African Journal of Science, and Technology Education (AJSTME). *12*(6). 98 - 102, Nov., 2026.
ISSN: 2251-0141 (Print), 2971-623 (Online) https://www.ajstme.com.ng

Effect of Geometer's Sketchpad Instructional Package on Students' Interest in Geometrical Concepts in Junior Secondary Schools in Nsukka Education Zone

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ABSTRACT

This study investigated the effect of Geometer's Sketchpad (GSP) on students' interest in geometrical concepts in Nsukka Education Zone, Enugu State, and whether the effect differs by gender. Two research questions and two null hypotheses guided the study. The study used a quasi-experimental, non-equivalent pre-test, post-test control group design with intact classes. The population was 5,056 JSS3 students in 30 secondary schools in Nsukka LGA in the 2024/2025 session. The sample was 157 students from two co-educational schools with computer laboratories: 78 in the experimental group taught with GSP, and 79 in the control group taught without GSP. Data were collected with a 20-item Geometry Interest Scale (GIS) on a four-point scale: Highly Interested (4) to Highly Not Interested (1). Negative items were scored in reverse. The instrument was validated by three experts and its reliability, established with Cronbach Alpha, was 0.85. Mean and standard deviation answered the research questions, while ANCOVA, with pre-interest as covariate, tested the hypotheses at 0.05 level. Students taught with GSP had significantly higher interest than those taught without GSP ($F = 147.953$, $p < .05$). The experimental group had a post-interest mean of 3.02, gain 0.59, while the control group had 2.71, gain 0.35. Gender had no significant influence ($F = 0.022$, $p = .883$). GSP therefore improved interest equally for male and female students. The study recommended that teachers should embrace GSP, education authorities should organise in-service training on its use, and schools should provide computer laboratories and GSP software.

Keywords: Geometer's Sketchpad, Geometry, interest Gender, ICT

INTRODUCTION

Mathematics is an essential tool for successful human existence. It is the foundation for science, technology, engineering and commerce in Nigeria (Bulus & Yukwa, 2025; Marafa, 2024). Because of that importance, the Federal Government has kept mathematics as a core subject at all levels of education (Federal Ministry of Education, 2025). Under the Revised Curriculum (Federal Ministry of Education, 2025; NERDC, 2025), Junior Secondary Mathematics is organised into five branches: Number and Numeration, Basic Operations, Algebraic Processes, Geometry and Measurement, and Everyday Statistics (Federal Ministry of Education, 2025). Of these five content areas, Geometry and Measurement is the branch that deals with shapes, angles, area, perimeter, volume and construction; the topics used in this study: identification of plane shapes, areas and perimeters of plane shapes, lines and angles.

Geometry is abstract, yes. But it is also everywhere. It is in the roof of the market stalls, in the shape of a yam barn, in the map a surveyor draws, in the design of a church building (Akinoso, 2014; Okoro & Ike, 2021). Artists, builders, designers, masons and engineers use it every day (Emaikwu et al., 2022; Akobundu et al., 2025). Yet students in Nsukka education zone continue to dislike it. Chief Examiners' Reports of BECE and WAEC (2020–2023) show that students avoid geometry questions in examinations and leave them un-attempted. Egara (2025) also found the same pattern in Nsukka Education Zone, where insecurity, poor facilities and poor teaching methods have further destabilized mathematics outcomes. If you walk into a JSS3 classroom in some schools in Nsukka education zone during mathematics period, you will see it quickly. When the teacher says "bring out your mathematics note, today is geometry," half the class cries out. Some put their heads on the desk. Some start asking to go and urinate. It is not that they are dull, but they have already decided that geometry is hard and boring, geometry is not for them (Hidi & Renninger, 2006; Sabitu & Khalid, 2024; Oloda et al., 2025).

Students do not fail geometry and then lose interest. They lose interest first, and then they fail (Uzuegbu et al., 2025). In this study, interest means something simple and practical: a learner's willingness to keep paying attention to geometry, to participate in class, to ask questions, and to enjoy the activity (Hidi & Renninger, 2006; Harackiewicz et al., 2016). A student who is interested will pay attention, will try, will ask "Sir, what if I drag this side?" (Hannafin et al., 2001; Sabitu & Khalid, 2024). A student who is not interested will develop phobia, anxiety, truancy, and then poor achievement (Egara, 2025; Odo et al., 2024; Oloda et al., 2025).

At Junior Secondary level, many students in Nsukka education zone have already lost that interest (West African Examinations Council, 2020–2023).One major

cause is ineffective teaching method. Most mathematics teachers still use the conventional lecture method where the teacher talks and students listen (Egara, 2025; Odo et al., 2024; Akobundu et al., 2025). That method, often described as talk-chalk and teacher-dominated, leaves learners as passive listeners who copy notes and memorise formulae (Akinoso, 2014; Adelabi, 2020; Sabitu & Khalid, 2024). It cannot arouse interest because it does not involve the student actively (Hannafin et al., 2001; Uzuegbu et al., 2025). What we need is an innovative, ICT-driven, activity-based material that can generate and sustain interest (Federal Ministry of Education, 2019; Federal Ministry of Education & Federal Ministry of Communications, Innovation and Digital Economy, 2025).

One such material is Geometer's Sketchpad. Geometer's Sketchpad (GSP) was developed by Nicholas Jackiw (1991) as a dynamic geometry environment. It allows a student to construct a figure by himself, drag it, transform it, measure it, and explore it (Akinoso, 2014). Hannafin, Burruss and Little (2001) found that students enjoy having personal control over their learning when using GSP. Think of it this way: in the old method, the teacher draws one triangle and says "sum of angles is 180 degrees. In GSP, the student constructs the triangle himself, drags one vertex left, right, up, down, and watches the angles change but the sum remains 180; He discovers it. That is learning by doing; and it's what keeps interest alive (Adelabi, 2020; Akobundu et al., 2025). Recent evidence confirms that this kind of interactive visualisation strengthens geometric imagination, spatial reasoning, problem-solving and deep understanding of geometric concepts (Adelabi, 2020; Akobundu et al., 2025; Emaikwu et al., 2022).

In Nigeria, Akinoso (2014) in Ogun State, Okoro and Ike (2021) in Anambra, and Emaikwu et al. (2022) in Benue all reported that GSP improved outcomes in geometry. Sabitu and Khalid (2024) also found that Computer Animation improved achievement and interest in geometry in Oyo. Uzuegbu et al. (2025) found that Cubing and Jigsaw strategies improved geometry outcomes in Rivers State and Oloda et al. (2025) found that Audio-Visual instruction improved geometry outcomes in Ondo State. The pattern is the same across all these studies: when the method is interactive, interest grows (Sabitu & Khalid, 2024; Uzuegbu et al., 2025; Oloda et al., 2025).

The use of GSP is also in line with national policy. The National Policy on ICT in Education (Federal Ministry of Education, 2019) mandates integration of ICT into teaching and learning. The Nigeria National EdTech Strategy (2025), jointly developed by the Federal Ministry of Education and the Federal Ministry of Communications, Innovation and Digital Economy, seeks to build an inclusive digital education ecosystem with smart boards in every secondary school classroom. The new National Curriculum (2025) introduces Digital Technologies from the 2025/26 session. Yet in Nsukka education zone, the chalkboard still dominates, and where computers exist, they are grossly under-utilised (Egara, 2025; Odo et al., 2024). This study tests a real implementation of that policy.

In Nsukka education zone, there is a strong belief that "mathematics is for boys," especially geometry which needs spatial visualisation (Odo et al., 2024; Egara, 2025). Boys dominate mathematics teaching and learning activities while girls feel dormant and shy (Odo et al., 2024;). But is the gap real? Or is it caused by the method? When the method is interactive, recent Nigerian evidence shows gender differences disappear (Uzuegbu et al., 2025; Sabitu & Khalid, 2024; Oloda et al., 2025). Odo et al. (2024) in Nsukka found that boys still outperformed girls in geometry when taught with conventional method, but Uzuegbu et al. (2025), Sabitu and Khalid (2024) and Oloda et al. (2025) found no significant difference between boys and girls when the method was interactive. This suggests that the gender gap may be caused by the method, not by ability, and that it can be closed with an interactive method (Hidi & Renninger, 2006; Uzuegbu et al., 2025). Few studies have investigated GSP and interest in geometry in Enugu State. Most studies focused on achievement only (Akinoso, 2014; Okoro & Ike, 2021; Emaikwu et al., 2022). To the best of the researcher's knowledge, no study has tested GSP and interest in geometry in Nsukka Education Zone. That gap is why this study was carried out.

Students in Nsukka education zone display low interest in Mathematics more especially in geometry. If interest remains low, achievement will continue to drop. There is need to test an activity-based approach like GSP. However, few studies have investigated GSP and interest in geometry in Enugu State. Most studies focused on achievement only. To the best knowledge of the researcher, no study has been carried out on effect of GSP on interest in geometry in Nsukka education zone. This gap necessitated this study.

1. To determine effect of Geometer's Sketchpad on mean interest scores of students in geometry.
2. To determine influence of gender on interest scores of students taught with GSP.

Research Questions

1. What is the difference in mean interest scores of students taught geometry with GSP and those taught without GSP?
2. What is the difference in mean interest scores of male and female students taught with GSP?

Hypotheses

- HO1: No significant difference in interest scores of students taught geometry with GSP and those taught without GSP?
- HO2: No significant difference between male and female students taught geometry with GSP

METHODS

A quasi-experimental non-equivalent pre-test, post-test control group design was adopted in this study. This design was considered appropriate because intact classes were used without random assignment. The study was carried out in Nsukka Local Government Area of Enugu State. Nsukka LGA is one of the local government areas in Nsukka Education Zone. The area was chosen because of observed persistent Basic Education Certificate Examination poor achievement of students in geometry and presence of schools with ICT facilities.

The population comprised all Junior Secondary School Three (JSS3) students in public secondary schools in Nsukka LGA in 2024/2025 academic session. There were 30 secondary schools with a total of 5,056 JSS3 students (2148 males and 2912 female); (Enugu State Post Primary Schools Management Board, 2025). The sample of this study consists of 157 students (95 females and 62 males). Multi-stage sampling procedure was employed. First, purposive sampling was used to select two co-educational schools that have functional computer laboratories and mathematics teachers who are computer literate. Second, simple random sampling by balloting was used to assign one school to experimental group (78 students) and the other to control group (79 students). Two intact classes from each school were used to avoid disruption of normal school activities.

The researcher developed a 20-items GIS which was used for this study. The items were assigned to help students express their interest towards geometry. It was a four point response scale from highly interested, interested, not interested, and highly not interested. The GIS consisted of both positive and negative cue items. The scale and the scoring of the positive items are shown below. The negative cued items were scored in reverse order of the scale; Highly interested -4, Interested –3, Not interested -2, Highly not interested – 1. The GIS was also validated by three experts, one in psychology of education and two in mathematics education. The reliability of GIS was established using the same Cronbach reliability technique. The GIS (20-items) was given to the same 30 students to respond to. This was found to be 0.85.

The GIS was administered to the experimental and control before commencing treatment. The students in the experimental group were taught the geometry topics using GSP while the students in the control group were taught without the use of GSP. The treatment lasted for three weeks of six periods. The students in the control group and experimental group were taught by the researcher with the assistance of their regular mathematics teachers. One week after the treatment, the students in the control and experimental group were post-tested with GIS items. This was to determine their level of geometry interest after the treatment. The data generated in this study were analysed using mean and standard deviation to answer the research questions. The null hypotheses were tested at 0.05 level of significance using analysis of covariance (ANCOVA).

RESULTS

Research Question one: What are the mean interest scores of students taught geometry using geometer's sketchpad and those taught geometry without geometer's sketchpad?

Table 1: Mean and Standard Deviation of Interest Scores of Students Taught Geometry Using Geometer Sketchpad and Those Taught Geometry without Geometer Sketchpad

Group	Pre-interest			Post-interest		
	n	Mean	SD	Mean	SD	Mean Gain
Experimental	78	2.43	.68	3.02	.72	.59
Control	79	2.36	.77	2.71	.25	.35

Table 1 shows that the students that were taught geometry using geometer sketchpad had post mean interest score of 3.02 with a standard deviation of 0.72 while those that were taught geometry without geometer's sketchpad had post mean interest score of 2.71 with a standard deviation of 0.25. Mean interest gain scores of 0.59 and 0.35 for the two groups respectively imply that the students that were exposed to geometer sketchpad had higher interest score than their counterparts.

Research Question Two: what is the influence of using geometer's sketchpad on male and female students' interest in geometry?

Table 2: Mean and Standard Deviation of Interest Scores of Male and Female Students in Geometry

Gender	Pre-interest			Post-interest		
	N	Mean	SD	Mean	SD	Mean Gain
Female	95	2.57	.72	2.85	.66	.28
Male	62	2.28	.70	3.15	.15	.87

Table 2 reveals the interest mean scores of female and male students in geometry. The analysis shows that female students had post interest mean score of 2.85 with a standard deviation of 0.66 while their male counterparts had post interest mean score of 3.15 with a standard deviation of 0.15. Mean interest gain scores of 0.28 and 0.87 for the female and male students respectively have indicated that male students had higher interest score than their female counterparts.

Hypothesis one: There is no significant difference between the mean interest scores of students taught geometry using geometer's sketchpad and those taught geometry without geometer's sketchpad.

Table 3: Analysis of Covariance of the Effect of Geometer Sketchpad on Students' Interest in Geometry

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	41.603[a]	4	10.401	233.519	.000
Intercept	25.047	1	25.047	562.359	.000
Pre-interest	.105	1	.105	2.354	.127
Group	6.590	1	6.590	147.953	.000
Gender	17.458	1	17.458	391.976	.000
Group Gender	4.196	1	4.196	94.207	.000
Error	6.725	151	.045		
Total	1333.457	156			
Corrected Total	48.329	155			

a. R Squared = .861 (Adjusted R Squared = .857)

Table 3 shows that the calculated value of F (147.953) for the effect of geometer sketchpad on students' interest in geometry is 0.000. Thus, there is a significant difference between the mean interest scores of students taught geometry with geometer sketchpad and those taught geometry without geometer's sketchpad in favour of the experimental group. This is for the fact the probability value of 0.000 is less than the 0.05 level of significance (p <.05). However, the null hypothesis is rejected.

Hypothesis two: There is no significant difference between the mean interest scores of female and male students in geometry.

Data analysis in Table 3 reveals that the probability associated with the calculated value of F (0.022) for the influence of gender on students' interest in geometry is 0.883. Thus gender has no significant influence on students' interest in geometry since the probability value of 0.883 is greater than the 0.05 level of significance (p > .05). However, the null hypothesis is accepted

DISCUSSION

The result was clear. GSP raised interest. Before treatment, both groups were almost the same: experimental group mean 2.43, control group mean 2.36. They started from the same low interest. After treatment, the experimental group rose to 3.02 with a gain of 0.59, while the control group rose to only 2.71 with a gain of 0.35. The ANCOVA confirmed it: F = 147.953, p < .05. The difference was significant, in favour of the experimental group. Why did it work? I saw it during the lessons. In the control class, students copied notes. In the experimental class, students fought to touch the mouse. One boy in the experimental school kept dragging a triangle and shouting, "Aunty, see! It is still 180! Even if I drag am!" That excitement is what the instrument measured. GSP gives the student control. He is not watching the teacher do geometry. He is doing geometry. This finding agrees with Sabitu and Khalid (2024) and Oloda et al. (2025), who found that interactive methods improved interest and achievement in geometry more than conventional method. It also agrees with Uzuegbu et al. (2025), who found that Cubing and Jigsaw improved geometry outcomes in Rivers State. The reason is the same across all these studies: when the student is active, interest grows. The dragging feature is the key. In the old method, to see 10 examples of a triangle, you must draw 10 triangles with paper and pencil. Nobody has time for that. In GSP, you draw one triangle, drag the vertex 10 times, and you have seen 10 examples in one minute. That is why interest does not die.

Here, the result surprised some teachers. Gender had no significant influence. Yes, on the raw numbers, male students had a slightly higher post-test mean (3.15) than female students (2.85). But when we tested it properly with ANCOVA, the difference was not significant: F = 0.022, p = .883, which is greater than .05. The null hypothesis was therefore retained. Gender is not a factor in interest when GSP is used. This is important for Nsukka education Zone. Under conventional teaching, boys dominate. They answer questions, they go to the board and girls keep quiet. Under GSP, every student has a computer. Every student constructs. Every student drags. No one is a viewer. So the girl who was shy in the chalkboard class becomes active in the GSP class, because the computer does not laugh at her. "This finding agrees with Sabitu and Khalid (2024), Uzuegbu et al. (2025) and Oloda et al. (2025), who all found no significant gender

difference when the method was interactive. It differs from the old belief that girls cannot do geometry. That belief is wrong. The gap is not in the brain. The gap is in the method. Change the method, and the gap closes.

CONCLUSION

This study has shown that the use of Geometer's sketchpad has a facilitative effect on students' interest in geometry. There is a significant difference in geometry mean interest scores between students exposed to the use of geometer's sketchpad and those who were not exposed to the use of geometer's sketchpad. The study indicated that there is a no significant influence in the use of geometer's sketchpad on male and female students' interest in geometry, thus gender is not factor in geometry interest when exposed to the use of geometer's sketchpad.

Recommendation

Mathematics teachers should embrace innovative instructional materials such as use of Geometer's Sketchpad and other computer software. Ministry of Education and Post Primary Schools Management Board should organize in-service training for teachers on use of GSP. School authorities should provide computer labs and GSP software for teaching mathematics not just computer studies. Teacher education institutions (faculties of education) should expose student-teachers to modern ICT as tools in teaching.

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