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Technolearn: Utilization of Geogebra Math Tool in Enhancing Students' Academic Performance in Mathematics

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ABSTRACT

Traditional teaching methods often struggle to engage students and provide them with the necessary tools to visualize and comprehend mathematical ideas. With the advancement of technology, tools like GeoGebra have been introduced to provide interactive, visual, and engaging approaches to learning mathematics. This study examined the effectiveness of utilizing the GeoGebra Math Tool in enhancing the academic performance of Grade 8 students in Mathematics at Isuko Integrated School during the School Year 2025–2026. The study employed a quantitative quasi-experimental design. A total of 38 Grade 8 students participated in the study through total enumeration sampling. Data were gathered using a validated mathematics achievement test for pretest and posttest measures, and an adopted survey questionnaire to assess the quality of the GeoGebra Math Tool in terms of content, graphics, accessibility, usability, and overall function. A paired-sample *t*-test was used to analyze the data. Results showed that the GeoGebra Math Tool was rated at a high extent across all quality indicators. Findings further revealed a significant improvement in students' academic performance after the integration of GeoGebra, as evidenced by a substantial increase in posttest scores. The computed *t*-value exceeded the critical value at the 0.05 level of significance, leading to the rejection of the null hypothesis. The study concludes that GeoGebra is an effective instructional tool that significantly enhances students' academic performance in Mathematics. Its integration is recommended, particularly in last-mile and resource-limited schools, to support meaningful and engaging mathematics learning.

Keywords: *Technology Integration, Contextualize Learning, Instructional Media, Multimedia learning.*



INTRODUCTION

Background of Study

Mathematics is a critical subject in the academic curriculum that plays a key role in critical thinking and problem-solving skills. Traditional teaching methods often struggle to engage students and provide them with the necessary tools to visualize and comprehend mathematical ideas. With technology, tools like GeoGebra have been introduced to provide interactive, visual, and engaging approaches to learning mathematics. Despite its availability, many students continue to face difficulties with mathematical concepts. This raises the need to investigate whether GeoGebra, as a teaching aid, can effectively enhance students' academic performance in last-mile school areas.

Within a robust international evidence base showing that dynamic mathematics software, especially GeoGebra improves learners' achievement, conceptual understanding, and self-regulated learning across diverse settings (Juandi et al., 2021). Meta-analytic and review studies consistently report positive effects of GeoGebra and related dynamic tools on mathematics performance, with benefits amplified when paired with inquiry-oriented pedagogies and thoughtfully designed implementation (Zhang, 2025).

Recent classroom investigations likewise find that GeoGebra-supported lessons strengthen geometry understanding and reasoning, and that integrating GeoGebra into flipped learning enhances students' autonomy. Engagement and outcomes are critical when resources are scarce and instructional time is limited (Gurmu, 2024; Ishartono et al., 2022).

Building on this global literature, TECHNOLEARN aims to localize best practices and visualization, interactive exploration, and formative feedback, so that learners in remote Philippine schools can translate technology-enabled mathematics experiences into measurable gains in academic performance and equitable opportunity.

In the Philippine context, the Department of Education (DepEd) has been actively working towards improving the quality of education, particularly in Science, Technology, Engineering, and Mathematics (STEM). According to DepEd Order No. 21, s. 2019, the Philippine education system is moving towards integrating digital tools in the classroom to address students' challenges in understanding difficult subjects like mathematics. However, Filipino students have consistently ranked among the lowest in international assessments such as PISA and TIMSS, raising concerns about the effectiveness of traditional teaching strategies (Roble, 2021).

Limited resources and reliance on conventional pedagogies are often cited as barriers to improving math achievement (Coronado, 2023). To address this, Philippine educators are increasingly exploring the integration of digital tools like GeoGebra to strengthen student learning and align with the broader vision of quality STEM education.



In particular, students in South Central Mindanao have struggled with low mathematics scores, highlighting the need for innovative teaching tools like GeoGebra to address these challenges. The DepEd has introduced initiatives such as the ICT for Education program to address the digital divide and promote the use of technology in schools. In South Central Mindanao, where a significant number of Indigenous and rural students face educational challenges, there has been an effort to implement ICT programs to bridge the gap (DepEd Region XII, 2020).

However, the integration of tools like GeoGebra into regular mathematics instruction has been minimal, and the impact of such tools on student performance remains understudied. Given the diversity of the student population in this region, incorporating technology like GeoGebra could help create a more engaging and effective learning environment.

Hence, quality mathematics education is a global priority, as reflected in the United Nations' Sustainable Development Goal 4 (SDG 4), which emphasizes inclusive and equitable quality education for all. Around the world, 21st-century learning initiatives highlight the role of educational technology in improving learning outcomes and expanding access (Khalil et al., 2020). In this context, integrating digital tools into mathematics classrooms is seen as a promising pathway for enhancing student performance and engagement (Coronado, 2023).

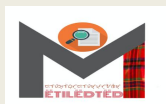
Generally, this study aimed to use the GeoGebra Math Tool to enhance the academic performance of Junior High School students in mathematics learning. Specifically, the researcher investigated how GeoGebra improved students' understanding of mathematical concepts, their problem-solving skills, and their overall engagement with the subject.

Statement of the Problem

Generally, this study aimed to determine the effectiveness of the GeoGebra math tool in enhancing the students' academic Performance at Isuko Integrated School, Isuko, Baluan, Palimbang, Sultan Kudarat during the school year 2025-2026.

Specifically, this study aimed to answer the following questions:

1. What is the quality of GeoGebra math tool, in terms of:
 - 1.1. Content;
 - 1.2. Graphics;
 - 1.3. Accessibility;
 - 1.4. Usability; and
 - 1.5. Overall Function?



-
2. What is the level of the students' academic performance in their pretest and posttest?
 3. Is there a significant difference between the students' academic performance in the pretest and posttest?

METHODOLOGY

Research Design

The study employed a quantitative research design, specifically a quasi-experimental approach, to determine the effectiveness of utilizing the GeoGebra Math Tool in enhancing students' academic performance in Mathematics at Isuko Integrated School, Division of Sultan Kudarat, during the school year 2025–2026.

According to Maciejewski (2020), the challenges involved in designing and executing a quasi-experimental assessment included considerations for design, measurement, and statistical concerns. These encompassed the selection of treatment and comparator cohorts, the definition of inclusion and exclusion criteria, and the distinction of five categories of explanatory factors prior to analysis to ensure internal validity. Additionally, the researcher addressed critical components such as data collection protocols, confidentiality, statistical power, and the resolution of significant analytical difficulties inherent in the quasi-experimental framework.

Respondents of the Study

This study's respondents were the Grade 8 students of Isuko Integrated School, officially enrolled for the school year 2025-2026. A total of 38 students will be part of this utilization.

Sampling Technique

This study employed the Total Enumeration Sampling Technique for Grade 8 students who were officially enrolled in Isuko Integrated School, division of Sultan Kudarat, during the school year 2025-2026. According to Ahmed (2024), Total Enumeration is appropriate when the target population is small, accessible, and manageable, as it allows researchers to include all members of the group, thereby eliminating sampling error and ensuring complete representation. This approach has been widely applied in recent studies across disciplines.

Research Instruments

The integration of GeoGebra in the class was used to test its effectiveness on the academic performance in Mathematics of the student-respondents. Further, an adopted survey questionnaire from Hadjerrouit, (2018) was employed to determine the quality of the GeoGebra math tool in teaching mathematics based on students' experience.



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The researcher also established a 5-Point Likert Scale to determine the quality of GeoGebra as a math tool in terms of content, graphics, accessibility, usability, and overall function.

RATING	RANGE OF MEAN	DESCRIPTIVE RATING	INTERPRETATION
5	4.20-5.00	Very High Extent	Meets above 91-100% quality relevance
4	3.40-4.19	High Extent	Meets above 75-90% quality relevance
3	2.60-3.39	Moderate Extent	Meets above 60-74% quality relevance
2	1.80-2.59	Less Extent	Meets above 35-39% quality relevance
1	1.00-1.79	Least Extent	Meets above 35-39% quality relevance

On the other hand, to determine the level of academic performance of Grade 8 students in their Mathematics class, the Classroom Assessment K to 12 Basic Education Program, which was adopted from DepED, DO 8, s, 2015, and patterned after the study of Ngag (2023) as an assessment tool intended for the students' achievements, was used:

Rating Scale	Description	Remarks
90%-100% (5)	Outstanding	Passed
85%-89% (4)	Very Satisfactory	Passed
80%-84% (3)	Satisfactory	Passed
75%-79% (2)	Fairly Satisfactory	Passed
Below 75% (1)	Did not meet the expectations	Failed



Data Gathering Procedure

After the Dean of the Graduate School of EWMCI granted permission to conduct the study, the researcher focused on the research problems stipulated in Chapter I.

A letter of request was sent to the Schools' Division Superintendent of Sultan Kudarat to allow the researcher to gather and process the data using official time at Isuko Integrated School.

Another letter was addressed to the School Principal of Isuko Integrated School, requesting permission to conduct the study during class time for instruction and test administration.

Before the conduct, the research proposal underwent ethical considerations. The researcher sought clearance from the EWMCI Research Ethics Committee (EREC).

The pre-test and post-test were used to identify the benefits of using GeoGebra in teaching Mathematics.

The academic progress of the students was evaluated using the K to 12 Assessment Tool, adopted from DepEd, DO 8, s, 2015, and based on the study of Ngag (2023).

Statistical Treatment Data

After data gathering, the data were arranged, collated, examined, and evaluated. The problems were addressed using the statistical techniques listed below:

The mean and standard deviation were used to describe the students' performance in the experimental groups on the pre-test and post-test. Additionally, the mean gain scores of the groups were calculated using a t-test to determine whether there was a significant difference in students' achievement between the pretest and posttest.

Scope and Limitations

This study focused on evaluating the GeoGebra Math Tool, a dynamic mathematics software, in enhancing the academic performance of Grade 8 junior high school students in mathematics. The research was conducted at Isuko Integrated School during the academic year 2025-2026, and it specifically covered lessons in mathematics where visualization and interactive exploration are most applicable. The study employed a quasi-experimental pretest-posttest to determine the effectiveness of the GeoGebra Math Tool in enhancing the students' academic performance.



The study was specific to Grade 8 students at Isuko Integrated School, and therefore, the findings did not fully represent students in private institutions, other grade levels, or different regions. The subject matter was confined to selected algebra and geometry topics, excluding other strands of mathematics such as statistics, trigonometry, and calculus. The intervention ran for three months, which might not be sufficient to capture long-term knowledge retention or the full potential of GeoGebra integration. In terms of technology, the investigation was limited to GeoGebra as the primary digital tool, with no inclusion of other educational technologies or applications. Moreover, external factors such as students' prior knowledge, socio-economic background, learning styles, and access to technology outside the classroom were beyond the scope of this research but might indirectly influence the outcomes.

RESULTS AND DISCUSSIONS

The findings revealed that the GeoGebra Math Tool was rated positively by students across all indicators: content, graphics, accessibility, usability, and overall function. In terms of content, students agreed that GeoGebra helped them understand mathematical lessons more clearly and that the examples and activities were aligned with classroom instruction. This indicates that the instructional content delivered through GeoGebra was relevant, clear, and supportive of learning.

The students described the visual features of GeoGebra as clear, engaging, and helpful in visualizing abstract mathematical concepts. The graphs, figures, and interactive animations contributed to increased interest and improved comprehension of lessons.

In terms of accessibility, the students generally agreed that GeoGebra was accessible on their personal devices and could be used both at school and at home. However, the use of GeoGebra during unstable internet conditions was rated as a moderate extent, indicating that connectivity remains a limitation. Despite this challenge, the tool was still considered largely accessible and convenient for learning.

The findings on usability showed that GeoGebra was easy to use. Students reported that they could navigate the menus and buttons with ease, learn how to use the tool quickly, and work independently with minimal assistance. The instant feedback provided by GeoGebra also supported efficient and effective learning.

In terms of overall function, students reported positive learning experiences when using GeoGebra. The tool increased their confidence in learning mathematics, encouraged active class participation, and improved their problem-solving skills. Most students expressed satisfaction with their overall experience and were willing to recommend GeoGebra to their classmates.

Finally, the results revealed a significant improvement in students' academic performance. The pretest results showed that students initially did not meet the expected level of performance in Mathematics. After using GeoGebra, the posttest results improved to a satisfactory level. Statistical analysis further revealed a significant difference between the pretest and posttest scores ($p = 0.001$), leading to the rejection of the null hypothesis.



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This finding confirms that the utilization of the GeoGebra Math Tool had a statistically significant effect on enhancing students' academic performance in Mathematics.

Conclusion

The following were the conclusions of the research in line with the findings of this study:

The study concluded that the GeoGebra Math Tool is an effective and high-quality instructional aid in teaching Mathematics. Its use supports a clearer understanding of mathematical concepts through relevant content, interactive visuals, and user-friendly features that allow students to learn independently with minimal assistance.

Further, GeoGebra in classroom instruction increases students' confidence, engagement, and problem-solving skills, contributing to more positive learning experiences.

Furthermore, students' academic performance in Mathematics significantly improved after using GeoGebra, as evidenced by higher posttest scores compared to pretest scores.

Finally, the significant difference between the pretest and posttest results confirmed that GeoGebra-assisted instruction had a measurable and positive effect on students' academic performance.

Recommendations

Considering the findings and conclusions of the research study, the following were recommended:

1. Teachers are encouraged to integrate GeoGebra into mathematics instruction to improve student engagement and understanding, especially in abstract topics.
2. School administrators should support ICT integration by providing access to digital tools and professional development opportunities for teachers.
3. The Department of Education (DepEd) may strengthen programs that promote the use of educational technology in mathematics, particularly in rural and last-mile schools.
4. Students should be encouraged to use GeoGebra as a supplementary learning tool to enhance independent learning and problem-solving skills.
5. Future researchers may conduct similar studies using larger samples, longer intervention periods, or different mathematical areas to further validate the effectiveness of GeoGebra.



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Compliance with Ethical Standards

In preparation for implementation, all plans and recommendations were presented to East-West Mindanao Colleges Inc to ensure compliance with prescribed procedures and protocols. In the context of using GeoGebra in enhancing students' academic performance, it was imperative to emphasize the paramount importance of ethical considerations. Before commencing this study, the following ethical principles were highlighted:

Informed Consent. Before participation, consent was obtained to the participants involved in the study. They must possess a comprehensive understanding of the study's objectives, methodologies, potential risks, and benefits. Furthermore, participation remained voluntary, allowing participants to withdraw from the study at any juncture without adverse consequences.

Anonymity and Confidentiality. To safeguard identities and responses, rigorous measures were in place to ensure anonymity and confidentiality. Rather than using actual names, pseudonyms or codes were used to uphold the participants' privacy. The collected data was securely stored with access restricted solely to the research team.

Avoiding Harm. Delicate subjects, such as the challenges inherent in their roles, were discussed with meticulous consideration for the potential emotional and psychological impact on the participants. Strategies were in place to minimize distress, and a support system was readily available to assist participants should the need arise.

Researcher-Participant Relationship. The researcher maintained a professional and respectful rapport when engaging with the participants. Any actions that might exploit or harm the participants were scrupulously avoided, ensuring their utmost dignity and respect throughout the research process.

Data Protection. Data protection laws and regulations were complied with to safeguard the participants' personal information. Stringent measures will be employed to ensure the secure storage and transmission of data.

Voluntary Participation. Participants were assured that their involvement in the study was voluntary, devoid of any coercion or external pressure.

Researcher Bias. The researcher remained vigilant regarding potential biases that might influence data collection and analysis, upholding objectivity and transparency throughout the research endeavor.

Institutional Approval. Before initiating the study, the researcher diligently sought ethical clearance from the pertinent institutional review boards or ethics committees.

Honesty and Integrity. The research findings were reported truthfully and accurately, devoid of manipulation or distortion to align with preconceived notions or biases.



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Beneficence. The potential benefits of the research were considered, ensuring that the study positively contributes to the education system.

Inclusion and Diversity. The study's structure prioritized inclusivity and diversity, encompassing a wide spectrum of effectiveness in using GeoGebra Math as a tool in enhancing students' academic performance.

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Declaration AI Tools Utilization

I do hereby declare the use AI tools, such as Chat GPT and Grammarly for grammar checking and sentence organization purposes only.

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