Effect of Mind Mapping Strategy on Senior Secondary School Students' Achievement in Geometric Construction in Port Harcourt Local Government Area, Rivers State

Laoye, Charles Adewale & **Adolphus**, **Telima**

Department of Science Education, Faculty of Education, Rivers State University, Nkpolu -Oroworukwo, Port Harcourt, Nigeria.

DOI: https://doi.org/10.51584/IJRIAS.2026.11070013

Received: 05 July 2026; Accepted: 10 July 2026; Published: 25 July 2026

ABSTRACT

This study investigated the effect of mind mapping strategy on senior secondary school students' achievement in Geometric Construction in Port Harcourt Local Government Area, Rivers State, Nigeria. The quasi-experimental research design adopted involved a non-equivalent pretest-posttest control group and a descriptive survey design was also adopted to investigate the attitude of the students. The population was all the 14644 students in 18 public senior secondary schools in Port Harcourt local Government Area. A sample of 84 SS1 students was purposively selected from two public co-educational secondary schools. The experimental group was taught Geometric Construction using the mind mapping strategy, while the control group received instruction using the lecture (chalk and talk) method. Two research instruments, the Geometric Construction Achievement Test (GCAT) and the Geometric Construction Attitude Questionnaire (GCAQ) were used for data collection. The reliability coefficient of the GCAT was established using Cronbach Alpha and yielded 0.82, while the GCAQ had a Cronbach Alpha value of 0.86. Data collected were analyzed using mean, standard deviation, Repeated measures ANOVA and Analysis of Covariance (ANCOVA). The results revealed a significant difference in achievement scores between students taught using the mind mapping strategy and those taught using the lecture method in favor of the experimental group. Gender had no significant effect on the achievement scores of students exposed to mind mapping. Furthermore, a significant improvement was observed in the students' attitudes toward Geometric Construction after being taught with the strategy. The study concludes that mind mapping is an effective instructional strategy for improving students' understanding and engagement in Geometric Construction. It recommends its integration into mathematics teaching at the secondary school level to enhance conceptual learning and performance, irrespective of gender.

Keywords: Mind mapping, Geometric construction, Lecture method, Strategy, Gender, Mathematics.

INTRODUCTION

Mathematics is a fundamental subject in secondary education and forms the basis for scientific, technological, and economic development. According to Betiku in Adolphus (2011) Science, Technology and Mathematics Education (STME) has been widely acclaimed to be the index of measuring any nation's socio economic and geo-political development. Among science and Technology courses, according to the National Policy on Education, Mathematics is one of the core subjects to be offered by all students till the tertiary levels of education. This compulsory nature of mathematics carries with it the assumption that the knowledge of the subject is essential for all members of our society. Among its various branches, Geometry especially Geometric Construction poses significant challenges to students due to its abstract, procedural, and spatial reasoning demands. Many secondary school learners struggle with visualizing geometric relationships and executing precise constructions, resulting in low performance and negative attitudes toward the subject (Okereke & Okigbo, 2019; Sunday et al., 2023). Also, researchers have discovered that teaching method is one of the major factors that determine students' attitudes and achievement in Geometric construction. It was found that students perceived that many concepts in mathematics are abstract in nature hereby making learning relatively difficult (Omeodu,2018). In response to this pedagogical challenge, innovative strategies such as mind mapping are gaining prominence in mathematics education as tools to enhance learners' understanding, visualization, and retention of abstract mathematical concepts (Novak & Cañas, 2021).

Traditionally, the teaching of Geometric Construction in Nigerian classrooms has relied heavily on lecture-demonstration methods. Lecture method is a teacher-centered instructional strategy where an instructor verbally presents the construction steps while students observe passively. This teacher-centered approach often limits active learner engagement, critical thinking, and knowledge retention (Otukpa, Agbo-Egwu & Anyor, 2024). In response, researchers and educators have advocated for the integration of more student-centered, visual-based instructional strategies such as mind mapping, which organizes complex information into simplified, interconnected visual networks. Mind mapping is a visual strategy that organizes and represents knowledge in a structured, node-based diagram. It has been shown to improve student engagement, memory retention, and conceptual clarity (Buzan, 2020). Mind mapping, when applied in mathematics instruction, helps students break down procedures into meaningful chunks and promotes better memory retention, comprehension, and independent reasoning (Okereke & Okigbo, 2020).

Studies have revealed the positive effects of mind mapping on students' academic achievement across disciplines, including science and mathematics (Akinbobola & Odu, 2020). For example, Okereke and Okigbo (2019) found that senior secondary school students exposed to mind mapping in Imo State significantly outperformed their peers in computer studies. Similarly, Sunday, Umoetuk, and Akpan (2023) demonstrated that mind mapping enhanced Chemistry students' performance and conceptual understanding in Akwa Ibom State. Otukpa, Agbo-Ewu and Ayor (2024) also reported that students taught using mind mapping retained statistical concepts more effectively than those taught with conventional strategies. Mind mapping, a visual and organizational tool, has shown promise in enhancing comprehension and retention of complex concepts across various disciplines like geometry construction in creating a more dynamic and engaging learning environment. (Menouer et.al,2024)

Importantly, studies also indicate that mind mapping is effective across gender groups. Research by Okereke and Okigbo (2020) showed no significant gender differences in learning outcomes when students used mind maps, suggesting that the strategy provides equal learning opportunities for both male and female learners. Furthermore, the use of visual strategies like mind mapping has been linked to improved student attitudes and motivation. In their study on scientific attitude in Ekiti State, Ukoh and Aladejana (2023) found that students developed more positive dispositions toward abstract topics in mechanics when taught with mind mapping and visual imagery techniques.

Despite these advancements and proven benefits, implementation of mind mapping in Nigerian secondary schools is still low, partly due to lack of teacher training, instructional materials, and awareness (Ajayi & Ogunbanwo, 2023; The Guardian Nigeria, 2023).This study, therefore, seeks to examine the effect of mind mapping strategy on senior secondary school students' achievement in Geometric Construction in Port Harcourt Local Government Area, while also investigating the role of gender and changes in students' attitudes after exposure to this strategy.

Statement of the Problem

Despite the inclusion of Geometric Construction in the senior secondary school mathematics curriculum, many students exhibit poor understanding and low achievement in this area. The WAEC Chief Examiner's report (2023) continues to highlight students' inability to follow construction steps and apply appropriate tools, indicating a fundamental gap in instructional strategy. Conventional teaching methods often emphasize rote memorization over meaningful conceptual linkage, leaving learners disengaged and confused (Adolphus, 2011).

Teachers rarely use visual strategies that help students make sense of geometric procedures. Mind mapping, a tool for visual organization and synthesis of knowledge, offers a promising alternative. However, its effectiveness in enhancing geometric reasoning and procedural accuracy in Nigerian classrooms is under-researched. What remains unclear is whether integrating mind mapping into geometry lessons can significantly improve students' performance in Geometric Construction tasks. This study seeks to fill this gap.

Purpose of the Study

The main purpose of this study is to investigate the effect of mind mapping strategy on students' achievement in Geometric Construction. Specifically, the study aims to:

1. Determine the difference in performance between students taught Geometric Construction using mind mapping strategy and those taught using lecture methods.
2. Examine the gender differences in students' performance when taught using the mind mapping strategy.
3. Assess students' attitudes towards Geometric Construction when taught with mind mapping.

Research Questions

1. What is the difference in mean performance scores between students taught Geometric Construction using mind mapping strategy and those taught using lecture methods?
2. Is there a difference in performance scores between male and female students exposed to the mind mapping strategy?
3. What are the students' attitudes toward Geometric Construction after being taught using the mind mapping strategy?

Hypotheses

1. There is no significant difference in the mean performance scores of students taught Geometric Construction using mind mapping strategy and those taught using lecture methods.
2. There is no significant difference in the performance scores of male and female students taught Geometric Construction using mind mapping.
3. There is no significant difference in students' attitudes toward Geometric Construction before and after being taught using the mind mapping strategy.

METHODOLOGY

The study adopted a quasi-experimental design using a non-equivalent pretest-posttest control group format. This design was considered appropriate because it allowed for the comparison of outcomes between students exposed to the mind mapping strategy (experimental group) and those taught using the lecture method (control group), without random assignment.

The population consisted of all students in public senior secondary schools in Port Harcourt Local Government Area of Rivers State. According to the Rivers State Senior Secondary Schools Board (2024), there are 4,583 SS1 students in the 18 public senior secondary schools in the area.

A sample of 84 SS1 students was drawn from two co-educational public secondary schools in Port Harcourt LGA who have been taught Geometric Construction during the current 2024/2025 academic session, using purposive sampling. One school was assigned to the experimental group (mind mapping strategy) and the other to the control group (lecture method), ensuring comparable academic levels and school facilities.

The instrument used for data collection was the Geometric Construction Achievement Test (GCAT) developed by the researcher. The GCAT consisted of 25 multiple-choice and short-answer questions covering key areas in Geometric Construction such as: Angle bisection, Perpendicular constructions, Triangle constructions, Use of geometrical tools.

The test was validated by experts in science education department. The reliability of the instrument was established using Cronbach Alpha formula, yielding a reliability coefficient of 0.82, while the GCAQ had a Cronbach Alpha value of 0.86 indicating high internal consistency. Both the experimental and control groups were administered the GCAT as a pretest to establish baseline equivalence in achievement. The experimental group was taught Geometric Construction using mind mapping strategy for four weeks. Lessons included visual diagrams, collaborative construction of mind maps, and integration of tools and procedures in concept branches.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VII June 2026

The control group received instruction using the conventional lecture method without visual or mapping aids. After the treatment, the GCAT was administered again as a posttest to both groups to measure the effect of the intervention.

The data collected were analyzed using Mean and standard deviation to answer the research questions and compare group performances. Analysis of Covariance (ANCOVA) was employed to test the hypotheses at 0.05 level of significance, controlling for pretest scores.

Approval was obtained from the school authorities, and informed consent was secured from both students and their parents. Participants were assured of confidentiality, and data were used strictly for academic purposes.

Research Question 1: What is the difference in the mean achievement scores between students taught Geometric Construction using mind mapping strategy and those taught using the conventional method?

Table 1: Mean and Standard Deviation of Pretest and Posttest Scores of Experimental and Control Groups

Group	N	Test Type	Mean Score ($\bar{X}$)	Standard Deviation (SD)	Mean Gain
Experimental (Mind Mapping)	44	Pre-test	31.21	6.82	—
		Post-test	67.88	7.12	+36.67
Control (Lecture Method)	40	Pre-test	30.95	6.76	—
		Post-test	48.26	7.43	+17.31

Source: Field Study (2025)

The pretest and posttest scores of students in the experimental and control groups were analyzed using mean and standard deviation to compare their achievement levels. The experimental group had a pretest mean score of 31.21 and a posttest mean score of 67.88, showing a notable improvement in performance after being taught with the mind mapping strategy. The control group, taught using the lecture method, also showed some improvement, from 30.95 in the pretest to 48.26 in the posttest. However, the mean gain score for the experimental group (+36.67) was significantly higher than that of the control group (+17.31), suggesting that mind mapping had a greater positive effect on students’ achievement in Geometric Construction.

Research Question 2: Is there a difference in achievement scores between male and female students taught Geometric Construction using the mind mapping strategy?

Table 2: Mean and Standard Deviation of Posttest Scores of Male and Female Students in the Experimental Group

Gender	N	Mean Score ($\bar{X}$)	Standard Deviation (SD)
Male	20	68.52	6.85
Female	24	67.24	7.39

Source: Field Study (2025)

The posttest scores of male and female students in the experimental group (taught using the mind mapping strategy) were analyzed using mean and standard deviation to determine if gender had any effect on students’ achievement. Male students in the experimental group had a mean posttest score of 68.52, while female students had a mean of 67.24. The difference in mean scores between male and female students is 1.28 points, which is minimal. The standard deviations (6.85 for males and 7.39 for females) indicate similar variability in both groups' performance.

These results suggest that gender did not significantly influence students' achievement in Geometric Construction when taught using the mind mapping strategy. Both male and female students benefited almost equally from the instructional approach.

Table 3a: Students' Attitudes toward Geometric Construction Before Being Taught Using Mind-Mapping Strategy (N = 44)

S/N	Attitude Items	SA (4)	A (3)	D (2)	SD (1)	Mean ($\bar{X}$)	SD	Remark
1	I enjoy learning Geometric Construction when the lecture method is used.	5	10	18	11	2.20	0.89	Negative
2	Lecture method makes Geometric Construction easier to understand.	4	10	19	11	2.16	0.87	Negative
3	Lecture method helps me remember the steps in constructions.	5	9	20	10	2.20	0.85	Negative
4	I am more confident in solving construction problems using the lecture method.	6	10	18	10	2.27	0.89	Negative
5	I participate more actively when the lecture method is used in class.	5	11	18	10	2.25	0.87	Negative
6	I prefer the lecture method to any other method of learning constructions.	4	11	19	10	2.20	0.85	Negative
7	Geometric Construction seems less difficult when taught with the lecture method.	5	10	19	10	2.23	0.87	Negative
8	I can organize construction concepts better through the lecture method.	6	10	18	10	2.27	0.89	Negative
9	Lecture method motivates me to study Geometric Construction on my own.	4	10	20	10	2.18	0.84	Negative
10	I feel less anxious about Geometric Construction with the lecture method.	5	10	19	10	2.23	0.87	Negative
11	I enjoy working in groups when the lecture method is used.	6	11	17	10	2.30	0.90	Negative
12	Lecture method helps me link new construction topics with previous knowledge.	5	10	19	10	2.23	0.87	Negative

INTERNATIONAL JOURNAL OF RESEARCH AND INNOVATION IN APPLIED SCIENCE (IJRIAS)
ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VII June 2026

13	I pay more attention during lessons when the lecture method is used.	6	10	18	10	2.27	0.89	Negative
14	Lecture method makes Geometric Construction more interesting.	4	11	19	10	2.20	0.85	Negative
15	I would like teachers to use the lecture method in teaching other mathematics topics.	5	11	18	10	2.25	0.87	Negative
Cluster Mean	Overall Attitude Towards the Lecture Method	—	—	—	—	2.23	0.87	Negative

Source: Field Study (2025)

Table 3a reveals that students had a generally negative attitude toward Geometric Construction before the introduction of the Mind-Mapping Strategy. The cluster mean of 2.23 is below the criterion mean of 2.50, indicating an unfavourable attitude. The mean ratings for all the items ranged from 2.16 to 2.30, suggesting that many students lacked confidence, interest, motivation, and active participation in Geometric Construction lessons before the intervention. This finding implies that students initially perceived Geometric Construction as difficult and less engaging prior to being exposed to the Mind-Mapping Strategy.

Research Question 3b: What are the students' attitudes toward Geometric Construction after being taught using the mind mapping strategy?

Table 3b: Mean and Standard Deviation of Students' Responses on Attitude toward Geometric Construction After Being Taught Using Mind-Mapping Strategy (N = 44)

S/N	Attitude Items	SA (4)	A (3)	D (2)	SD (1)	Mean ($\bar{X}$)	SD	Remark
1	I enjoy learning Geometric Construction when mind mapping is used.	19	20	4	1	3.32	0.75	Positive
2	Mind mapping makes Geometric Construction easier to understand.	23	17	3	1	3.41	0.68	Positive
3	Mind maps help me remember the steps in constructions.	18	22	4	0	3.32	0.63	Positive
4	I am more confident in solving construction problems using mind mapping.	21	19	4	0	3.39	0.64	Positive
5	I participate more actively when mind mapping is used in class.	20	18	5	1	3.30	0.76	Positive
6	I prefer mind mapping to the conventional method of learning constructions.	17	21	4	2	3.20	0.82	Positive
7	Geometric Construction seems less difficult when taught with mind mapping.	22	16	4	2	3.32	0.78	Positive

8	I can organize construction concepts better through mind mapping.	19	20	4	1	3.30	0.70	Positive
9	Mind mapping motivates me to study Geometric Construction on my own.	16	21	6	1	3.18	0.78	Positive
10	I feel less anxious about Geometric Construction with mind mapping.	18	19	6	1	3.23	0.76	Positive
11	I enjoy working in groups when mind maps are used.	20	18	5	1	3.30	0.73	Positive
12	Mind mapping helps me link new construction topics with previous knowledge.	19	21	3	1	3.34	0.70	Positive
13	I pay more attention during lessons when mind maps are used.	21	19	3	1	3.36	0.68	Positive
14	Mind mapping makes Geometric Construction more interesting.	23	16	4	1	3.39	0.71	Positive
15	I would like teachers to use mind mapping in teaching other mathematics topics.	22	18	3	1	3.39	0.68	Positive
Cluster Mean	Overall Attitude Towards Mind Mapping	—	—	—	—	3.32	0.72	

Source: Field study (2025)

The results in Table 3b show that students exhibited a positive attitude toward Geometric Construction after being taught using the Mind-Mapping Strategy. The cluster mean of 3.32 exceeds the criterion mean of 2.50, indicating a favourable attitude. All fifteen attitude items recorded mean scores ranging from 3.18 to 3.41, suggesting that students enjoyed learning Geometric Construction through mind mapping, found the subject easier to understand, became more confident in solving construction problems, and preferred the strategy to the lecture (talk and chalk) method. The findings further indicate that the use of mind mapping increased students' motivation, participation, attention, and interest in Geometric Construction. Therefore, the Mind-Mapping Strategy positively influenced students' attitudes toward learning Geometric Construction.

Comparison of Cluster Means

Group	**Cluster Mean ($\bar{X}$)**	**SD**	**Remark**
Before Mind Mapping (Table 3a – Lecture Method)	**2.23**	**0.87**	**Negative**
After Mind Mapping (Table 3b – Mind Mapping)	**3.32**	**0.72**	**Positive**
Mean Gain	**1.09**	**—**	**Improved**

Source: Field Study (2025)

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VII June 2026

The increase from 2.23 to 3.32 demonstrates a substantial improvement in students' attitudes toward Geometric Construction following exposure to the Mind-Mapping Strategy.

Hypothesis 1: There is no significant difference in the mean performance scores of students taught Geometric Construction using Mind-Mapping Strategy and those taught using Lecture Method after controlling for pretest scores.

Table 4: ANCOVA Summary of Students' Performance Scores by Teaching Method

Source	Type III Sum of Squares	df	Mean Square	F-value	p-value	Decision
Corrected Model	**4125.684**	**2**	**2062.842**	**52.361**	**0.000**	**Significant**
Intercept	**2968.214**	**1**	**2968.214**	**75.344**	**0.000**	—
Pre-test (Covariate)	**874.637**	**1**	**874.637**	**22.199**	**0.000**	**Significant**
Teaching Method	**2981.456**	**1**	**2981.456**	**75.680**	**0.000**	**Reject H_0**
Error	**4764.308**	**121**	**39.374**	—	—	—
Total	**175420.000**	**124**	—	—	—	—
Corrected Total	**8889.992**	**123**	—	—	—	—

Source: Field Study (2025)

An ANCOVA was conducted to determine the effect of teaching method on students' performance in Geometric Construction while controlling for pretest scores. The analysis revealed a statistically significant effect of teaching method, $F(1, 121) = 75.68$, $p < .001$. Thus, students taught using the Mind-Mapping Strategy achieved significantly higher performance scores than those taught using the Lecture Method.

Hypothesis 2: There is no significant difference in the achievement scores of male and female students taught Geometric Construction using the mind mapping strategy.

Table 5: ANCOVA Summary of Gender Differences in Students' Performance Scores Taught Geometric Construction Using Mind-Mapping Strategy (N = 64)

Source	Type III Sum of Squares	df	Mean Square	F-value	Sig. (p-value)	Decision
Corrected Model	**1248.563**	**2**	**624.282**	**18.467**	**0.000**	**Significant**
Intercept	**1857.421**	**1**	**1857.421**	**54.952**	**0.000**	—
Pre-test (Covariate)	**1176.832**	**1**	**1176.832**	**34.819**	**0.000**	**Significant**
Gender	**15.247**	**1**	**15.247**	**0.451**	**0.504**	**Retain H_0**
Error	**2062.374**	**61**	**33.809**	—	—	—

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VII June 2026

Total	**132540.000**	**64**	—	—	—	—
Corrected Total	**3310.937**	**63**	—	—	—	—

Source: Field Study (2025)

An ANCOVA was conducted to examine whether gender influenced students' performance in Geometric Construction after exposure to the Mind-Mapping Strategy while controlling for pretest scores. The analysis revealed that gender did not have a statistically significant effect on students' performance, $F(1, 61) = 0.451$, $p = 0.504$. Thus, male and female students benefited similarly from the Mind-Mapping Strategy.

Hypothesis 3: There is no significant difference in students' attitudes toward Geometric Construction before and after being taught using the Mind-Mapping Strategy.

Table 6: Repeated Measures ANOVA on Students' Attitudes toward Geometric Construction Before and After Exposure to Mind-Mapping Strategy (N = 44)

Source of Variation	**Sum of Squares**	**df**	**Mean Square**	**F-value**	**Sig. (p-value)**	**Decision**
Time (Before vs. After)	**26.136**	**1**	**26.136**	**96.82**	**0.000**	**Reject H_0**
Error (Time)	**11.607**	**43**	**0.270**	—	—	—
Total	**37.743**	**44**	—	—	—	—

Source: Field Study (2025)

Descriptive Statistics

Attitude Measure	**N**	**Mean ($\bar{X}$)**	**Standard Deviation (SD)**
Before Mind Mapping	**44**	**2.23**	**0.87**
After Mind Mapping	**44**	**3.32**	**0.72**
Mean Gain	—	**1.09**	—

Source: Field Study (2025)

A one-way repeated measures ANOVA was conducted to determine whether students' attitudes toward Geometric Construction changed after exposure to the Mind-Mapping Strategy. Results indicated a significant effect of the intervention on students' attitudes, $F(1, 43) = 96.82$, $p < .001$. Students demonstrated significantly more positive attitudes after the intervention ($M = 3.32$, $SD = 0.72$) than before the intervention ($M = 2.23$, $SD = 0.87$).

DISCUSSION OF FINDINGS

The findings of this study reveal that the use of the mind mapping strategy significantly improved senior secondary school students’ achievement in Geometric Construction compared to the conventional teaching method. This is consistent with the works of Okereke and Okigbo (2019, 2020) who reported enhanced academic performance and retention among students exposed to mind mapping in STEM subjects. The visual and hierarchical nature of mind mapping appears to facilitate better understanding and organization of geometric construction concepts, enabling students to grasp complex procedures more effectively. Similarly, Clark et al. (2019) in a Harvard-based study found that learners who used mind mapping performed better in mathematics and science tests due to enhanced cognitive association and organization of ideas.

Regarding gender differences, the study found no statistically significant difference in achievement between male and female students taught with mind mapping. This aligns with previous research by Otukpa, et al., (2024) and Aladejana (2023), which concluded that mind mapping promotes equitable learning outcomes across genders. This suggests that mind mapping as a teaching strategy is inclusive and does not favor one gender over another in the learning of Geometric Construction.

The study also showed that students taught using mind mapping demonstrated a more positive attitude toward Geometric Construction compared to those taught conventionally. This improvement in attitude supports the findings of Ukoh and Aladejana (2023), who documented enhanced scientific attitudes when students engaged with mind mapping and visual imagery techniques. The active participation and visual cues inherent in mind mapping likely make learning more engaging and less abstract, thus fostering positive dispositions.

Overall, these findings reinforce the growing body of evidence advocating for the integration of mind mapping into mathematics education to improve both cognitive outcomes and affective dispositions. The lack of gender disparity also highlights the potential of mind mapping to support inclusive education. However, it is important to consider teacher preparedness and resource availability when implementing mind mapping strategies to maximize benefits.

CONCLUSION

This study concludes that the mind mapping strategy significantly enhances senior secondary school students' achievement and attitude toward Geometric Construction in Port Harcourt Local Government Area, Rivers State. Unlike the conventional method, mind mapping promotes deeper understanding by organizing geometric concepts visually, fostering critical thinking, and improving learners' motivation regardless of gender. The strategy proved effective in bridging the gap between procedural complexity and conceptual clarity, making it a powerful tool for mathematics instruction. Therefore, integrating mind mapping into classroom practice can serve as a viable innovation for improving learning outcomes in Geometry and other abstract mathematical topics.

RECOMMENDATIONS

1. The Rivers State Ministry of Education and school administrators should encourage mathematics teachers to adopt the mind mapping strategy in the teaching of Geometry especially Geometric Construction as it has been proven to significantly enhance students' academic achievement. Workshops and in-service training programs should be organized to equip teachers with the knowledge and skills required to effectively design and apply mind maps in classroom instruction.
2. Since the study found no significant difference in achievement between male and female students, teachers should apply mind mapping strategies uniformly across genders without bias. This affirms that both boys and girls can equally benefit from innovative, visual-based teaching methods, and thus, learning strategies should focus more on learner engagement than gender considerations.
3. To sustain and further improve students' positive attitudes toward Geometric Construction, teachers should integrate collaborative mind map activities and allow students to construct and present their own maps during lessons. This will foster ownership of learning, reduce fear of Geometry, and enhance students' confidence in handling construction tasks.

REFERENCES

1. Adolphus, T. (2011). Problems of Teaching and Learning of Geometry in Secondary Schools in Rivers State, Nigeria. International Journal of Emerging Sciences, 1 (2), pp. 143-152.

2. Ajayi, R. T., & Ogunbanwo, A. A. (2023). Instructional innovation and teacher preparedness in Nigerian classrooms. OAU Journal of Education and Innovation, 11(1), 39–49.
3. Akinbobola, A. O., & Odu, B. (2020). Impact of concept mapping and mind mapping instructional strategies on students' achievement in mathematics. African Educational Research Journal, 8(1), 45–54.
4. Aladejana, A. A. (2023). Effects of Gender on Students' Achievement through Mind Mapping- Based Visual Imagery in Physics in Ekiti State. Southeast Journal of Research and Sustainable Development (SEJRSD), 6(1), 103–112. https://sejrsd.org.ng/index.php/SEJRSD/article/view/250
5. Buzan, T. (2020). The Mind Map Book: Unlock Your Creativity, Boost Your Memory, Change Your Life. BBC Active.
6. Clark, M., Rivers, D., & Chan, K. (2019). Learning mathematics through visual networks: A study of mind mapping. Harvard Educational Review, 89(1), 115–132.
7. Menouer, B., Faouzi, L., Zennou, F.,Sbaa,M & Nachit,B. (2024).Effects of employing mind mapping techniques in geometry instruction on logical thinking abilities. Journal of pedagogy and teacher education.16(60),220-226.
8. Novak, J. D., & Cañas, A. J. (2021). The theory underlying concept maps and how to construct them. Institute for Human and Machine Cognition.
9. Okereke, S. C., & Okigbo, E. C. (2019). Effectiveness of Mind-Mapping Teaching Strategy in Enhancing Senior Secondary School Students' Achievement and Interest in Computer Studies. Journal of Science, Technology and Mathematics Education (JOSTMED), 15(1), 123–134. https://journals.unizik.edu.ng/jstme/article/view/483
10. Okereke, S. C., & Okigbo, E. C. (2020). Effect of Mind-Mapping Teaching Strategy on Students' Retention in Senior Secondary School Computer Studies in Imo State. Journal of Science, Technology and Mathematics Education (JOSTMED), 16(2), 76–89. https://journals.unizik.edu.ng/jstme/article/view/483
11. Omeodu, M.D. (2018).Effect of Concept Mapping in Teachng of Physics in Senior Secondary Schools in Portharcourt Local Government Area Rivers State. European Scientific Journal.14(31),71-81. https://doi.org/10.19044/esj.2018.v14n31p71
12. Otukpa, E. A., Agbo-Egwu, A. O., & Anyor, J. W. (2024). Effect of Mind Mapping Instructional Strategy on Upper Basic Education Three Students' Achievement and Retention in Statistics in Agatu, Benue State. Nigerian Journal of Mathematics Education (NJME), 6(1), 44–59. https://ngsme.villagemath.net/journals/ver/v6i1/otukpa-agbo-egwu-anyor
13. Sunday, I. J., Umoetuk, G. S., & Akpan, F. E. (2023). Mind Mapping-Based Instructional Strategy Delivery and Students' Academic Achievement in Science in Akwa Ibom State. The Journal of Academic and Business Studies (TJABS), 5(4), 88–98. https://zienjournals.com/index.php/tjabs/article/view/4599
14. The Guardian Nigeria. (2023, March 16). Why schools must integrate visual learning into the curriculum. The Guardian Newspaper. https://guardian.ng
15. Ukoh, M. O., & Aladejana, A. A. (2023). Effects of Mind Mapping and Visual Imagery Instruction Strategies on Senior Secondary School Students' Scientific Attitude to Mechanics in Ekiti State. Journal Inovasi Pendidikan IPA (JIPI), 9(2), 337–349. https://journal.uny.ac.id/index.php/jipi/article/view/54458
16. Rivers State Senior Secondary Schools Board (2024). Office of Statistics: Rivers State Senior
17. Secondary Schools Board Students Enrollment for First Term 2024/2025 Session. Rivers State Senior Secondary Schools Board.
18. West African Examinations Council (2023). Chief Examiners' Report: West African Senior School Certificate Examination May/June 2023 – Mathematics. Lagos: West African Examinations Council.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VII June 2026

APPENDICES

APPENDIX I

Geometric Construction Attitude Questionnaire (GCAQ)

Instructions:
Please respond to each statement by ticking the option that best describes your level of agreement.

| SA = Strongly Agree (4) | A = Agree (3) | D = Disagree (2) | SD = Strongly Disagree (1) |

Section A: Interest and Motivation

S/N	Statement	SA	A	D	SD
1	I enjoy learning about Geometric Construction.				
2	Geometric Construction is an interesting topic in Mathematics.				
3	I look forward to classes involving construction with compass and ruler.				
4	The use of diagrams and visual tools makes learning Geometry easier.				
5	I feel motivated to learn when teachers use mind mapping in lessons.				

Section B: Confidence and Participation

S/N	Statement	SA	A	D	SD
6	I feel confident when constructing angles and lines in Geometry.				
7	I understand better when I draw diagrams myself.				
8	I can solve Geometric Construction tasks without much difficulty.				
9	I prefer participating actively in Geometry class activities.				
10	I am able to explain construction steps to my classmates.				

Section C: Perceived Usefulness and Relevance

S/N	Statement	SA	A	D	SD
11	Geometric Construction is useful in real-life activities like drawing.				
12	I believe Geometry is important for my future studies or career.				
13	I will need construction skills in higher mathematics.				

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VII June 2026

14	I see the relevance of Geometric Construction in technical subjects.				
15	Mind mapping helps me understand how construction steps are connected.				

Scoring Guide

I. Each item is scored: SA = 4, A = 3, D = 2, SD = 1

II. Maximum total score = 60; Minimum = 15

III. A score of ≥2.50 mean per item indicates a positive attitude

IV. Reliability can be tested using Cronbach's Alpha

Geometric Construction Achievement Test (GCAT)

This is a 10-item multiple-choice test designed to assess SS1 students' achievement in basic Geometric Construction topics.

Instructions: Choose the correct answer from options A–D.

Sample Items

1. Which of the following instruments is essential for constructing angles?

A. Protractor
B. Set square
C. Compass ☑
D. Divider

2. What is the first step when bisecting a given angle?

A. Measure the angle

B. Draw a line perpendicular to it

C. Mark equal arcs from the angle's vertex ☑

D. Draw a circle

3. To construct a perpendicular bisector of a line segment, you must:

A. Draw an arc only on one side

B. Use a ruler only

C. Draw arcs from both endpoints ☑

D. Estimate the midpoint

4. The correct instrument combination for constructions is:

A. Pencil and eraser

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VII June 2026

B. Set square and ruler

C. Ruler and protractor

D. Compass and straightedge ☑

5. In constructing a 60° angle, one must:

A. Draw a perpendicular bisector

B. Draw arcs from a point on a line ☑

C. Measure with a protractor

D. Fold the paper

6. A triangle constructed with all sides equal is called:

A. Isosceles

B. Right-angled

C. Equilateral ☑

D. Scalene

7. What is the minimum number of steps to construct a perpendicular to a line from a point not on the line?

A. 1

B. 2

C. 3 ☑

D. 4

8. A key reason for learning constructions is to:

A. Pass exams

B. Memorize formulas

C. Understand shape relationships ☑

D. Avoid drawing

9. Which of these cannot be used in classical geometric constructions?

A. Compass

B. Divider

C. Protractor ☑

D. Ruler

10. The intersection of two arcs during construction determines:

A. An endpoint

B. The midpoint

C. The construction angle

D. A new point of precision ☑

Scoring

I. Each correct answer: 1 mark

II. Total Score: 10

III. High achievement: 8–10

IV. Average: 5–7

V. Low: Below 5

Lesson Plan: Geometric Construction Using Mind Mapping Strategy

Subject: Mathematics
Class: SS1
Topic: Geometric Construction

Sub-topic: Bisecting Angles and Constructing Perpendicular Lines

Duration: 80 minutes

Date: 06/04/2026

Number of Students: 40

Teaching Strategy: Mind Mapping Strategy

Teaching Aid: Compass, ruler, pencil, cardboard, chart paper, projector (if available), and prepared mind maps.

Instructional Objectives:

At the end of the lesson, students should be able to:

1. Define geometric construction.
2. Use a compass and straightedge to bisect an angle and construct perpendicular lines.
3. Create a mind map to organize steps and tools involved in geometric constructions.
4. Demonstrate improved understanding through group discussions and class presentations.

Entry Behaviour

Students have been introduced to basic geometry concepts and can identify geometrical instruments (compass, ruler, etc.).

Instructional Materials

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VII June 2026

I. Chalkboard/whiteboard

II. Pre-drawn mind map templates

III. Compass and rulers for each student

IV. Manilla papers for group activity

V. Projector (optional)

Lesson Development

Steps	Teacher's Activities	Students' Activities	Time
INTRODUCTION	Reviews prior knowledge on angles and lines. Asks students to describe geometric instruments.	Respond by identifying instruments and discussing their uses.	10 mins
Presentation Step 1	Introduces "Geometric Construction" and defines it. Draws mind map skeleton with "Geometric Construction" as the central concept.	Listen attentively and copy the mind map structure.	10 mins
Presentation Step 2	Demonstrates how to bisect an angle using compass and straightedge. Fills in the first branch of the mind map with steps.	Follow the demonstration using their instruments.	15 mins
Presentation Step 3	Guides students to construct a perpendicular line from a point on a line. Adds another branch to the mind map.	Perform the construction and update their own mind map accordingly.	15 mins
Group Activity	Divides class into 5 groups. Each group creates a full mind map with at least 3 constructions (angle bisection, perpendicular from a point, equilateral triangle).	Collaborate in groups to construct figures and complete mind maps.	20 mins
Presentation and Feedback	Each group presents their mind map and explains the constructions. Teacher provides feedback and corrections.	Present work and respond to feedback.	10 mins

Evaluation

Oral Questions:

1. What is geometric construction?
2. List the instruments used in geometric construction.
3. What are the steps for bisecting an angle using a compass?

Written Exercise:

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VII June 2026

1. Complete a partially drawn mind map with steps for constructing:

a. Perpendicular from a point

b. Bisecting an angle

2. Individually construct both figures on plain paper.

Assignment

Draw a complete mind map on "Types of Geometric Constructions" (e.g., bisecting lines, constructing triangles, angle transfer). Include tools and steps.

Conclusion

The teacher summarizes the lesson, reinforces the importance of visualization in geometry through mind mapping, and encourages continued use of the strategy for complex constructions.

Lesson Plan Format Used: Activity-Based / 21st Century Competency-Oriented Lesson Plan (ASEI)

LESSON PLAN (LECTURE-DEMONSTRATION METHOD)

Subject: Mathematics

Class: SS1

Topic: Geometric Construction

Sub-topic: Bisecting Angles and Constructing Perpendicular Lines

Date: 06/04/2026

Duration: 80 Minutes

Class Size: 42

Teaching Method: Conventional (Lecture-Demonstration Method)

Instructional Materials: Compass, ruler, pencil, chalkboard, whiteboard, textbook, drawing sheets.

Instructional Objectives

At the end of the lesson, students should be able to:

I. Define geometric construction.

II. List instruments used in geometric construction.

III. Accurately bisect a given angle using compass and ruler.

IV. Construct a perpendicular line from a given point on a line.

Entry Behaviour

Students are already familiar with basic geometrical terms like points, lines, and angles, and can identify common geometrical instruments.

Previous Knowledge

Students have been introduced to different types of angles and properties of lines.

Instructional Procedure

Steps	Teacher's Activities	Students' Activities	Time
INTRODUCTION	Asks questions to review previous knowledge (e.g., "What is an angle?", "What is a line?")	Respond to questions and identify geometric tools.	10 mins
Step 1	Introduces the topic: "Geometric Construction". Writes definition on the board.	Listen and take notes.	10 mins
Step 2	Lists and explains tools: compass, ruler, pencil. Demonstrates on the board.	Observe and ask questions.	10 mins
Step 3	Demonstrates how to bisect an angle using compass and ruler step-by-step on the board.	Copy the procedure into notebooks and attempt same individually.	15 mins
Step 4	Demonstrates how to draw a perpendicular from a point on a line using a compass.	Practice on their own using drawing instruments.	15 mins
Step 5	Walks around the class, checks students' work, and corrects mistakes.	Submit their constructions for checking.	10 mins
Summary	Recaps key points: definitions, steps for constructions, tools used.	Ask questions and seek clarification where needed.	5 mins
Assignment	Instructs students to practice construction of equilateral triangles at home.	Take note of the homework.	5 mins

Evaluation

Oral Questions:

1. What is geometric construction?
2. Name three tools used in geometric construction.
3. What are the steps for bisecting an angle?

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VII June 2026

Class Exercise:

I. Use your compass and ruler to:

a. Bisect a 60° angle.

b. Construct a perpendicular from a point on a given line.

CONCLUSION

The teacher summarizes the lesson and reinforces the importance of accuracy and precision in geometric constructions. Students are reminded to bring their instruments for the next class.

Teacher's Name/Signature: ___________________________

Supervisor's Signature: ______________________________

Date Reviewed: ____________________________________

Comparison Table: Conventional Method vs. Mind Mapping Strategy

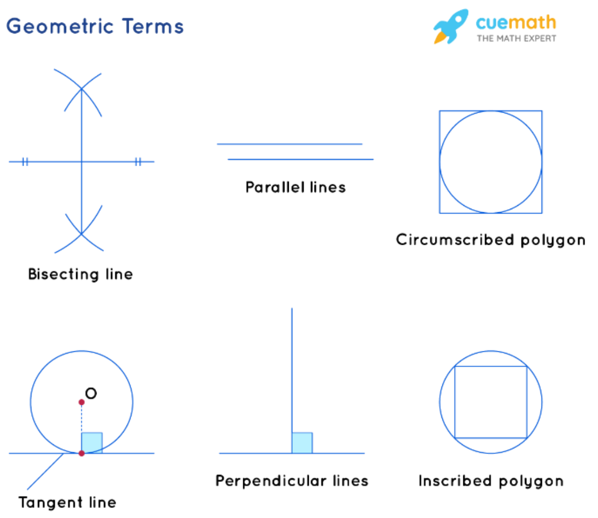
S/N	Feature	Conventional Method	Mind Mapping Strategy
1.	**Instructional Approach**	Teacher-centered (lecture and demonstration)	Learner-centered (visual and interactive learning)
2.	**Content Presentation**	Sequential explanation on chalkboard/whiteboard	Concepts organized visually in a central mind map with branches
3.	**Student Engagement**	Passive — students mainly observe and copy	Active — students build, modify, and apply mind maps during learning
4.	**Memory Retention**	Rote memorization is common	Improved retention through association and visual organization
5.	**Development of Critical Thinking**	Minimal — mostly procedural focus	Encourages reasoning, linkage of concepts, and decision-making
6.	**Use of Learning Aids**	Limited to compass, ruler, and chalkboard	Compass, ruler, colored charts, diagrams, and pre-designed mind maps
7.	**Gender Sensitivity**	May favor more confident students	Equal participation; promotes collaboration across genders
8.	**Attitude Toward Topic**	Often neutral or uninterested	More positive; promotes curiosity and enjoyment in learning
9.	**Assessment Approach**	Traditional written/classwork-based	Includes visual presentations, collaborative evaluation, and construction
10.	**Effect on Achievement**	Moderate improvement	High improvement in understanding and performance

Summary

I. The **lecture-demonstrtion method** is easier to implement and familiar to most teachers, but it tends to limit student engagement and creativity.

II. The **mind mapping strategy** promotes deeper understanding, better retention, and a more positive attitude towards Geometry, especially **Geometric Construction**.

Geometric Constructions Chart



Concepts of Geometric Construction

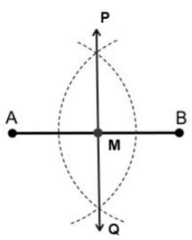
Today, we will learn about construction basics and explore concepts of geometric construction with a given solved example.

Figures need to be drawn for various applications such as the construction of a building, tool design, and other engineering design purposes. To draw such figures, we need the following geometric tools:

1. Scale or ruler with 'cm' and 'mm' mentioned on sides.
2. Set-Squares pairs of 30°,60°,90°, and 45°,45°, and 90°.
3. Compass with an attached pencil.
4. Protractor for angle measurement.

The instruments mentioned above are used for geometrical figure drawing of specific measurements. These figures are mainly drawn using a compass, scale, and protractor. Here we will understand the basic concepts regarding the construction. With those concepts, it will help us in solving construction problems.

Construction of Perpendicular Bisector



ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VII June 2026

Steps for geometric construction:

Step1 – Draw a line AB with a scale.

Step2 – Now take a compass and put a point on A to extend the compass more than half of the line.

Step3 – From the same point A, make a semi-circular arc above and below the line.

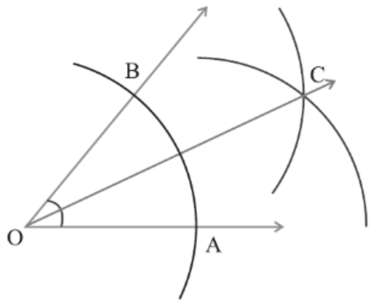
Step4 – Repeat the same step at point B without changes in compass extension.

Step5 – You will get two intersected points above and below the line. Name these points P and Q.

Step6 – Now join the line PQ, and you will see we get ∠ 90° at ∠ PMB.

Step7- So ∠ PMB is our Perpendicular Bisector so ,∠ PMB=∠ PMA=∠ AMQ=∠ QMB.

Construction of an Angle Bisector



Steps for geometric construction:

Step1 – Construct a line that bisects an acute angle into two congruent parts.

Step2 – Name the vertex as point O, and we need one more point C to detriment the angle bisector line.

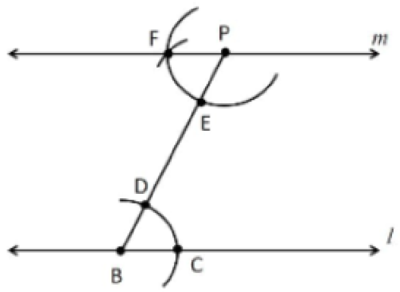
Step3 – Take a compass with an arbitrary extension that intersects the given lines, and we will get points A and B.

Step4 – Now, from points A and B, make the arc to form an intersection point C.

Step5 – Now join points C and O.

Step6 – From OC we get angle bisector ∠COA and ∠COA=∠COB.

Construction of a parallel line



Steps for geometric construction:

Step1 – In the given line l take any arbitrary point as B.

INTERNATIONAL JOURNAL OF RESEARCH AND INNOVATION IN APPLIED SCIENCE (IJRIAS)
ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VII June 2026

Step2 – From point B make an acute angle which you prefer using a protractor.

Step3 – Using a compass, make an arc intersecting the lines from vertex B.

Step4 – Name the two intersecting points D and C.

Step5 – Use a compass to measure the distance between D and C.

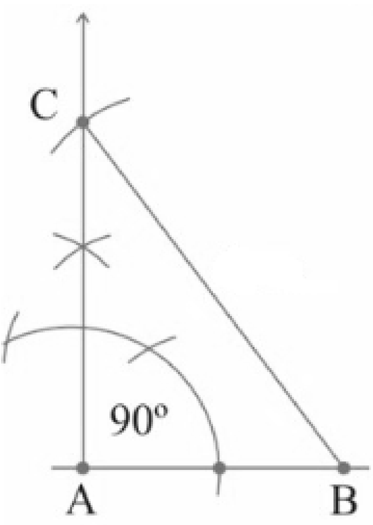
Step6 – Now with that distance, place it in the line which has point D, and in that choose any position from which you want to make a parallel line.

Step7 – Name it point E and make an arc. Position the compass at some distance and name it as point P such that BD=PE.

Step8 – From point P make an arc such that it intersects the arc. Name the arc intersection point as E and join points P and F.

Step9 – Hence the construction of the parallel line is done.

Construction of Triangle (Right Angled)



Steps for geometric construction:

Step1 – Draw a line of the required length AB.

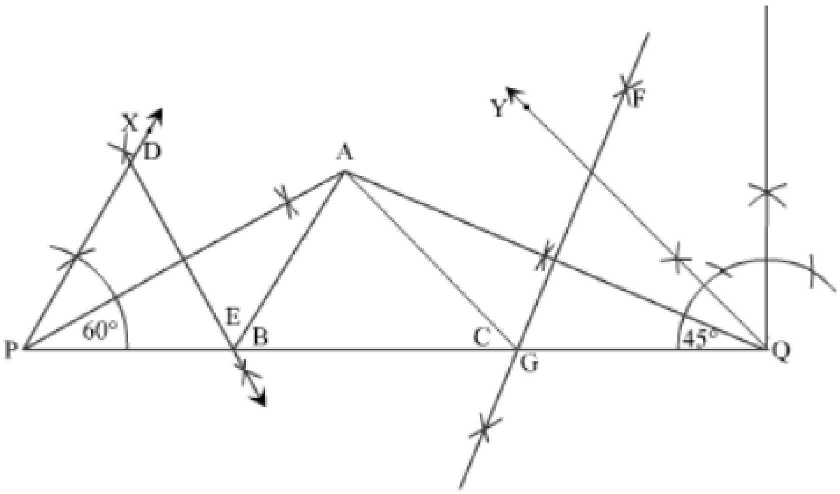
Step2 – Now at point A draw a perpendicular bisector and mark it as point C at the required distance from C.

Step3 – Join points B and C.

Step4 – You now have a basic right-angled triangle.

Solved Example: Construct a triangle ABC in which ∠B=60°, ∠C=45°, and AB+BC+CA=11cm.

Solution:



Steps for Construction:

Step1 – With a scale draw line PQ=11 cm (AB+BC+CA=11 cm).

Step2 – Now point P using the compass makes a 60° at point P by first making an arc at point P of any arbitrary extension.

Step3 – At the point where the arc bisects PQ, place the compass and again bisect the previous arc, which was made from point P.

Step4 – Now again, make the arc on the left-hand side from the same point and now go to that previous point by bisecting the arc.

Step5 – From that point, bisect the arc on the left-hand side and from point P join it, and a 60° angle is formed.

Step6 – Follow the same steps to further bisect the 60° angle to get 30° angle.

Step7 – Name that line segment as PA and ∠APQ=30°.

Step8 – Now at point Q construct a perpendicular bisector to form a 90° angle at Q.

Step9 – Now using the angle-bisector method make 45° at point Q and name that as line MQ.

Step10 – So we will get ∠MQG=45°, now again by using the angle bisector method make an angle of 22.5°.

Step11 – Extend the angle bisector line to intersect line PA. Now keeping A as a common point the formed line is AQ.

Step12 – Draw perpendicular bisectors DE and AP such that they intersect PQ at B and FG of AQ to intersect PQ at C.

Step13 – Join AB and AC.

Step14 – ABC is the required triangle.

Conclusion

The above example used all basic concepts of constructions, as listed below:

I. Perpendicular bisector in which at a given point 90° is constructed and can be used to mark the midpoint of the given unknown line
II. Angle bisector for dividing the angle into two congruent parts

III. Parallel line construction at a given distance can be done with arc measurements from a given point
IV. The right-angled triangle can be constructed with the perpendicular bisector method