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QUALITY ASSURANCE AND TECHNOLOGICAL EFFICACY ON THE INSTRUCTIONAL COMPETENCE OF MATHEMATICS TEACHERS

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ABSTRACT

The research was conducted to examine the influence of quality assurance and technological efficacy to the instructional competence of Mathematics teachers in public schools in the districts of Quezon, Division of Bukidnon. The method used in this study is a quantitative approach with with descriptive-correlation research design.

Findings revealed that mathematics teachers exhibit high quality assurance, technological efficacy, and instructional competency. Correlation analysis showed a significant positive relationship between quality assurance and technological efficacy to instructional competence of Mathematics teachers, Regression analysis indicated that instructional and monitoring and evaluation, technological knowledge, and technological content knowledge are predictors of instructional competence of Mathematics teachers.

Keyword: Quality Assurance, Technological Efficacy, Instructional Improvement, Professional development, Mathematics teaching

1. INTRODUCTION

The background of the study which explored the quality assurance, technological efficacy, and mathematics teachers' instructional competence. Previous investigations showed mathematics teachers generally had high instructional competence, with strong ratings in guidance, management, and evaluation skills (Gonzalo, 2025). Teachers' instructional competencies were often rated as very evident, correlating with outstanding performance in task execution. Regarding technology, some studies indicated that teachers demonstrated highly capable technological competency, though it sometimes varied across age groups, with younger teachers often showing higher levels (Sarangani District Study, 2021-2022). In terms of skills, teachers were frequently found to be very skillful in technology use (Misamis Occidental Study, 2024-2025). However, despite training, some still lacked competence in pedagogical technology use, with some studies noting that teachers mainly used technology for personal tasks rather than classroom learning (Graham et al., 2021 as cited in).

The research gap persisted despite high reported competence levels. For example, although technological capability was high, its relationship with teaching proficiency was only weak positive (Sarangani District Study, 2021-2022). Literature also suggested the need for more specific frameworks capturing teacher knowledge complexity when integrating technology into specific mathematics content, since general models like TPACK alone were sometimes insufficient (Zambak & Tyminski, 2020; Morales-García et al., 2022 as cited in). Additionally, technological skills did not significantly influence learners' mathematics performance in one study (Misamis Occidental Study, 2024-2025). Instructional supervision and quality assurance mechanisms were examined as critical for effective teaching and curriculum implementation (Niger State Study, 2025). Strong quality assurance arrangements were positively linked to future teachers' math and pedagogy knowledge (Teacher Education and Development Study in Mathematics, pre-2018 data).

The relationship among variables was examined across studies. A direct link existed between strong national quality assurance systems and future teachers' knowledge of mathematics and pedagogy. Technology and competency studies found that both technological and pedagogical competence support effective classroom technology use (Chou et al., 2018; Li, Yamaguchi, & Takada, 2018 as cited in). When technological competence aligned with pedagogical competence, teachers' technology use showed predictive outcomes (Suárez-Rodríguez et al., 2018 as cited in). Pedagogical competence shaped technology use (Rural Schools Study), and instructional competence predicted teaching task performance. Yet one high school setting showed only a weak positive correlation between technological capability and teaching proficiency (Sarangani District Study, 2021-2022). Teacher Development Needs Study also emphasized that the Philippine Professional Standards for Teachers and technological efficacy improve teaching quality when teachers receive training and resources, enabling better math instruction and student performance.

1.1.Statement of the Problem

This study aimed to determine the relationships among quality assurance, technology efficacy and instructional competency of Mathematics teachers.

Specifically, it answers the following:

1. What is the level of quality assurance practiced by math teachers' in terms of:
    a. Curriculum Alignment and Standard Compliance
    b. Instructional Monitoring and Evaluation
    c. Professional Development and Continuous Improvement?
2. What is the level of technological efficacy math teachers, in terms of:
    a. Technology Knowledge
    b. Technological Content Knowlegde
    c. Technological Pedagogical Knowledge
    d. Technological Pedagogical Content Knowledge?
3. What is the level of competency of Math teachers in terms of:
    a. Knowledge of the Subject Matters
    b. Teaching Strategies and Methodologies
    c. Clasroom Management
    d. Professional Characteristics and Traits?
4. What relationship exists between the instructional competence of Math teachers and:
    a. Quality assurance
    b. Technological efficacy
5. Which variable best predicts the instructional competence of Math teachers?

1.2. Theoretical Framework of the Study

The theoretical framework examined how quality assurance, technological effectiveness, and mathematics teachers' teaching competency interact and shape educational practice. Quality assurance processes, such as evaluation and professional development, were viewed as essential for improving competency and ensuring teachers access support to incorporate best practices and technology (Gonzalo, 2025). A key gap remained in understanding how these measures specifically influence teachers' technological efficacy and daily instructional practices, since many studies did not clearly link quality assurance frameworks to day-to-day competence (Lopez East District Study, n.d.). Integration varied with institutional support (Sarangani District Study, 2021-2022). The study found that high technological efficacy positively correlated with enhanced instructional competency (Claro et al., 2018 as cited in) and that quality assurance in professional development increased teachers' technology self-efficacy, improving instructional competency (Dogan et al., 2021 as cited in).

1.3. Conceptual Framework of the Study

The conceptual framework showed the presumed flow from quality assurance and technological efficacy (independent inputs) to instructional competency of mathematics teachers (dependent output). Quality assurance referred to policies and practices maintaining or improving teacher education quality, consistently associated with stronger mathematics pedagogy knowledge (Teacher Education and Development Study in Mathematics, cited in). Technological efficacy described teachers' capability and confidence using technology for mathematics teaching. The gap was the lack of a model mapping how current quality assurance systems promote or hinder technological efficacy and thus instructional competency; some evidence also suggested technology skill may not improve student performance (Misamis Occidental Study, 2024-2025, cited in). Prior studies supported the framework: robust quality assurance through training and support increases technological efficacy, and combined technology and pedagogy competence predicts instructional competency (Chou et al., 2018; Li, Yamaguchi, & Takada, 2018, cited in).

The research paradigm are illustrated below:

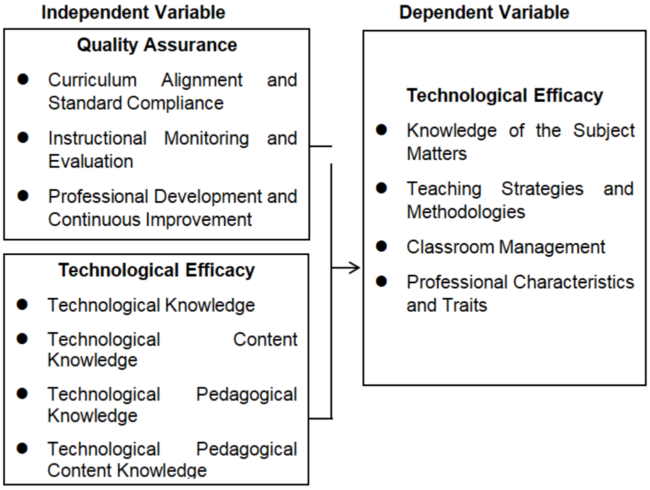

Figure 2. Schematic Diagram showing the relationship of Quality Assurance and Technological Efficacy on the Instructional Competency of Mathematics Teacher

For the guidance in the analysis of findings of the study and for statistical testing purposes, the following hypotheses will be tested at a 0.05 level of significance:

HO1 = There is no significant relationship between the Instructional Competence of Mathematics Teacher and

a. Quality Assurance

b. Technological Efficacy

HO2 = There is no variable that best predicts the Instructional Competence of Mathematics Teacher

2. METHODOLOGY

This study employed a quantitative research design, specifically a descriptive correlation design, to assess relationships among two or more variables, quality assurance and technological efficacy, and instructional competence of math teachers. The descriptive design helps describe the levels of quality assurance, technological efficacy, and instructional competence of Math teachers. A correlation design was used to examine the relationship between the independent variables, quality assurance and technological efficacy, and the dependent variables, instructional competence of Math teachers.

This study was conducted in Quezon District, Bukidnon, Philippines. This district is part of the Division of Bukidnon in Region X and encompasses a variety of public elementary and secondary schools.

The study focused specifically on two hundred and forty (240) public elementary and secondary school teachers within the municipality for the academic year 2025 – 2026. The purpose of the research in this location was to gather information that will be useful to both the local school community and to further the understanding of instructional delivery practices and teacher management.

The respondents of this study were randomly selected, two hundred and forty (240) elementary and secondary public school teachers of Quezon Districts, Division of Bukidnon. Regardless of their specialization during the school year 2025 – 2026. The respondents rated themselves in their quality assurance, technological efficacy and instructional competence practices.

Before gathering the necessary data, the researcher requested for a Research Ethics Committee (REC) permit from the university research office. Permission was given to conduct pilot testing of the questionnaire to establish reliability and validity. A letter addressed to the Bukidnon Division Superintendent was prepared for approval to conduct the study within the division. The approved request served as the basis for the public schools' district supervisors and the district-in-charge of Quezon, Division of Bukidnon, to distribute the questionnaire to the study respondents.

Upon the approval, the researcher sent invitation letters to the participants. The letter provided information on the study's purpose and the nature of their participation. Before conducting the survey, participants were given and informed consent form. Consent to participate means they accept the invitation to participate the study, agree to provide relevant information, and answer the questions honestly. It also includes an agreement that the respondents may withdraw their participation for valid reasons.

Respecting participants' autonomy, the researcher ensures anonymity by instructing public school teachers not to write their names. The respondents demonstrate their commitment to this search by volunteering without any expectation of reward. Then, if they agree to complete the questionnaire anonymously, they would sign the informed consent form, which would then be placed in a box before completing the questionnaire. After giving the respondents one week to complete the survey, SMS and e-mail reminders were sent, thanking them for their utmost participation.

3. RESULTS AND DISCUSSION

This section discusses the results of the gathered data and their interpretation. It further summarizes the findings necessary to draw conclusions and recommendations.

Quality Assurance Practiced by Math Teachers

Table 1 presents the level of quality assurance practiced by Math teachers.

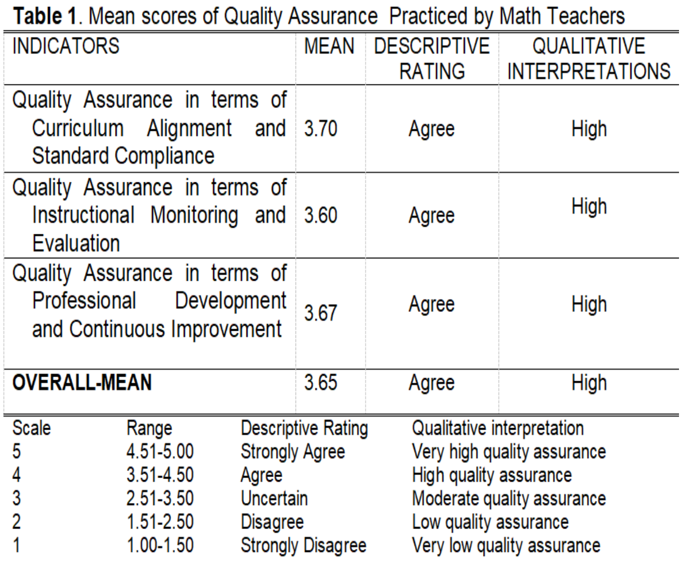

Table 1. Mean scores of Quality Assurance Practiced by Math Teachers

INDICATORS	MEAN	DESCRIPTIVE RATING	QUALITATIVE INTERPRETATIONS
Quality Assurance in terms of Curriculum Alignment and Standard Compliance	3.70	Agree	High
Quality Assurance in terms of Instructional Monitoring and Evaluation	3.60	Agree	High
Quality Assurance in terms of Professional Development and Continuous Improvement	3.67	Agree	High
OVERALL-MEAN	3.65	Agree	High

Scale	Range	Descriptive Rating	Qualitative interpretation
5	4.51-5.00	Strongly Agree	Very high quality assurance
4	3.51-4.50	Agree	High quality assurance
3	2.51-3.50	Uncertain	Moderate quality assurance
2	1.51-2.50	Disagree	Low quality assurance
1	1.00-1.50	Strongly Disagree	Very low quality assurance

Table 1 shows that the mean scores of quality assurance practiced by math teachers is high with an overall mean of 3.65 and a descriptive rating of Agree. This means respondents consistently practice quality assurance actions that help strengthen math teaching. When looking at the indicators, teachers report the highest quality assurance in Curriculum Alignment and Standard Compliance with a mean of 3.70. This suggests that teachers are most consistent in making sure math instruction matches curriculum requirements and standards, helping ensure lessons and learning expectations are aligned. The next indicator is Professional Development and Continuous Improvement with a mean of 3.67, indicating that teachers also actively improve their teaching through ongoing learning and growth activities. Lastly, Instructional Monitoring and Evaluation has a mean of 3.60, which is slightly lower but still in the Agree and High range, showing that teachers carry out monitoring and evaluation practices, though this may be the area where improvement or consistency can still be strengthened.

3.1. Technological Efficacy of Math Teachers

Table 2 presents the level of technological efficacy of Math teachers.

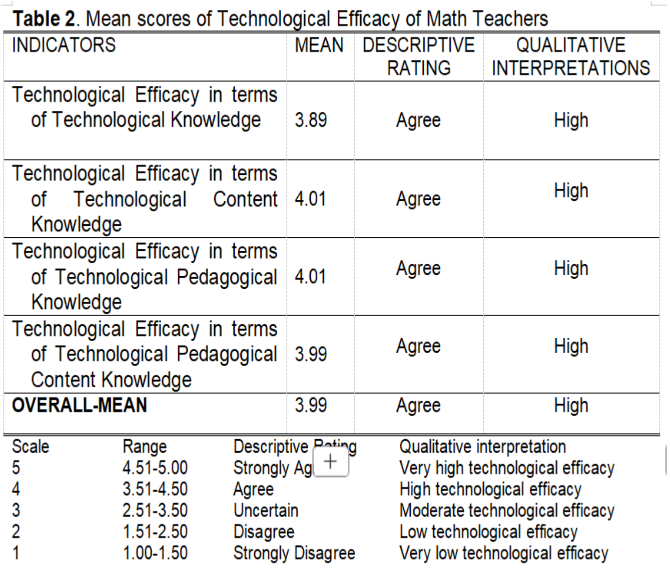

Table 2. Mean scores of Technological Efficacy of Math Teachers

INDICATORS	MEAN	DESCRIPTIVE RATING	QUALITATIVE INTERPRETATIONS
Technological Efficacy in terms of Technological Knowledge	3.89	Agree	High
Technological Efficacy in terms of Technological Content Knowledge	4.01	Agree	High
Technological Efficacy in terms of Technological Pedagogical Knowledge	4.01	Agree	High
Technological Efficacy in terms of Technological Pedagogical Content Knowledge	3.99	Agree	High
OVERALL-MEAN	3.99	Agree	High

Scale	Range	Descriptive Rating	Qualitative interpretation
5	4.51-5.00	Strongly Ag	Very high technological efficacy
4	3.51-4.50	Agree	High technological efficacy
3	2.51-3.50	Uncertain	Moderate technological efficacy
2	1.51-2.50	Disagree	Low technological efficacy
1	1.00-1.50	Strongly Disagree	Very low technological efficacy

Table 2 shows that the mean scores across four key domains: Technological Knowledge (3.89), Technological Content Knowledge (4.01), Technological Pedagogical Knowledge (4.01), and Technological Pedagogical Content Knowledge (3.99). The overall mean score for technological efficacy among mathematics teachers is 3.99, which corresponds to a descriptive rating of "Agree" and a qualitative interpretation of "High." The data reveals a remarkably consistent level of technological efficacy, with all domain scores clustering tightly between 3.89 and 4.01. The highest scores are tied between Technological Content Knowledge and Technological Pedagogical Knowledge (both at 4.01), while

Technological Knowledge (3.89) represents the lowest, though still high, area of confidence. This indicates that teachers are generally equally comfortable with the tools themselves, the content-specific application of those tools, and the pedagogical methods used to integrate them.

In addition, the high, uniform mean scores suggest that the participating mathematics teachers have reached a balanced proficiency in their technological capabilities. The slightly higher scores in Content and Pedagogical knowledge compared to general Technological knowledge imply that these educators are more adept at applying technology to solve specific teaching problems than they are at navigating general technical functions. This is a positive sign for instructional quality, as it shows that teachers are prioritizing pedagogical utility and content relevance over mere technical skill.

The supporting literature consistently shows that teachers' self-efficacy in technology is a vital predictor of their actual classroom performance and their willingness to adopt new teaching methodologies. Studies emphasize that when teachers achieve a high, balanced proficiency in technological, pedagogical, and content knowledge, they are better equipped to enhance student engagement and academic outcomes. Furthermore, evidence suggests that fostering high levels of technological efficacy is essential for sustaining long-term quality assurance in instructional delivery within modern school environments.

3.2. Instructional Competency of Math Teachers

Table 3 presents the overall instructional competence of Math teachers

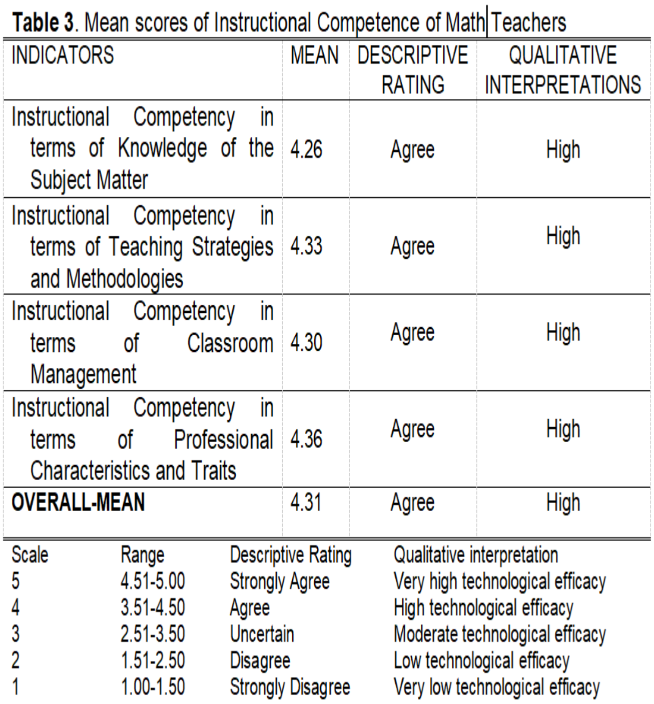

Table 3. Mean scores of Instructional Competence of Math Teachers

INDICATORS	MEAN	DESCRIPTIVE RATING	QUALITATIVE INTERPRETATIONS
Instructional Competency in terms of Knowledge of the Subject Matter	4.26	Agree	High
Instructional Competency in terms of Teaching Strategies and Methodologies	4.33	Agree	High
Instructional Competency in terms of Classroom Management	4.30	Agree	High
Instructional Competency in terms of Professional Characteristics and Traits	4.36	Agree	High
OVERALL-MEAN	4.31	Agree	High

Scale	Range	Descriptive Rating	Qualitative interpretation
5	4.51-5.00	Strongly Agree	Very high technological efficacy
4	3.51-4.50	Agree	High technological efficacy
3	2.51-3.50	Uncertain	Moderate technological efficacy
2	1.51-2.50	Disagree	Low technological efficacy
1	1.00-1.50	Strongly Disagree	Very low technological efficacy

Table 3 shows that the mean scores across four core instructional domains: Professional Characteristics and Traits (4.36), Teaching Strategies and Methodologies (4.33), Classroom Management (4.30), and Knowledge of the Subject Matter (4.26). The overall mean score for instructional competency is 4.31, which corresponds to a "High" descriptive rating. The data demonstrates remarkable consistency in competency across all categories, with all domain scores falling within a narrow range of 4.26 to 4.36. Professional Characteristics and Traits rank as the highest area of perceived competency, while Subject Matter Knowledge though still rated as highly proficient is the lowest scoring domain in this specific comparison.

In addition, the high, uniform mean scores suggest that the participating mathematics teachers perceive themselves as well rounded professionals who balance soft skills, such as professional enthusiasm, with technical classroom management and pedagogical expertise. The slight edge in "Professional Characteristics" suggests that intrinsic motivation and commitment to growth may be the strongest drivers of instructional identity, while the high scores across the board indicate that these teachers are effectively integrating multiple facets of professional life into their daily practice.

The supporting literature consistently indicates that instructional competency is a multidimensional construct, where teacher enthusiasm and professional traits significantly amplify the effectiveness of pedagogical strategies and content knowledge. Studies emphasize that when teachers maintain high, balanced proficiency across these domains, they create more stable and responsive learning environments for students. Furthermore, evidence suggests that fostering a professional culture that values both subject matter expertise and ongoing personal growth is essential for sustaining long-term quality assurance in mathematics education.

3.3. Correlation of Quality Assurance and Technological Efficacy on Instructional Competency of Mathematics Teachers

Table 4 reveals a correlation between quality assurance and technological efficacy in Mathematics teachers instructional competency.

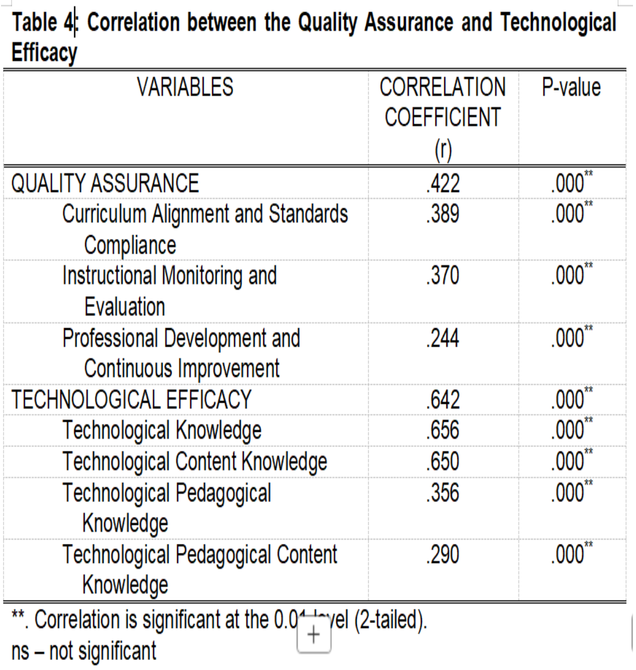

Table 4: Correlation between the Quality Assurance and Technological Efficacy

VARIABLES	CORRELATION COEFFICIENT (r)	P-value
QUALITY ASSURANCE	.422	.000**
Curriculum Alignment and Standards Compliance	.389	.000**
Instructional Monitoring and Evaluation	.370	.000**
Professional Development and Continuous Improvement	.244	.000**
TECHNOLOGICAL EFFICACY	.642	.000**
Technological Knowledge	.656	.000**
Technological Content Knowledge	.650	.000**
Technological Pedagogical Knowledge	.356	.000**
Technological Pedagogical Content Knowledge	.290	.000**

**. Correlation is significant at the 0.01 level (2-tailed).
ns – not significant

Table 4 shows that the correlation analysis has a significant positive relationship between Quality Assurance and Technological Efficacy (r = .642, p = 000). Specific components of Quality Assurance, such as "Curriculum Alignment and Standards Compliance" (r = .389) and "Instructional Monitoring and Evaluation" (r = .370), show moderate significant correlations with technological efficacy. Furthermore, components of Technological Efficacy, particularly "Technological Knowledge" (r = .656) and "Technological Content Knowledge" (r = .650), demonstrate strong, significant positive correlations with the overall quality assurance framework. The data confirms that as teachers' technological efficacy increases, their ability to adhere to quality assurance standards also improves. The strongest correlations appear between foundational technological knowledge and the overall Quality Assurance framework. While "Professional Development" (r = .244) and "Technological Pedagogical Content Knowledge" (r = .290) show weaker correlations, they remain statistically significant, suggesting that while the link exists, it is more pronounced in core technical and subject-specific domains rather than in broader professional development or complex pedagogical synthesis.

In addition, this significant correlation indicates that technology is not just an add on but a fundamental driver of quality assurance in modern mathematics education. Teachers who feel confident in their technical and content-specific technological knowledge are better equipped to align their curricula and monitor instructional quality effectively. The weaker correlation with professional development suggests that current training programs might not be fully bridging the gap between theoretical professional growth and the practical, daily integration of technology for quality assurance.

The supporting literature underscores that teachers' digital competencies are positively related to instructional interactivity, which in turn directly elevates the quality of teaching and learning experiences. Furthermore, studies demonstrate that aligning technology investments with specific curriculum goals significantly enhances teacher effectiveness and maximizes the utility of instructional resources. Finally, evidence suggests that the effective integration of technology is heavily influenced by the teachers' own knowledge and skills, which act as a foundational barrier or enabler for high-quality instruction.

3.4. Regression Analysis of Quality Assurance and Technological Efficacy on Instructional Competency of Mathematics Teacher

Table 5 presents the regression analysis of the relationship between quality assurance and technological competency on instructional competency of Mathematics teachers. This explores the instructional competencies of mathematics teachers, analyzing how subject matter knowledge, pedagogical strategies, and professional traits contribute to an effective and high-quality classroom learning environment.

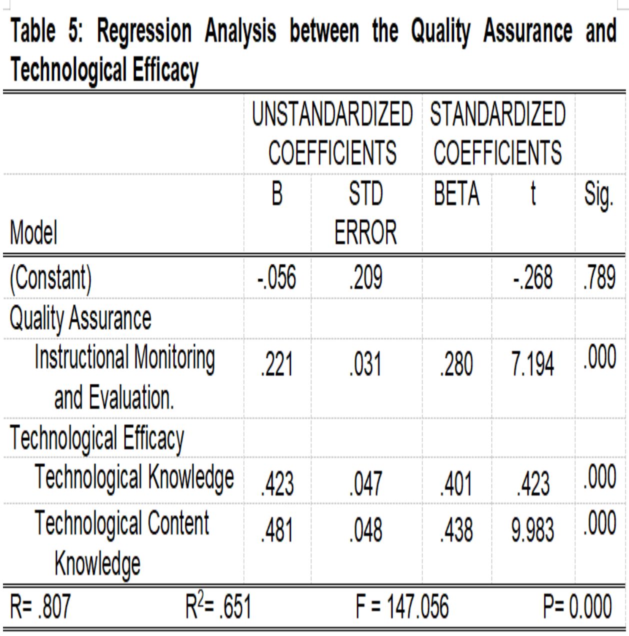

Table 5: Regression Analysis between the Quality Assurance and Technological Efficacy

	UNSTANDARDIZED COEFFICIENTS		STANDARDIZED COEFFICIENTS		
Model	B	STD ERROR	BETA	t	Sig.
(Constant)	-.056	.209		-.268	.789
Quality Assurance					
Instructional Monitoring and Evaluation.	.221	.031	.280	7.194	.000
Technological Efficacy					
Technological Knowledge	.423	.047	.401	.423	.000
Technological Content Knowledge	.481	.048	.438	9.983	.000
R= .807	R^2= .651		F = 147.056		P= 0.000

The regression model demonstrates a strong relationship between the independent variables (Quality Assurance and Technological Efficacy) and instructional competency, yielding a high coefficient of determination (R2 = .651. This indicates that approximately 65.1% of the variance in instructional competency is explained by these variables. Significant predictors include Technological Content Knowledge (β = .438), Technological Knowledge (β = .401), and Instructional Monitoring and Evaluation (β = .280), all of which show a significant positive impact (p = .000).

The regression equation derived from this analysis is expressed as follows:

$Y = -0.056 + 0.221X1 + 0.423X2 + 0.481X3$

Where:

Y = Instructional Competency

X1 = Instructional Monitoring and Evaluation

X2 = Technological Knowledge

X3 = Technological Content Knowledge

The regression equation identifies "Instructional Monitoring and Evaluation" (X1), "Technological Knowledge" (X2), and "Technological Content Knowledge" (X3) as significant contributors to instructional competency (Y). The model shows that Technological Content Knowledge (X3 = 0.481) exerts the strongest positive influence on instructional competency, followed by Technological Knowledge (X2 = 0.423), and finally Instructional Monitoring and Evaluation (X1 = 0.221).

The coefficients indicate that for every unit increase in Technological Content Knowledge, instructional competency is predicted to increase by 0.481 units, holding other factors constant. The constant (−0.056) suggests a minor downward baseline, which is fully offset by the positive contributions of the independent variables. The result confirms that the ability to integrate technology with mathematical content is the primary driver of teaching success, more so than general technological awareness or oversight processes.

This model highlights that instructional competency is not merely a product of monitoring and evaluation but is heavily dependent on a teacher's ability to weave technology into the very fabric of the math curriculum. While instructional monitoring provides necessary accountability (X1), the high weight on X3 demonstrates that professional development should move beyond general technical training and focus on the deep, content-specific integration of technology to maximize instructional impact.

The supporting literature confirms that the integration of content and technology is central to effective teaching, as outlined in the TPACK framework, where content knowledge dictates how technology is best applied to enhance student learning. Additionally, studies show that structured instructional monitoring and evaluation significantly increase teacher accountability and pedagogical quality, further contributing to improved performance. Finally, evidence indicates that teachers' technological efficacy, when aligned with specific pedagogical strategies, serves as a major determinant of their ability to foster high-level student achievement in mathematics.

4. CONCLUSION

Based on the results of the study, the following conclusion were derived:

Mathematics teachers demonstrate a high level practiced of quality assurance mechanisms, with curriculum alignment, instructional monitoring, and professional development all contributing to a strong, collaborative framework. This high-level adherence suggests that structured quality assurance processes are effectively integrated into school practices, providing teachers with the necessary foundations to deliver consistent mathematics instruction.

Mathematics teachers demonstrate a consistently high level of technological efficacy across all measured domains, including technological knowledge, content knowledge, pedagogical knowledge, and integrated content knowledge. This balanced proficiency indicates that teachers are well prepared to incorporate digital tools into their instructional practices, successfully bridging the gap between general technical skills and the specialized requirements of effective mathematics teaching.

Mathematics teachers demonstrate a high level of instructional competence across all critical domains, including subject matter knowledge, teaching methodology, classroom management, and professional character. The consistency of these high scores reflects a well-rounded teaching force that effectively balances deep academic knowledge with the interpersonal and pedagogical skills necessary to foster a productive, high-quality learning environment for all students.

Correlation analysis establishes a statistically significant positive relationship between Quality Assurance frameworks and the Technological Efficacy of mathematics teachers. This indicates that structured institutional processes such as curriculum alignment and instructional monitoring serve as foundational pillars that directly empower teachers to develop and apply their technological skills more effectively within the classroom. The findings confirm that technological proficiency is not an isolated skill but is deeply interdependent with the quality assurance structures designed to guide teaching standards and professional growth.

The regression analysis confirms that quality assurance practices and technological efficacy are powerful joint predictors of instructional competency, accounting for 65.1% of the variation in teacher performance. Specifically, the findings demonstrate that technological content knowledge is the most influential driver of competency, followed by technological knowledge and instructional monitoring, proving that instructional success in mathematics is best achieved when teachers possess specialized, content-focused digital skills supported by systematic monitoring frameworks.

5.RECOMMENDATIONS

Findings and conclusion of the study led to some recommendations:

Teachers may adopt a collaborative, growth-oriented mindset, working closely with supervisors and peers to identify strengths and areas for improvement. They should engage in personalized professional development focused on technology integration, differentiated instruction, and peer-to-peer learning networks. Mathematics teachers should also actively participate in curriculum planning and review to keep standards rigorous and responsive to students' evolving needs.

Educational institutions personnel may move beyond basic technological training and provide specialized, high-impact professional development. Schools should foster "communities of practice" where teachers can share effective digital pedagogical strategies, deepen their mastery of innovative software that targets complex mathematical concepts, and shift from using technology in isolated classrooms to taking on collaborative, school-wide technology leadership roles.

The school administrators may prioritize the implementation of mentorship programs that pair veteran teachers with newer faculty to share successful teaching strategies and classroom management techniques. Furthermore, schools should provide specialized professional development that targets advanced pedagogical research and innovative instructional technologies, allowing teachers to evolve beyond their current high-performance levels. Finally, institutions should create mechanisms that celebrate professional enthusiasm and lifelong learning, ensuring that the intrinsic motivation of teachers is consistently nurtured and supported by the school community.

Policy makers may embed technological training into quality assurance systems, ensuring that professional development and curriculum guidelines treat digital tools as a standard part of teaching. They should strengthen monitoring through technology-based pedagogical reviews and support targeted professional development that connects general technology skills with specialized technological pedagogical content knowledge to improve teaching and learning.

Curriculum creators may design targeted professional development at the intersection of technology and mathematics, not general technical training. They should align monitoring systems to give data-driven feedback on how teachers use digital tools for specific math topics and allocate resources to deepen teachers' technological pedagogical content knowledge, as this strongly supports instructional quality and classroom effectiveness.

Lastly, future researchers are encourage to conduct additional research employing quantitative or qualitative designs to validate the study findings across various Math teachers' practices.and engages.

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