpose, procedures, risks, benefits, and participants' rights (National Human Genome Research Institute, 2022).

RESULTS AND DISCUSSION

Table 1. Quality of Implementation of Teachers' Instructional Strategies

Quality of Implementation of Teachers' Instructional Strategies	Mean	Standard Deviation	Interpretation
Situation			
Lesson Planning	4.56	0.527	Outstanding
Instructional Materials and Resources	4.33	0.500	Very Satisfactory
Procedure (Instructional Activities)	4.44	0.726	Very Satisfactory

Classroom Management	4.22	0.441	Very Satisfactory
Section Mean	**4.39**	**0.40**	**Very Satisfactory**
Task			
Teacher's Competence	4.78	0.441	Outstanding
Lesson Establishment/Development	4.33	0.500	Very Satisfactory
Interaction or Discussion	4.44	0.527	Very Satisfactory
Instructional Models and Strategies	4.00	0.500	Very Satisfactory
Enrichment (Application)	4.22	0.441	Very Satisfactory
Section Mean	**4.36**	**0.44**	**Very Satisfactory**
Action			
Student/Class Engagement	4.00	0.500	Very Satisfactory
Response (Quality of Answers)	3.89	0.601	Very Satisfactory
Outputs (Quality of Works)	3.78	0.441	Very Satisfactory
Section Mean	**3.89**	**0.41**	**Very Satisfactory**
Result			
Outcomes	4.22	0.667	Very Satisfactory
Assessment of Learning (Reflection)	4.22	0.667	Very Satisfactory
Section Mean	**4.22**	**0.667**	**Very Satisfactory**
Grand Mean	**4.00**	**0.50**	**Very Satisfactory**

This study measured the quality of the educators' implementation of instructional strategies based on their fellow teachers' observations. The table 1 above presents the analysis results involving the computed mean and standard deviation and the corresponding verbal interpretation of statistical data for each primary and secondary variable. Collectively, these results describe the quality of teachers' implementation of their chosen instructional strategies.

The highest mean of 4.39 was obtained among the four indicators, corresponding to the verbal interpretation of Very Satisfactory. This implies that most teacher respondents believed that implementing the instructional strategies was highly regarded due to the perceived outcome, which is observed through the students' numerical scores, ratings after implementation, and reflections on their overall evaluation of their experience.

On the other hand, Action, which evaluated the students' behavior during the implementation, obtained the lowest mean of 3.89, yet it is still regarded as Very Satisfactory. This implies that throughout the teaching sessions, the evaluators observed that the students were able to express their ideas and impart conclusive thoughts relevant to the lessons, that the students were able to attain deeper comprehension of the lessons and develop necessary skills related to them, and that the students were able to try out strategies and maximize the use of resources to come up with best solutions.

The overall mean of 4.00, with an SD of 0.5, indicated the quality of implementing teachers' instructional strategies in mathematics class was very satisfactory. This implies that the educators' overall impressions indicate the teachers' adequate ability to carry out effective teaching strategies during Math classes, encompassing all points of consideration to describe an effective instructional approach.

Özdoğru (2022) highlighted that the progressive change brought by modern times and technology calls for the adaptive change in the instructional approach implemented in educational settings to address and sustain the learning needs of the current and future generations. The researchers pointed out that effective modern teaching

strategies should foster collaborative and active learning among the students. It should be student-centered, indicating that it must be based on the students' learning demands, relate to the extent of their capabilities, and facilitate a self-regulated learning approach. Most importantly, it calls for educators' creativity and proactive approach to ensure efficiency.

Table 2. Level of Critical Thinking Ability of the Students

Critical Thinking Skills	Mean	SD	Verbal Interpretation
Inference	3.03	0.65	Good critical thinking ability
Deduction	2.72	0.67	Good critical thinking ability
Evaluation of Arguments	2.89	0.60	Good critical thinking ability
Grand Mean	**2.86**	**0.64**	**Good critical thinking ability**

3.26 – 4.00: Outstanding critical thinking ability

2.51 – 3.25: Good critical thinking ability

1.76 – 2.50: Satisfactory critical thinking ability

1.00 – 1.75: Needs Improvement

To measure the students' critical thinking ability in this study, the researcher formulated a questionnaire focused on three (3) indicators: inference, deduction, and argument evaluation. The results showed that among the three indicators, the majority of the respondents exhibit a higher level of critical thinking ability in terms of Inference (M=3.03; SD=.65). The overall mean score of the student respondents is 2.86, with an SD of 0.64, which indicates a good level of critical thinking ability.

This implies that most students exhibit substantial competence, especially in making inferences. This signifies their ability to evaluate gathered information, data, and arguments and properly justify these collected pieces of information to reach logical conclusions. Murawski (2014) noted that students who develop decent critical thinking skills often express themselves as more thoughtful and reserved. They explore by probing challenging questions to widen their understanding of essential facts and information. They welcome criticism and embrace mistakes as a significant part of the learning process.

In addition, they are capable of distinguishing factual information from opinions. They can favor logic over emotions in tough situations, which allows them to analyze the situation, evaluate available resources, and devise a realistic solution that uses available resources to address difficulties.

Table 3. Level of Students' Creativity

Creativity	Mean	SD	Verbal Interpretation
Fluency	2.66	0.72	Good creative thinking ability
Flexibility	2.96	0.70	Good creative thinking ability
Elaboration	2.75	0.66	Good creative thinking ability
Grand Mean	**2.79**	**0.62**	**Good creative thinking ability**

3.26 – 4.00: Outstanding creative thinking ability

2.51 – 3.25: Good creative thinking ability

1.76 – 2.50: Satisfactory creative thinking ability

1.00 – 1.75: Needs Improvement

To measure the students' creativity level, the researcher formulated a questionnaire focused on three (3) indicators: fluency, flexibility, and elaboration. The results showed that many of the respondents exhibited a higher level of creative thinking skills in terms of Flexibility (M=2.96; SD=.70). Overall, they obtained a mean score of 2.79 with an SD of 0.62, which describes their creative thinking ability at a good level.

This implies that most students demonstrate open-mindedness, adaptiveness, good communication skills, resourcefulness, and flexibility. In creative thinking, flexibility is the ability to think outside the box to shift perspective, often promoting ideas that may be deemed different (Teacher First, n.d.).

Kaplan (2023) describes creative thinking as effectively generating unique and appropriate ideas and resolutions to address specific situations. This ability involves individuals' capacity to brainstorm and dare approaches to various conditions. They tend to take advantage of available resources to explore options. Different research has examined techniques for empowering students' creative thinking abilities through academic activities like creative writing (Senel & Bağçeci, 2019) and a project-based learning approach (Wijayati et al., 2019).

Table 4. Significance of the Relationship between Quality of Implementation of Teachers' Instructional Strategies and Critical Thinking and Creativity of the Students

Variables		***r***	***p***	**Remarks**	**Decision**	**V.I.**
Quality of Implementation of Teachers' Instructional Strategies	**Critical Thinking**	0.176	0.677	Negligible Correlation	Failed to reject the null hypothesis	No significant relationship
	Creativity	0.072	0.865	Negligible Correlation	Failed to reject the null hypothesis	No significant relationship

0.80 – 1.00: Very Strong Correlation

0.60 – 0.79: Strong Correlation

0.40 – 0.59: Moderate Correlation

0.20 – 0.39: Weak Correlation

0.00 – 0.19: Negligible Correlation

As part of the primary objective of this study, the researcher examined the significance of the relationship between the quality of implementation of teachers' instructional strategies and the students' critical thinking and creativity using Spearman's Rank-Order Correlation. The results revealed that for critical thinking, the computed *r-value* was 0.176, indicating a negligible correlation, with a *p-value* of 0.677, thus failing to reject the null hypothesis. Similarly, an *r-value* of 0.072 was obtained for creativity, suggesting a negligible correlation, with a *p-value* of 0.865, again leading to the failure to reject the null hypothesis. These results imply that the quality of instructional strategy implementation has no statistically significant relationship with the students' critical thinking and creativity.

While some studies of Mirza and Jabeen (2024) emphasize the influential role of teachers in fostering critical and creative thinking through well-implemented strategies like inquiry-based learning and questioning techniques, the present study's findings suggest otherwise. This contrast may be attributed to several contextual and methodological factors. Specifically, this study did not administer a pre-assessment of students' critical and creative thinking skills prior to the implementation of the instructional strategies. Without baseline data, it becomes difficult to determine whether the observed levels of critical and creative thinking reflect any growth or decline attributable to the strategies used. This lack of a pre-post comparison limits the ability to assess the

true effectiveness of the teaching interventions and may explain, at least in part, why no statistically significant relationship was found in the quantitative analysis. Future studies would benefit from incorporating a pre-assessment to establish a baseline and better capture the impact of instructional strategies on students' cognitive skill development.

Moreover, the findings are supported by Masek and Yamin (2012), who found no significant difference in critical thinking between students exposed to Problem-Based Learning and those under traditional instruction, suggesting that instructional strategy alone may not significantly affect critical thinking outcomes. Similarly, Andreucci-Annunziata et al. (2023), in their meta-review of studies on critical thinking in higher education, concluded that even when specific strategies are implemented to improve critical thinking, students do not consistently show significant gains. These insights reinforce that while instructional strategies matter, their effectiveness may be heavily mediated by other variables such as student motivation, classroom environment, learning resources, and individual cognitive styles.

In light of these findings, it is important to consider that developing critical and creative thinking skills may require a more holistic, multifaceted approach, rather than relying solely on instructional strategies.

The quantitative phase established that teachers' instructional strategies were rated "Very Satisfactory" (SOP 1), students achieved "Good" levels of critical thinking (SOP 2) and creativity (SOP 3), yet no significant relationship emerged between these strategies and student outcomes (SOP 4). The qualitative phase explores the perceptions and experiences of teachers and students to explain this discrepancy through thematic analysis aligned to each SOP.

Table 5. Summary of Emergent Themes and Final Themes

Emergent Themes	Final Themes
Learning activities and research-based projects	Instructional strategies fostering critical and creative thinking abilities
Teaching methods honing critical thinking skill	
Teaching methods honing creative thinking skill.	
Challenges faced relevant to the implementation of instructional strategies	Perception of the participants towards the implementation of instructional strategies

Instructional Strategies fostering critical and creative thinking abilities

Learning Activities and Research-Based Projects

Teachers designed hands-on tasks, logic puzzles, Math Olympics, and real-world data investigations to stretch students' thinking: "Participating in problem-solving activities like logic puzzles and Math Olympiads has significantly enhanced my critical thinking and creativity."

Despite this very satisfactory implementation, students reported that the complexity of these projects often exceeded the time available, leading to surface engagement rather than deep understanding. In other words, while these activities' intent and perceived value are high, the depth of student engagement was insufficient to move the quantitative indicator.

B. Teaching Methods: Honing Critical Thinking

Teachers used debates, inquiry-based tasks, and open-ended questioning to sharpen analysis: "I encourage my students to ask questions, analyze perspectives, and find solutions on their own."

Although students enjoyed the intellectual challenge, many admitted feeling hesitant when required to articulate their reasoning under timed test conditions, limiting the measurable impact on their critical-thinking scores.

C. Teaching Methods: Honing Creative Thinking

Storytelling, group art projects, and puzzles were employed to spark creativity: "I give students opportunities to express themselves through stories and art. They learn to take risks without fear of mistakes."

Students confirmed that these strategies made math more engaging, but lacking foundational confidence prevented them from fully expressing creativity during formal assessments.

Perceptions of Participants Towards the Implementation of Instructional Strategies

A. Challenges in Implementation

Across interviews, three barriers consistently emerged:

Time Constraints: "We must rush through the curriculum; long projects get shortened or cut." Limited instructional time meant activities intended to cultivate higher-order thinking were frequently abbreviated.

Task Complexity: "Some problems were so complex that I gave up before exploring deeper solutions." When tasks overwhelmed students, they disengaged, dampening critical and creative thinking.

Student Hesitation & Confidence: "I worry about picking the 'right' answer when there is more than one." Fear of making mistakes led many students to play it safe in assessments rather than demonstrate innovative or analytical thinking.

These barriers help explain why, despite the high quality and positive perceptions of instructional strategies, no significant relationship was detected quantitatively: many students never reached the level of sustained engagement or confidence needed for those strategies to translate into improved test scores.

DISCUSSION OF FINDINGS

The findings of this study provided a nuanced understanding of how teachers' instructional strategies are implemented and their relationship with students' critical and creative thinking skills.

1. Quality of Implementation of Instructional Strategies

The implementation of teachers' instructional strategies was rated as Very Satisfactory overall (M=4.00, SD=0.50), with specific indicators such as Lesson Planning (M=4.56) and Teacher Competence (M=4.78) rated Outstanding. This implies that teachers in the study planned well, demonstrated a high level of competence, and applied instructional procedures, materials, and classroom management strategies effectively. These findings affirm that teachers are meeting expected standards in instructional delivery and are consistent with Özdoğru's (2022) argument that adaptive, student-centered, and creative strategies are necessary in modern education.

2. Students' Critical Thinking Ability

Students demonstrated a Good level of critical thinking ability (M=2.86, SD=0.64), with Inference scoring highest (M=3.03). This suggests that students are relatively competent in interpreting information and making logical connections. However, Deduction and Evaluation of Arguments received slightly lower ratings, indicating room for improvement in deeper cognitive processing. These findings align with Murawski's (2014) view that students with good critical thinking tend to question ideas thoughtfully and prefer logical reasoning over emotional reactions.

3. Students' Creative Thinking Ability

Students' creative thinking was also rated Good (M=2.79, SD=0.62), with Flexibility as the highest-rated indicator (M=2.96). This reflects the students' capacity to adapt to diverse ideas and perspectives, think outside

the box, and propose various approaches to problem-solving. These findings support Kaplan (2023) and Wijayati et al. (2019), who emphasize that creative thinking involves generating original ideas and applying them appropriately across contexts.

4. Relationship Between Instructional Strategies and Thinking Skills

Despite the Very Satisfactory implementation of instructional strategies and Good levels of thinking skills, statistical analysis revealed no significant relationship between the two. The correlation coefficients between instructional quality and critical thinking *(r=0.176, p=0.677)* and between instructional quality and creativity *(r=0.072, p=0.865)* both indicate negligible correlation. This suggests that, within this context, well-implemented teaching strategies did not automatically translate to higher levels of critical or creative thinking.

These results challenge common assumptions and are consistent with studies like Masek and Yamin (2012) and Andreucci-Annunziata et al. (2023), which suggest that teaching strategies alone may not directly impact thinking outcomes. External factors such as student motivation, assessment pressure, time constraints, and classroom culture likely mediate this relationship.

5. Qualitative Findings as Explanatory Lens

The qualitative phase provided clarity on the lack of statistical correlation. Though instructional strategies such as research projects, debates, inquiry tasks, and creative group activities were implemented, both teachers and students highlighted time constraints, assessment limitations, and surface-level engagement as key barriers. Students often felt rushed or uncertain in timed assessments, which may have masked their true cognitive and creative capabilities. These insights indicate that deeper student engagement, longer-term activities, and diversified assessment strategies may be necessary to reveal the full impact of instructional quality on student thinking skills.

CONCLUSION

This study examined the relationship between instructional practices and students' thinking abilities. While the findings showed that instructional strategies were implemented at a very satisfactory level and students demonstrated good levels of critical and creative thinking, no statistically significant relationship was found between these variables. However, qualitative data revealed that instructional approaches such as inquiry-based tasks, research activities, and collaborative learning were perceived positively by students and teachers alike.

It is important to note that the absence of a pre-assessment of students' critical and creative thinking skills is a methodological limitation. Without baseline data, the study could not measure whether students' skills improved due to instructional strategies, making it difficult to draw firm conclusions about effectiveness. Despite this, the study offers valuable insights into how instructional quality and engagement may influence learning processes and perceptions in the mathematics classroom.

Conflict of Interests

The authors declared no conflict of interest.

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