NASARAWA STATE UNIVERSITY

KNOWLEDGE FOR DEVELOPMENT

JOURNAL OF SCIENCE, TECHNOLOGY AND EDUCATION (JSTE)

A PUBLICATION OF THE DEPARTMENT OF SCIENCE, TECHNOLOGY & MATHEMATICS EDUCATION (STME), NASARAWA STATE UNIVERSITY, KEFFI

VOLUME 9

ISSN: 2651-5539

JOURNAL OF SCIENCE, TECHNOLOGY AND EDUCATION (JSTE) VOL. 9. NO. 19

JSTE PUBLICATIONS, 2025 www.nsukjste.com/

ISSN: 2651-5539

EFFECT OF DESMOS INSTRUCTIONAL SOFTWARE ON INTEREST IN QUADRATIC GRAPHS AMONG SECONDARY SCHOOL STUDENTS IN KARU, NASARAWA STATE, NIGERIA

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Citation: Anaekwe, C. F., Musa, D. C. & Azige, G. D. (2025). Effect of Desmos instructional software on interest in quadratic graphs among secondary school students in Karu, Nasarawa State, Nigeria. *Journal of Science, Technology, and Education (JSTE)*; www.nsukjste.com/ *9*(19), 250-262

Abstract

This study determined the effect of Desmos Instructional Software on interest in quadratic graphs among secondary school students in Karu, Nasarawa State, Nigeria. A quasi-experimental research design of pre-test, post-test, control group was used in this study. The population of the study comprised 10,543 senior secondary school two (SS2) students in Karu, Nasarawa State. Ninety-two (92) students from two intact classes, of which 44 were male and 48 were female, were made up of 44 students in the experimental group purposively selected and 48 students in the control group randomly picked for this study. Two research questions and two null hypotheses guided the study. The instrument for data collection was the Quadratic Graph Interest Scale (QGIS). The instrument was validated by three experts with an average validity index of 0.84. The reliability of the QGIS was determined using Cronbach Alpha and was found to be 0.89. Descriptive statistics of mean and standard deviation were used to answer the research questions, while inferential statistics of Analysis of Covariance (ANCOVA) was used to test the null hypotheses at a 0.05 level of significance. The findings revealed that Desmos Instructional Software significantly enhanced students' interest in quadratic graphs, and had no significant difference between male and female students. It was recommended that mathematics teachers integrate Desmos Instructional Software into classroom instruction to improve students' interest in mathematics.

Keywords: Desmos, interest, quadratic graphs, instructional software, mathematics education.

Introduction

Mathematics is commonly defined as the study of quantities, numbers, shapes, patterns, and their relationships, using logical reasoning and computational methods to solve problems (Fitzmaurice et al., 2021). It plays a vital role in science, engineering, technology, and economics by fostering problem-solving and analytical skills essential for individual and societal advancement (Smith, 2017; Vos, 2020).

Because of its significance, mathematics is a core subject in Nigeria's education system, compulsory for all students at the primary and secondary school levels (Atiku, 2018). Despite its importance, many secondary school students in Nigeria display low interest in mathematics, especially in challenging topics such as quadratic graphs. Interest is a motivational and emotional state that drives students to engage in learning because they find it personally meaningful, useful, or enjoyable (Hidi & Renninger, 2006). Students who are genuinely interested in mathematics are more likely to engage actively, persist through challenges, and achieve long-term mastery of concepts. Conversely, low interest often results in disengagement, lack of participation, and poor performance. Research shows that higher levels of mathematics interest are strongly associated with improved persistence and willingness to take on mathematics-related careers, particularly in STEM fields (Hasni, 2014; Harackiewicz et al., 2008). Interest in mathematics enables students to stay steadfast in the face of difficult and abstract concepts like geometry, polynomials, and algebra. One of these abstract concepts is quadratic graphs.

Quadratic functions form a core component of the senior secondary school mathematics curriculum. They are foundational for developing problem-solving skills and analytical thinking, with applications in physics, engineering, economics, and other STEM-related disciplines. However, in Nigeria and particularly in Nasarawa State, students have persistent difficulties in interpreting quadratic graphs. Reports by the West African Examinations Council (WAEC) have consistently highlighted students' struggles in understanding key graph features such as the vertex, axis of symmetry, intercepts, and the overall behavior of parabolic curves. These difficulties are exacerbated by conventional teaching methods that rely heavily on rote memorization and manual plotting, which do little to engage students or develop their conceptual understanding. As a result, many students lose interest in mathematics, viewing

it as abstract and disconnected from their lives. Mathematics educators have been seeking a way to make abstract concepts lucid to maximise learners' engagement and productivity, and one of the ways of improving the teaching and learning of mathematics is by using technology.

The integration of technology into mathematics instruction has emerged as a promising way to improve students' interest. Desmos instructional software provides an interactive platform where students can manipulate equations and observe real-time changes in graphs. This dynamic learning environment supports exploration and discovery, enabling students to see immediate visual connections between algebraic expressions and their graphical representations. Such tools align with student-centered learning theories, making lessons more engaging and meaningful while stimulating curiosity and motivation. Desmos has the potential to bridge the gender gap in learning mathematics by providing an equitable platform where students can easily interact with concrete means and visualize those abstract concepts.

Furthermore, gender differences in mathematics education have been widely studied globally, with research showing that sociocultural and psychological factors often lead to disparities between male and female students. In Nigeria, gender stereotypes and unequal access to resources can negatively influence female students' participation and interest in mathematics (Musa & Samuel, 2019). These disparities are especially evident in rural and underserved communities like Karu, Nasarawa State, where cultural expectations may discourage girls from pursuing mathematics and related STEM careers. Lower levels of mathematics interest among female students contribute to their underrepresentation in STEM fields, creating long-term societal and economic implications.

Studies suggest that technology-based interventions like Desmos can play a role in reducing gender gaps by providing equal opportunities for exploration and engagement. When female students interact with interactive digital tools, they often report higher confidence and interest levels, as such tools reduce math anxiety and promote positive learning experiences (Bamberger, 2014; Wang & Degol, 2013). By creating a collaborative and inclusive learning environment, Desmos has the potential to close gender gaps and inspire more female students to develop sustained interest in mathematics.

Given the persistent challenges of low student interest and gender disparities, there is a pressing need to explore innovative instructional approaches that can make mathematics learning more engaging. This study focuses on the use of Desmos instructional software as a tool to improve students' interest in quadratic graphs. It also examines whether male and female students benefit equally from this technology-enhanced approach, with the goal of identifying strategies that promote inclusivity and equity in mathematics education.

Statement of the Problem

Mathematics is a foundational subject essential for academic success and critical thinking. However, students' interest in mathematics, particularly in topics like quadratic graphs, remains alarmingly low in Nigeria, and notably in Nasarawa State. Conventional teaching methods, characterized by rote memorization and manual plotting, fail to actively engage students or make learning meaningful. These methods often leave students unable to connect theoretical concepts to graphical representations, resulting in disinterest and frustration.

The persistent reports from WAEC Chief Examiners highlight this problem, showing year after year that students struggle with interpreting quadratic graphs, understanding their features, and applying them to real-life situations. In underserved communities, limited access to modern teaching tools and a lack of exposure to interactive resources further compound these difficulties. Female students are particularly affected, as gender stereotypes and socio-cultural barriers contribute to lower levels of confidence and interest in mathematics.

Desmos instructional software offers a potential solution to these challenges. By providing an interactive platform where students can manipulate equations and instantly see the corresponding graphs, Desmos makes abstract concepts tangible and engaging. Importantly, its offline capabilities make it accessible to students in low-income households who may have limited internet access but own affordable mobile devices.

Despite its potential, there is limited empirical evidence in Nasarawa State on whether using Desmos can significantly improve students' interest in mathematics and whether its impact differs by gender. This study therefore, sought to address these gaps by investigating the effect of Desmos instructional software on students' interest in quadratic graphs, with a particular focus on gender differences.

Purpose of the Study

The main purpose of this study was to investigate the effect of Desmos instructional software on students' interest in quadratic graphs among secondary school students in Karu, Nasarawa State, Nigeria. Specifically, the study sought to:

1. determine the interest of students taught quadratic graphs using Desmos instructional software.
2. ascertain the interest of male and female students taught quadratic graphs using Desmos instructional software.

Research Questions

The study was guided by the following research questions:

1. What are the mean interest ratings of students taught quadratic graphs using Desmos instructional software and those taught using the conventional method?
2. What are the mean interest ratings of male and female students taught quadratic graphs using Desmos instructional software?

Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance:

H_{O1}: There is no significant difference in the mean interest ratings of students taught quadratic graphs using Desmos instructional software and those taught using the conventional method.

H_{O2}: There is no significant difference in the mean interest ratings of male and female students taught quadratic graphs using Desmos instructional software.

Methodology

This study adopted a quasi-experimental design involving a pre-test and post-test with one experimental group and one control group. Intact classes were used since random assignment was not feasible. The experimental group was taught quadratic graphs using Desmos instructional software, while the control group was taught using the conventional method. A pre-test was administered to both groups to establish baseline equivalence before the intervention.

The population comprised 10,543 Senior Secondary School II students in Karu Local Government Area of Nasarawa State during the 2024/2025 academic session. A sample of 92 students (44 males and 48 females) was selected using purposive sampling. Two intact classes were assigned to experimental and control groups, respectively.

The primary instrument used to measure students' interest was the Quadratic Graphs Interest Scale (QGIS), consisting of 20 items, 10 positively worded and 10 negatively worded, rated on a four-point scale. Higher scores indicated a stronger interest in quadratic graphs. The instrument was validated by experts and had a validity index of 0.84 and a reliability coefficient of 0.89, determined using Cronbach Alpha. The intervention lasted five weeks, with four 40-minute lessons each week. The experimental group used Desmos to explore quadratic equations dynamically, observing real-time changes to graph features such as vertex, intercepts, and transformations. The control group was taught the same content using traditional board work and manual plotting techniques. Both groups completed the QGIS before and after the intervention as pre-test and post-test measures.

Data were analyzed using descriptive statistics (mean and standard deviation) to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the hypotheses at a 0.05 level of significance.

Results

The results of the study are presented according to the research questions and hypotheses that focused on students' interest in quadratic graphs.

Research Question 1: What are the mean interest ratings of students taught quadratic graphs using Desmos instructional software and those taught using conventional method?

Table 1: Mean Interest Ratings and Standard Deviation of Students Taught Using Desmos Instructional Software and Conventional Method

Group		Pre Interest	Post Interest
Desmos	Mean	63.91	70.50
	N	44	44
	Std. Deviation (σ)	7.999	7.245
Conventional	Mean ($\bar{x}$)	56.25	60.08
	N	48	48
	Std. Deviation	9.663	7.654

Table 1 shows that the pre-interest and post-interest mean scores of students taught with Desmos instructional software increased from 63.91 to 70.50. Similarly, students taught using the conventional method recorded an increase from 56.25 to 60.08. This suggests that both methods improved students' interest, but the increase was more pronounced in the Desmos group.

Hypothesis One: There is no significant difference in the mean interest ratings of students taught quadratic graphs using Desmos instructional software and those taught using the conventional method.

Table 2: ANCOVA Results on Mean Interest Ratings of Students in Desmos and Conventional Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2763.080a	2	1381.540	25.948	.000	.368
Intercept	5555.905	1	5555.905	104.352	.000	.540
Pre Interest	272.138	1	272.138	5.111	.026	.054
Group	**1537.250**	**1**	**1537.250**	**28.873**	**.000**	**.245**
Error	4738.529	89	53.242			
Total	396982.000	92				
Corrected Total	7501.609	91				

a. R Squared = .368 (Adjusted R Squared = .354)

Table 2 shows that the calculated F-ratio for Group is 28.873 with a significance level of 0.000, which is less than the alpha value of 0.05. This indicates a significant difference in the mean interest ratings between students taught using Desmos instructional software and those taught using the conventional method. Thus, Hypothesis One is rejected, meaning that Desmos instructional software significantly improved students' interest in quadratic graphs.

Research Question 2

What are the mean interest ratings of male and female students taught quadratic graphs using Desmos instructional software?

Table 3: Mean Interest Ratings of Male and Female Students in the Desmos Group

Gender		Pre Interest	Post Interest
	Mean	62.72	71.78
Male	N	18	18
	Std. Deviation(σ)	7.111	7.167
	Mean($\bar{x}$)	64.73	69.62
Female	N	26	26
	Std. Deviation	8.600	7.305

Table 3 indicates that male students' mean interest scores increased from 62.72 to 71.78, while female students' scores increased from 64.73 to 69.62. This suggests that both male and female students experienced an improvement in interest after being taught with Desmos.

Hypothesis Two

There is no significant difference in the mean interest ratings of male and female students taught quadratic graphs using Desmos instructional software.

Table 4: ANCOVA Results on Mean Interest Ratings of Male and Female Students in the Desmos Group

Dependent Variable: Post-Interest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	286.125a	2	143.062	2.976	.062	.127
Intercept	1766.917	1	1766.917	36.757	.000	.473
Pre Interest	236.390	1	236.390	4.918	.032	.107
Gender	**79.514**	**1**	**79.514**	**1.654**	**.206**	**.039**
Error	1970.875	41	48.070			
Total	220948.000	44				
Corrected Total	2257.000	43				

a. R Squared = .127 (Adjusted R Squared = .084)

Table 4 shows that the F-ratio for Gender is 1.654 with a p-value of 0.206, which is greater than the alpha value of 0.05. This indicates that there is no significant difference in the mean interest ratings of male and female students taught using Desmos instructional software. Therefore, Hypothesis Two is not rejected. This suggests that Desmos instructional software is equally effective for both male and female students in fostering interest in quadratic graphs

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Discussion of Findings

The findings reveal that students taught quadratic graphs using Desmos instructional software demonstrated significantly higher levels of interest compared to those taught using conventional methods. This indicates that interactive digital tools like Desmos have the potential to engage students more effectively by making abstract mathematical concepts visually appealing and easier to understand. These results are consistent with the studies of Montijo (2017) and Prepuse (2019), who found that technology-based teaching methods increase students' motivation and positive attitudes toward mathematics.

Further, the study found that gender had no significant effect on students' interest. Both male and female students benefited equally from the use of Desmos. This aligns with the work of Bamberger (2014) and Wang and Degol (2013), who observed that technology-supported mathematics instruction can bridge gender gaps by providing equitable opportunities for active participation and exploration. The finding is particularly relevant in contexts like Nasarawa State, where cultural and societal factors often limit female students' engagement in mathematics.

Overall, the study demonstrates that incorporating Desmos into mathematics instruction enhances student interest while promoting inclusivity, as it does not favor one gender over another.

Conclusion

The study concluded that the use of Desmos instructional software improved students' interest in learning quadratic graphs compared to the conventional teaching method. Both male and female students benefited equally, indicating that Desmos provides an inclusive and engaging learning environment. These findings highlight the potential of technology-based instructional strategies in fostering positive attitudes and

sustained interest in mathematics among secondary school students.

Recommendations

Based on the findings, the following recommendations were made:

1. Mathematics teachers should integrate Desmos instructional software into lessons to make learning more engaging and to boost students' interest in mathematics.
2. School administrators should provide regular training and workshops to equip teachers with the skills needed to use Desmos effectively.
3. Curriculum planners and policymakers should include technology-based tools like Desmos in the mathematics curriculum to promote widespread adoption across schools.
4. Efforts should be made to provide affordable access to digital devices to ensure equitable use of technology for all students, regardless of gender.

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