

## Effect of Generative Teaching Strategy on Students' Motivation in Geometry in Maiduguri Secondary Schools, Nigeria

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### Abstract

*Low student motivation in geometry presents a significant challenge in the educational landscape of Maiduguri Metropolis, largely attributed to the prevalence of conventional teaching methods. This study aimed to investigate the effect of the Generative Teaching Strategy (GTS) compared to the Conventional Method of Teaching (CMT) on the motivation of secondary school students. A quasi-experimental, pretest-post-test non-equivalent groups design was employed with a sample of 106 SS2 students from two intact classes. One group (N = 52) received instruction via GTS, while the control group (N = 54) was taught using CMT over a period of six weeks. The Geometry Motivation Questionnaire (GMQ) was administered as both a pre-test and a post-test, and the data were analysed using the Mann-Whitney U test. Results revealed a statistically significant difference in post-intervention motivation scores ( $U = 609.5, p = .001$ ), with the GTS group demonstrating a substantially higher mean rank (68.21) than the CMT group (38.22). It is concluded that the Generative Teaching Strategy is a significantly more effective pedagogical approach than the conventional method for enhancing student motivation in geometry within this context, offering a validated solution for educators seeking to improve student engagement. Considering the findings from this study, it is recommended that the Borno State Ministry of Education, along with relevant curriculum authorities, formally integrate Generative Teaching Strategy (GTS) principles into the official secondary school mathematics curriculum and teacher training manuals. Geometry teachers are also encouraged to incorporate GTS activities into their instructional practices.*

**Keywords:** *Generative Teaching Strategy, student motivation, geometry, quasi-experimental design, conventional teaching method*

### INTRODUCTION

The integration of mathematics, particularly geometry, into secondary school curricula is paramount for developing students' critical thinking, problem-solving skills, and logical reasoning abilities. Engaging with geometric concepts equips students to face complex real-world challenges and promotes the deeper conceptual understanding essential in STEM fields (Akinwamide, 2022; Atoyebi & Atoyebi, 2022). However, despite its significance, a pressing challenge within the Nigerian educational landscape, particularly in Borno State, is the pervasive lack of motivation among students toward mathematics. Research indicates that many students experience anxiety which negatively impacts their engagement, and traditional

instructional strategies often fail to address this issue, further diminishing motivation (Atoyebi & Atoyebi, 2022; Mata et al., 2012). A primary contributor to this problem is the continued reliance on Conventional Teaching Methods (CMT), which are typically characterized by teacher-centred lectures that emphasise rote memorisation over genuine understanding and often fail to foster the active engagement necessary for mastering abstract concepts (Rahimi & Shirani, 2018; Wenzel et al., 2021).

In contrast, student-centred approaches like the Generative Teaching Strategy (GTS) present a promising alternative. The theoretical basis for GTS's potential effectiveness is robust, grounded in several key learning and motivation theories. Firstly, Generative Learning Theory, as developed by scholars like Wittrock, posits that individuals learn best when they actively participate in the learning process by generating their own understanding rather than passively receiving information (Fiorella & Mayer, 2015). GTS operationalises this theory through core activities such as summarisation, concept mapping, and peer teaching. Secondly, its motivational impact is explained by Self-Determination Theory (SDT), which argues that intrinsic motivation is nurtured when the psychological needs for autonomy, competence, and relatedness are met (Ryan & Deci, 2000). Finally, Expectancy-Value Theory (EVT) complements this by suggesting that motivation is influenced by a student's belief in their ability to succeed (expectancy) and the perceived relevance of the task (value) (Perez et al., 2019). The active, collaborative, and empowering nature of GTS directly aligns with fostering these conditions.

Motivation in mathematics is a multifaceted construct encompassing both intrinsic (engagement driven by personal interest) and extrinsic (engagement driven by external rewards) components (Güvendir, 2016). Key factors influencing this construct include self-efficacy, the belief in one's ability to succeed (Ali & Hassan, 2019); task value, the perceived importance of the subject (Oyedeji, 2017); and mathematics anxiety, a significant hindrance to engagement (Ay & Doğan, 2024). These components are especially critical in geometry, where visual-spatial reasoning and abstract thinking are required. Highly motivated students are more likely to persist through complex problems and explore diverse problem-solving strategies, leading to better academic performance (Halimah et al., 2022; Nugraha et al., 2021).

Despite the strong theoretical support for GTS and the documented limitations of CMT, a significant research gap persists. While empirical studies have linked GTS with enhanced cognitive outcomes like knowledge acquisition (Wahyuni et al., 2024), research specifically analysing its effect on student motivation remains limited (Rahimi & Shirani, 2018). Furthermore, there is a distinct lack of localised evidence validating its effectiveness within the

specific context of geometry education in Maiduguri. While broad studies advocate for innovative instructional methods, a thorough examination addressing the local conditions and cultural factors in Borno State is lacking (Usman et al., 2020; Yakubu & Apoenchir, 2024). This study, therefore, aims to address this gap by systematically investigating the effect of the Generative Teaching Strategy on secondary school students' motivation in geometry compared to the Conventional Method of Teaching.

### **Statement of the Problem**

Despite the critical importance of geometry for developing analytical skills, a significant and persistent problem within the secondary education system of Maiduguri Metropolis is the pervasive low motivation among students towards the subject. This issue is perpetuated by the widespread reliance on Conventional Teaching Methods (CMT), which, through passive, teacher-centred instruction, fail to foster active engagement and consequently contribute to student anxiety, poor academic performance, and a diminished pipeline into STEM-related fields.

While student-centred approaches like the Generative Teaching Strategy (GTS) are theoretically well-supported for enhancing engagement (Yurt, 2015; Yang & Mîndrilă, 2020), a critical gap exists between this theoretical promise and localised, empirical proof. Specifically, there is a lack of evidence validating the effectiveness of GTS on student motivation within the context of geometry education in the unique educational environment of Maiduguri. This study is therefore designed to address this specific problem by systematically investigating the effect of the Generative Teaching Strategy on students' motivation in geometry compared to the conventional methods currently in use.

### **Research Question**

The study was guided by the following research question:

What is the difference between the motivation scores of students taught geometry using the Generative Teaching Strategy (GTS) and those taught using the Conventional Method of Teaching (CMT)?

### **Hypothesis**

The study tested the following null hypothesis at 0.05 level of significance:

**H<sub>01</sub>:** There is no significant difference in the motivation scores of students taught geometry using the Generative Teaching Strategy (GTS) and those taught using the Conventional Method of Teaching (CMT).

## **METHODOLOGY**

### **Research Design**

This study utilised a quantitative, quasi-experimental approach, specifically a pretest-post-test non-equivalent groups design, to systematically assess the impact of the Generative Teaching Strategy (GTS) on students' motivation in geometry. This design was chosen due to the ethical and logistical limitations of random assignment in a real-world school setting, as randomisation could have disrupted existing class structures (Atoyebi & Atoyebi, 2022). A quasi-experimental design allows for the exploration of cause-and-effect relationships within the constraints of such environments (Creswell, 2014). The independent variable was the teaching method, operationalised at two levels: the Generative Teaching Strategy (GTS) and the Conventional Method of Teaching (CMT). The dependent variable was students' motivation in geometry, as measured by post-test scores, with pre-test scores serving as a covariate in the analysis.

### **Population and Sample Size**

The study population consisted of all 3,468 Senior Secondary (SS II) students enrolled in public coeducational secondary schools within Maiduguri Metropolis, Borno State, Nigeria. From this population, a purposive sampling technique was used to select two secondary schools that met the participation criteria. The selected schools were coeducational institutions with students from diverse tribal backgrounds, primarily Kanuri and Babur Bura. To minimise disruption to the regular class schedules, intact classes were used. The final sample comprised 106 students: 52 in the experimental group (GTS) and 54 in the control group (CMT), with a gender distribution of 59 males and 47 females. To ensure anonymity, the two participating schools were coded as School A and School B.

### **Instrument for Data Collection**

The study adapted the Mathematics Motivation Questionnaire (MMQ) by Fiorella et al. (2021) to create the Geometry Motivation Questionnaire (GMQ). This instrument consisted of 19 items designed to measure students' motivation in geometry across several indices, including intrinsic motivation, extrinsic motivation, self-efficacy, utility value, and test anxiety. Responses were captured on a 5-point Likert scale ranging from 'Strongly Disagree' to 'Strongly Agree'. The content and construct validity of the GMQ were supported by the literature and confirmed through expert evaluations (Akinwamide, 2022). Reliability was established via pilot testing, which yielded a Cronbach's Alpha of 0.79 for the GMQ during the pre-test phase, indicating adequate internal consistency.

## Procedure

The study was conducted in three distinct phases over a seven-week period:

1. **Pre-Test Phase (Week 1)** : The Geometry Motivation Questionnaire (GMQ) was administered to all participants in both the experimental and control groups to establish a baseline measure of their motivation.
2. **Intervention Phase (Weeks 2-7)**: Over six weeks, the experimental group received geometry instruction based on GTS. Key activities included students actively drawing and explaining geometric concepts, generating their own problem-solving tasks, and engaging in structured peer-teaching sessions. The control group was concurrently taught the same curriculum topics using CMT, which was characterised by teacher-led explanations, textbook exercises, and whole-class discussions. To ensure treatment fidelity, the GTS teacher received prior training, and adherence to both teaching methods was monitored through lesson plan reviews and periodic observational checklists.
3. **Post-Test Phase (End of Week 7)**: Immediately following the intervention period, the GMQ was re-administered to all participants to evaluate the change in their motivation in geometry.

## Ethical Considerations

Ethical standards were strictly maintained throughout the study. Approval was obtained from the Borno State Ministry of Education and the principals of the participating schools. Informed consent was secured from parents and assent from students prior to participation. To ensure confidentiality, all data were anonymised using codes rather than names. Participants were clearly informed that their involvement was voluntary and that they could withdraw at any time without penalty. Furthermore, equity was maintained by ensuring the control group received standard, approved instruction. The research findings were to be shared with the participating schools upon completion of the study.

## RESULTS

### Baseline Comparison of Pre-test Attitude Scores by Group

Table 1: Pre-test Motivation Scores for Experimental and Control Groups

Groups	N	Mean Rank	Mean Rank Difference
Experimental	52	53.1	0.79
Control	54	53.89	
Total	106		

Table 1 presents the analysis of the pre-test attitude scores for the experimental and control groups before the intervention. The experimental group (N = 52) had a mean rank of 53.10,

while the control group (N = 54) had a mean rank of 53.89. The calculated difference between the mean ranks was a minimal 0.79. These results indicate that the pre-test motivation scores of the experimental and control groups were closely aligned at the beginning of the study.

**Research Question:** What is the difference between the motivation scores of students taught geometry using the Generative Teaching Strategy (GTS) and those taught using the Conventional Method of Teaching (CMT)?

Table 2: Mean Ranks of Post-Intervention Motivation Scores for the Generative Teaching Strategy (GTS) and Conventional Method of Teaching (CMT) Groups

Groups	N	Mean Rank	Mean Rank Difference
Experimental	54	68.21	29.99
Control	52	38.22	
Total	106		

Table 2 shows the mean ranks of post-intervention motivation scores for both the experimental and control groups. The experimental group (N = 54), which was exposed to the Generative Teaching Strategy, recorded a mean rank of 68.21, while the control group (N = 52), taught with the Conventional Method of Teaching, recorded a mean rank of 38.22. The resulting mean rank difference was 29.99, indicating that the motivation scores of the experimental group were, on average, ranked higher than those of the control group.

**H<sub>01</sub>:** There is no significant difference in the motivation scores of students taught geometry using the Generative Teaching Strategy (GTS) and those taught using the Conventional Method of Teaching (CMT).

Table 3 Mann-Whitney U Test Comparing Post-Intervention Motivation of the Generative Teaching Strategy (GTS) and Conventional Method of Teaching (CMT) Groups

Groups	N	Mean Rank	Sum of Ranks	U-Value	P-Value
Experimental	54	68.21	1987.5	609.5	0.001
Control	52	38.22	3683.5		
Total	106				

Table 3 presents the results of the Mann-Whitney U test, which was conducted to test the null hypothesis stating there is no significant difference in the motivation scores of students taught with the Generative Teaching Strategy and those taught with the Conventional Method of Teaching. The analysis yielded a U-value of 609.5 and a p-value of 0.001. Since the p-value of 0.001 is less than the standard alpha level of 0.05, the result is statistically significant. Therefore, the null hypothesis is rejected. This significant difference favours the experimental group, which recorded a higher mean rank (68.21) compared to the control group (38.22).

## DISCUSSION

The primary finding of this study was a statistically significant difference between the post-intervention motivation scores of students taught geometry with the Generative Teaching Strategy (GTS) and those taught with the Conventional Method of Teaching (CMT). The results of the Mann-Whitney U test ( $U = 609.5$ ,  $p = .001$ ) led to the rejection of the null hypothesis, which posited no significant difference between the groups. The descriptive data further clarified this outcome, showing a substantially higher mean rank for the experimental group (68.21) compared to the control group (38.22). This large difference in ranks suggests not only a statistically significant but also a practically meaningful effect, indicating that GTS was considerably more effective in enhancing student motivation in the context of this study. The rejection of the null hypothesis provides a clear and direct answer to the research question. The results demonstrate that the teaching method employed has a significant impact on student motivation in geometry. The findings indicate that GTS is not merely an alternative to CMT but a superior pedagogical strategy for fostering motivation among secondary school students in the Maiduguri Metropolis. This conclusion is strengthened by the baseline data, which showed that both groups began the study with nearly identical levels of motivation, suggesting the observed post-intervention difference can be confidently attributed to the teaching method. These findings align with existing literature in several important ways. Firstly, they support the claims of researchers who have highlighted the limitations of conventional, teacher-centred methods in fostering student engagement and motivation (Rahimi & Shirani, 2018; Wenzel et al., 2021). Secondly, the results are consistent with broader research indicating that active, student-centred learning strategies lead to improved affective and cognitive outcomes (Wahyuni et al., 2024). Most importantly, this study directly addresses the specific research gap identified by Usman et al. (2020) and Yakubu & Apoenchir (2024) by providing localised, empirical evidence for the effectiveness of GTS on *motivation in geometry* within the unique educational context of Borno State, a void previously noted in the literature.

The superior motivational outcomes of the GTS group can be explained through the theoretical frameworks that underpinned this study. The findings offer strong support for Wittrock's Generative Learning Theory, as students were not passive recipients of information but were actively engaged in generating their own understanding through summarisation and peer teaching (Fiorella & Mayer, 2015). This active process is inherently more engaging than the passive reception typical of CMT.

Furthermore, the success of GTS can be interpreted through the lens of Self-Determination Theory (SDT). The core activities of GTS likely satisfied the three fundamental psychological

needs: **Autonomy:** By generating their own examples and explaining concepts in their own words, students experienced a sense of control and ownership over their learning. **Competence:** Successfully teaching a concept to a peer or creating a coherent concept map provided tangible proof of mastery, thereby building self-efficacy and a feeling of competence. **Relatedness:** The collaborative nature of peer teaching fostered a positive social learning environment, enhancing students' sense of connection to their classmates.

Finally, the results also align with Expectancy-Value Theory (EVT). As students' feelings of competence grew, their expectancy for success in geometry likely increased. Simultaneously, by connecting geometric concepts to their own understanding and explaining them to others, the subject matter may have become more relevant and useful, thus increasing its perceived task value (Perez et al., 2019). In contrast, the conventional method offers fewer opportunities to develop these crucial motivational pillars.

## **Implications of the Findings of the Study**

### **Practical Implications**

The findings of this study offer clear, actionable implications for improving mathematics education in Maiduguri, Borno State, and similar contexts facing challenges with student motivation.

**For Teachers:** The most direct implication is for classroom practitioners. Instead of relying solely on conventional, lecture-based instruction, geometry teachers are encouraged to incorporate Generative Teaching Strategy (GTS) activities into their lessons. Simple, low-cost strategies such as dedicating time for students to summarise concepts in their own words, engage in structured peer-teaching sessions, or generate their own example problems can shift students from being passive listeners to active participants. This shift is critical for building the self-efficacy and intrinsic interest that drive motivation.

**For School Administrators:** Principals and school leaders have a crucial role in fostering an environment where innovative teaching can thrive. They should facilitate professional development workshops and training on GTS for their mathematics teachers. Furthermore, they can support implementation by adjusting classroom observation criteria to value student engagement and collaborative learning, rather than just quiet compliance. Creating Professional Learning Communities (PLCs) where teachers can share successes and challenges with GTS would further support its sustained use.

**For Curriculum Developers and Policymakers:** On a systemic level, the Borno State Ministry of Education and other curriculum bodies should consider formally integrating GTS

principles into the official secondary school mathematics curriculum and teacher training manuals. Providing teachers with resources, sample lesson plans, and embedding GTS in both pre-service and in-service teacher education programmes would help institutionalise this effective strategy, ensuring its benefits are widespread and long-lasting. Embracing GTS represents a strategic, evidence-based investment in enhancing student engagement and improving educational outcomes across the region.

### **Theoretical Implications**

The findings of this research also carry significant theoretical implications, contributing to the broader understanding of learning and motivation in a specific educational context.

**Extending Generative Learning Theory:** This study extends the application of Wittrock's Generative Learning Theory beyond its traditional focus on cognitive outcomes (e.g., knowledge retention and transfer). It provides strong empirical evidence that the active, meaning-making process inherent in generative learning is not just cognitively beneficial but also profoundly affective. The results demonstrate that the very act of generating knowledge, through explaining, mapping, and teaching, is an inherently motivating process for students, thereby linking the cognitive mechanism of the theory to a crucial emotional and psychological outcome.

**Contextualising Motivation Theories:** Furthermore, this research serves as a practical, **contextualised** validation of Self-Determination Theory (SDT) and Expectancy-Value Theory (EVT) within the field of geometry education in a non-Western setting. The study acts as an empirical bridge, showing how the abstract psychological needs outlined by SDT (autonomy, competence, relatedness) can be directly satisfied through the specific activities of GTS. It demonstrates that GTS is an effective mechanism for fostering these needs in a real-world classroom, thus validating the cross-cultural applicability of these motivational frameworks. In essence, this research moves beyond theoretical postulation to provide a clear, evidence-based example of how to design a learning environment that effectively nurtures student motivation.

### **Limitations of the Study**

While this study provides valuable insights into the effectiveness of the Generative Teaching Strategy, its findings should be considered considering several limitations. These limitations, inherent in the study's design and scope, offer important directions for future research.

1. The specificity of the sample limits the generalisability of the findings. The study was conducted exclusively with SS2 students in two secondary schools within Maiduguri Metropolis. The unique educational, cultural, and socioeconomic context of this region

means that the results may not be directly applicable to students in other parts of Nigeria or in different international settings. Therefore, caution should be exercised when extrapolating these findings to broader populations.

2. The measurement of the dependent variable was based solely on a self-report motivation questionnaire. While the instrument demonstrated good reliability, self-report measures are susceptible to biases such as social desirability, where students may respond in a way they perceive as favourable rather than entirely truthfully. Future studies could strengthen their validity by incorporating multiple data sources, such as behavioural observations of student engagement or qualitative interviews.
3. The duration of the intervention was limited to six weeks. This timeframe may have been sufficient to capture an initial increase in motivation, potentially influenced by a novelty effect from the new teaching method. However, it is insufficient to determine whether the motivational gains are sustainable over a longer academic term or year.
4. Despite efforts to ensure treatment fidelity through teacher training and checklists, the potential for a teacher effect cannot be entirely ruled out. The individual enthusiasm, experience, and personality of the teacher in the experimental group may have contributed to the positive outcomes, making it difficult to isolate the effect of the GTS methodology from the influence of the teacher.

Finally, this study focused exclusively on motivation and did not measure the corresponding impact on academic achievement. While motivation is a critical precursor to learning, this research does not provide direct evidence that the increased motivation from GTS translated into improved geometry test scores. Future research should investigate both variables concurrently to provide a more complete picture of the strategy's overall effectiveness.

## **CONCLUSION**

In conclusion, this study provides compelling, evidence-based support for the effectiveness of the Generative Teaching Strategy. The findings demonstrate that GTS is a significantly more powerful pedagogical tool than the Conventional Method of Teaching for enhancing the motivation of secondary school students in geometry within the Maiduguri context. By transforming students from passive listeners into active participants in their own learning, the strategy directly addresses the root causes of disengagement prevalent in traditional classrooms. Therefore, GTS represents not just an alternative pedagogical approach, but a validated and promising solution for revitalising student interest and engagement in mathematics education in the region.

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