



# From Tales to Triangles: Storytelling’s Effect on Students’ Understanding of Trigonometric Ratios

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## Abstract

## Review Article

This study investigated the effectiveness of a storytelling-based instructional approach in enhancing the conceptual understanding and practical application of trigonometric ratios among Grade 9 students at Victoria High School, Aglipay, Quirino. Grounded in the theories of Contextualized Learning, Cognitive Load Theory, and Narrative Transportation, the research addressed the perception of mathematics as abstract and disconnected from real-world utility. A quasi-experimental research design was employed, involving an experimental group (storytelling-based instruction) and a control group (traditional instruction). The results showed significant improvements in both groups' performance, but the experimental group significantly outperformed the control group ( $t = 4.013, p < .001$ ) with a higher mean gain (11.72) and large effect size ( $d=1.169$ ). The results indicate that Storytelling significantly improves the performance of students in trigonometric ratios. It is recommended that educators integrate blended approaches such as digital storytelling and gamification to further contextualize Grade 9 concepts like SOH-CAH-TOA within student-centered interests and real-world scenarios.

**Keywords:** Storytelling-based Instruction, Trigonometric Ratios, Contextualized Learning, SOH-CAH-TOA, Grade 9 Mathematics.

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## Introduction

Mathematics is a cornerstone of learning, crucial for honing logical thinking, analytical skills, and the ability to solve problems. Trigonometry, as a branch of mathematics, explores the connection between a triangle’s angles and sides, but it often feels distant and theoretical to students. This is amplified by the teaching method that prioritizes memorized formulas and step-by-step problem solving than giving contextual and meaningful learning through its real-world use and application

(Adhikari & Subedi, 2021). Recent international assessments like Programme for International Student Assessment (PISA, 2018; 2022) and the Trends in International Mathematics and Science Study show a consistently low performance of Filipino students in mathematics (Bacsal & Marco, 2023). To address this, the Department of Education launched the MATATAG: Bansang Makabata, Batang Makabansa Agenda in January 2023 to make the curriculum relevant and improve education through seeking innovative strategies and



approaches in teaching Mathematics (DepEd, 2023). One innovative strategy is the narrative approach or the use of storytelling. According to Dietiker et al. (2023), stories arrest students’ participation and emotional engagement. This is parallel to the concept of constructivism that allows learners to make information and learning through significant real-world experiences. Previous research suggests that this approach increases interest in complex concepts and transforms classrooms from rote procedural repetition into a place for deep conceptual thinking (Amita, 2023; Junkin, 2023). However, storytelling has been increasingly applied in early mathematics and elementary contexts, while its use in secondary-level topics such as trigonometry remains underexplored.

This study aims to investigate the effect of storytelling on the understanding of trigonometric ratios in practical contexts among Grade 9 students of Victoria High School.

**Methodology**

This study employed a quasi-experimental, non-equivalent pretest-posttest design to evaluate the effectiveness of storytelling-based instruction compared to the traditional method in solving Trigonometric ratios in Practical Contexts. The participants were 54 Grade 9 students from two intact classes at Victoria High School, who went through a

homogeneity test using a standardized diagnostic test in mathematics (Levene’s test = 0.458,  $p = 0.501$ ), consisting of 24 students in the Experimental Group (Storytelling Group) and 30 students in the Control Group (Traditional Group). Purposive sampling was used to select these respondents. The two-week study started with a pre-assessment for both experimental groups to determine their baseline knowledge in mathematics. During the experimental phase, the Experimental group received a mix of storytelling instruction and traditional teaching methods, while the control group was taught using pure traditional lecture-based teaching.

The proponent utilized a teacher-made pretest-posttest multiple-choice test in trigonometric ratios, validated by experts for content, clarity, and language use, test format and organization, and reliability, as the primary source of data collection. The collected data were analyzed using the independent samples t-tests and Cohen’s  $d$  when significant differences and effect size of the Storytelling Approach were evaluated. Additionally, the Shapiro-Wilk test was used to test the normality of the data, and Levene’s tests in ensuring the comparable baseline knowledge of the participants between groups. Ethical standards were strictly maintained through informed consent and the use of a participant coding system for data privacy and confidentiality.

**Results and Discussions**

Table 1. Pretest Performance of the Participants in Solving Trigonometric Ratios as Reflected by the Mean Percent Score

Group	N	Mean Percent Score	SD	T	p-value	Decision
Storytelling Group	24	63.44	2.34	-0.621	0.537	Fail to reject Ho
Traditional Group	30	63.83	2.32			

*p-value ≤ 0.05 is significant*

The pretest performance of the two experimental groups presented in Table 1 reveals comparable baseline levels of proficiency ( $t = -0.621, p = .537$ ),

with Storytelling Group’s mean score of 63.44 (SD= 2.34) and Traditional Group’s mean score of 63.83 (SD= 2.32), in solving trigonometric ratios,

indicating that the mean difference is not statistically significant. This result confirms the homogeneity of

the two experimental groups, which is relevant in conducting quasi-experimental research.

Table 2. Posttest Performance of the Participants in Solving Trigonometric Ratios as Reflected by the Mean Percent Score

Group	N	Mean Percent Score	SD	t	p-value	Decision
Storytelling Group	24	75.16	6.74	4.013	<.001	Reject Ho
Traditional Group	30	69.71	2.84			

*p-value ≤ 0.05 is significant*

The analysis of significant difference in the mean scores of the two groups in the posttest utilizing the independent samples t-test reveals a statistically significant result,  $t = 4.01$ ,  $p < .001$ , highlighting that the Storytelling Group achieved significantly higher posttest scores ( $M = 75.16$ ,  $SD = 6.74$ ) than the Traditional Group ( $M = 69.71$ ,  $SD = 2.84$ ). This suggests that the storytelling approach is more effective than traditional methods in improving performance in trigonometric ratios.

This result is supported by the studies by Saifi and Lal (2024), Ani et al. (2024), and Lemonidis (2024), which demonstrate that the storytelling

approach significantly boosts academic achievement and problem-solving skills in primary learners, particularly in mathematics and complex concept acquisition. This success extends to secondary education, where Al-Bayati and Hassan (2023) noted marked improvements in geometric and trigonometric proficiency. Reinforced by Shemy's (2021) findings, the data collectively suggest that the narrative structures with technology create a more impactful learning environment than traditional instruction, even for learners at the preschool level, as evidenced by increased engagement and retention of information among young children.

Table 3. Comparison of the Mean Gain Scores of the Participants in the Pretest and Posttest on Solving Trigonometric Ratios

Group	N	Mean Gain	SD	t	p-value	Cohen's d	Decision
Storytelling Group	24	11.72	6.33	4.425	< .001	1.169	Reject Ho
Traditional Group	30	5.88	3.15				

*p-value ≤ 0.05 is significant*

*Cohen's d: small effect size = around 0.2  
medium effect size = around 0.5  
large effect size = around 0.8 or higher*

The comparison of the mean gain scores reveals that both groups showed improvements, where the Storytelling Group ( $M = 11.72$ ,  $SD = 6.33$ )

achieved a higher mean gain than the Traditional Group ( $M = 5.88$ ,  $SD = 3.15$ ). Independent samples t-test reveals a statistically significant difference,  $t =$

4.425,  $p < .001$ , indicating that participants exposed to the storytelling-based instructional approach gained greater improvement in solving trigonometric ratios compared to those who underwent traditional instruction. This validates that the higher mean gain presented in the Storytelling Group can be attributed to the effectiveness of the instructional approach and not due to chance.

These results align with Katipogle et al. (2024), who found that storytelling led to a statistically significant increase in academic achievement among Grade 5 students compared to traditional methods. Furthermore, the findings support Katipogle et al. (2021), where a mean gain of 5.18 was observed in Grade 3 participants, confirming that storytelling serves as a tangible catalyst for improving mathematical problem-solving abilities across various educational levels.

Moreover, the findings reveal that in terms of practical significance, the calculated Cohen's  $d$  of 1.169 represents a large effect size, exceeding the 0.80 threshold for substantial practical impact. This suggests that the difference in mean gains between the two groups is substantial and educationally meaningful. This means that the average student in the Storytelling Group would be expected to outperform 88% of those in the Traditional Group. The storytelling intervention demonstrated a transformational effect on learning abstract trigonometric concepts by nearly doubling the improvement of the control group.

These findings align with the meta-analysis by Zhang and Ma (2023), which confirms that narrative-integrated models enhance cognitive engagement and retention compared to traditional instruction. Similarly, Sherwood and Makar (2024) argue that storytelling explains complex mathematical topics by presenting authentic, relatable contexts. The large effect size observed in this study ( $d = 1.169$ ) is consistent with studies of Dai et al. (2022), which reported a medium-to-large effect ( $d = 0.74$ ) in narrative-based learning interventions, while Saifi and Lal (2024) and Ani et al. (2024) observed large effects of  $d = 0.81$  and  $d = 0.85$ , respectively. Furthermore, Al-Bayati and Hassan (2023) demonstrated a transformative impact

with an exceptionally high effect size of  $d = 0.94$ . These results suggest that contextualizing mathematics through storytelling shifts the performance curve significantly more than traditional teaching practices toward understanding of abstract concepts.

Based on the study's findings, the proponent concluded that, while both methods yielded significant results, posttest outcomes revealed a substantial advantage for the storytelling group, which achieved a mean gain nearly double that of the traditional group. These significant differences in mean gain scores, coupled with a large effect size, underscore that the storytelling approach has the potential of contextualized and engaging instructional strategy to facilitate deeper understanding and improved achievement in mathematics as a highly effective pedagogical tool for improving Grade 9 students' mastery of trigonometry in practical contexts.

Evidence indicates that the storytelling approach, particularly when blended with traditional instruction, serves as a superior pedagogical tool, resulting in significantly higher academic performance and a large effect size. Therefore, educators and instructional designers may consider incorporating integrated strategies such as active learning, systematic problem-solving, and contextual storytelling to maximize conceptual understanding in trigonometry and related mathematical fields. Future research and curriculum design may explore digital storytelling or gamified platforms to convert high motivation into measurable academic gains, specifically by contextualizing Grade 9 concepts like SOH-CAH-TOA within real-world scenarios and students' personal interests.

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