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Effects of Visual, Auditory and Kinesthetic Learning Strategy on Interest of Basic School Students in Geometry, FCT Abuja, Nigeria

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Abstract. *The study examined effects of visual, auditory and kinesthetic learning strategy on interest of Basic School students in geometry, FCT Abuja, Nigeria. The study adopted a quasi-experimental pre-test, post-test control group research design. The target populations of this study comprised all JSSII students offering Mathematics in FCT Abuja. Two schools were randomly selected from the 2 Basic Schools in Gwagwalada Area Council and sixty (60) students were selected from each school using systematic sampling. The geometry Interest Inventory (GII) was adopted from Ritter and Marris in Jekayinfa, (2019) for interest testing before and after the treatment. The Geometry Interest Inventory (GII was administered) to both groups and their scripts were collected Data collected was analyzed using mean and standard deviation to answer the research questions, while Mann Whitney was used to test the hypotheses on interest. The study found that the VAK learning strategy have a positive impact on the interest of Basic schools' students in FCT among others and recommendations were made that teachers should consider integrating VAK learning strategies into their teaching practices to enhance students' interest and in Geometry.*

Key words: *Visual, Auditory and Kinesthetic Learning Strategy, Interest, Basic School Students, and Geometry.*

Introduction

Education plays a critical role in the development of individuals and societies, it is the foundation upon which individuals build knowledge, skills, and values that shape their futures. In the field of education, science education stands as a cornerstone, aiming to foster not only knowledge but also curiosity and innovation. Among the various branches of science, mathematics holds particular significance, as it is essential for problem-solving and logical thinking. Fennema, et al., (2017) submitted that science education, particularly mathematics, provides a unique challenge for students due to the abstract nature of many mathematical concepts. Geometry, as a subset of mathematics, is one of the areas that require students to not only understand numerical concepts but also develop spatial awareness and logical reasoning). Unlike arithmetic or algebra, which may rely heavily on numerical manipulation, geometry is more visual in nature. This demands that students engage in mental imagery and reasoning about shapes and their properties. Mayero, (2019) noted that educators have recognized the importance of engaging students through diverse teaching strategies. Strategies such as visual, auditory, and kinesthetic learning strategy, aims to cater to different learning styles and enhance students' understanding of mathematical concepts. Such strategies not only aim to improve academic achievement but also seek to ignite students' interest in the subject

According to Hidi, et al., (2016) who said that students' interest in mathematics, particularly in geometry, is a critical factor that affects their academic success. When students are engaged with the subject, they are more likely to put in the effort required to understand the concepts and improve their achievement. Interest in mathematics is influenced by various factors, including the methods of instruction, the relevance of the material, and the perceived difficulty of the content. However, for many students, geometry can be a difficult and abstract topic to grasp. Traditional methods of teaching, such as lecture-based instruction, may not be sufficient to generate interest or foster deep understanding. This is where alternative learning strategies such as visual, auditory, and kinesthetic learning strategy come into play. Marzano, (2017) submitted that this strategy offers diverse ways to engage students, catering to different learning styles and providing a more holistic approach to instruction. Study has shown that students who are taught using multimodal learning strategies those that incorporate visual, auditory, and kinesthetic elements tend to perform better academically compared to those who are taught using traditional methods (Pashler et al., 2018). By integrating various sensory modalities, this strategy provides multiple pathways for students to engage with and understand mathematical concepts. This, in turn, can lead to improved deeper understanding, and higher academic achievement. In the content of geometry, it has been observed that students' preferences for specific learning strategies may vary by gender.

Agboola and Aratiba (2017) agreed that male students may prefer more visual or spatial learning approaches, while female students may be more likely to engage with auditory or verbal methods. Understanding these differences can help teachers tailor their teaching strategies to meet the needs of all students, regardless of gender, and foster a more inclusive learning environment. The visual, auditory, and kinesthetic learning strategy represents three distinct approaches that engage different senses and cognitive processes. Visual learners typically benefit from diagrams, charts, and other visual representations that help them understand concepts. Auditory learners, on the other hand, thrive on spoken explanations, discussions, and audio recordings. Kinesthetic learners, who often excel when engaged in hands-on activities, learn best through physical movement and manipulation of objects (Kayode, et al., 2017). Each of these modalities has the potential to enhance students' understanding and interest in geometry. Visual modal, for instance, can help students develop spatial reasoning skills by providing them with clear, concrete representations of geometric shapes and their properties. Auditory modal can be useful for explaining abstract concepts and encouraging verbal reasoning, while kinesthetic modal allows students to explore geometric concepts through physical activity and interaction with tangible objects. This strategy may allow students to process information in different ways, making it more likely that they will engage with and retain the material. The effects of visual, auditory, and kinesthetic learning strategy on students' interest in geometry is complex and multifaceted. Thus, it is necessary to carry out this research on effects of visual, auditory and kinesthetic learning strategy on the interest and academic achievement of basic school students in geometry in FCT, Abuja.

Statement of the Problem

The teaching and learning of geometry, a critical aspect of mathematics, has long posed challenges for teachers, particularly in how to engage students and improve their interest. Conventional methods of teaching geometry, which typically rely on direct instruction and passive learning, have been found to be less effective in fostering deep interest among students (Zhao et al., 2019). Despite the implementation of conventional methods, many students continue to struggle with geometry, exhibiting low interest and outcomes on that aspect of mathematics. Gbadebo, (2021) posted that teaching methods outstandingly align with students' learning preferences, particularly their interest levels. Also, Ubom, et al (2024) submitted that when students are more interested in a subject, they tend to invest more effort into learning, leading to better achievement. However, many students, especially those with lack of interest, struggle to see the relevance of mathematics to their lives, often resulting in disengagement and poor academic outcomes. This presents a significant issue, as low levels of interest and achievement in mathematics can have long-term consequences for students' academic trajectories and their ability to engage in science-related fields in the future.

Furthermore, it is important to consider the role of gender in students' learning outcomes, as Aregbesola, et al (2024) submitted that male and female students may respond differently to various teaching strategies. It is unclear whether the VAK learning strategy has a differential impact on the academic achievement and interest of male and female students, particularly in the area of geometry.

Therefore, the question arises: how do visual, auditory, and kinesthetic learning strategy affects the interest of basic school students, particularly in the area of geometry? Also, how these different learning modalities influence students' engagement with geometry? Additionally, the study will consider how gender may play a role in shaping students' responses to these strategies. The VAK learning strategy, which uses visual aids, auditory materials, and kinesthetic activities, is propose to engage students through their preferred sensory modalities, thereby may tend to foster a deeper understanding of mathematical concepts like geometry. Thus, this study aims to investigate the differences in the mean interest and achievement scores between students taught geometry using the VAK strategy and those taught using conventional methods. Additionally, the study will examine whether gender plays a significant role in students' responses to these teaching strategies.

Objectives of the Study

The purpose of the study is to examine the effects of visual, auditory and kinesthetic learning strategy on the interest of Basic school students in geometry in FCT Abuja. Specifically, the following are objectives of the study:

i. Determine the effects of Visual, Auditory and Kinesthetic learning strategy on students' interest in geometry.

ii. Examine the effects of Visual, Auditory and Kinesthetic learning strategy on interest of male and female students in geometry.

Research Questions

The following research questions are formulated to guide the study:

i. What is the difference in the mean interest of students taught geometry with Visual Auditory Kinesthetic learning strategy and those taught geometry with conventional teaching method?

ii. What is the difference in the mean interest of male and female students taught geometry with the Visual, Auditory and Kinesthetic learning strategy?

Hypothesis

$H0_1$: There is no significant difference between the mean interest scores of students taught geometry with visual, Auditory and Kinesthetic (VAK) learning strategy and those taught geometry with conventional teaching method. (CTM)

$H0_2$: There is no significant difference between the interest ratings of male and female students taught geometry with visual, Auditory and kinesthetic (VAK) learning style.

Theoretical Framework

The VAK learning styles theory, developed by Walter Burke Barbe (1979) and refined by Neil Fleming (1987), emphasizes that students learn best when instructional strategies align with their preferred sensory modality visual, auditory, or kinesthetic. Applying this theory to geometry instruction plays a crucial role in sustaining students' interest by catering to their unique learning preferences. Visual learners develop a stronger interest in geometry when lessons incorporate diagrams, charts, and color-coded notes, making abstract concepts more tangible. Auditory learners stay engaged through discussions, storytelling, and rhythmic explanations that help them process geometric ideas verbally. Kinesthetic learners, who prefer hands-on activities, maintain their enthusiasm by constructing models, using geometric tools, and participating in interactive projects that allow them to physically engage with the subject matter. By integrating all three modalities, teachers create a dynamic and stimulating learning environment that enhances students' curiosity and motivation. A multisensory approach not only improves comprehension but also sustains students' interest in geometry, making learning more enjoyable and meaningful.

Literature

The evolution of mathematics education in Nigeria has transitioned from indigenous counting systems to a structured, modern curriculum influenced by global advancements. Before the advent of formal Western education, various ethnic groups practiced informal mathematical learning. The Yoruba used concrete objects, rhymes, and games to teach enumeration, while the Igbo and Hausa integrated mathematical concepts into daily activities like trade and farming. These traditional methods emphasized the practical applications of mathematics in everyday life. Western-style education was introduced by Christian missionaries in 1842, initially focusing on literacy and Bible studies before incorporating arithmetic as a fundamental subject. However, it was not until the early 20th century that substantial changes in mathematical education began to take shape. The first major curriculum reform occurred in the 1930s, intensifying in the 1950s, as a shift from rote memorization to more meaningful arithmetic methods gained traction. This period saw the introduction of textbooks such as *Efficiency Arithmetic* and *A Shilling Arithmetic*, which, despite improving arithmetic instruction, lacked broader mathematical concepts like algebra and geometry.

A second wave of reform emerged in the 1960s, influenced by global scientific and technological advancements, particularly after the Soviet Union's launch of Sputnik in 1957. This event spurred international efforts to strengthen STEM education, leading to the introduction of modern mathematics in Nigeria. The African Mathematics Programme (AMP), established in 1962, played a vital role in this transition by producing teaching materials and training teachers. Nigeria's notable contribution to the AMP was the Lagos experiment, led by Professor Grace Alele-Williams, which introduced modern mathematics into Lagos primary schools by 1971. In 1970, the Nigerian government furthered educational reform by establishing the Nigerian Educational Research Council (NERC), now known as the Nigerian Educational Research and Development Council (NERDC). This institution focused on modernizing school curricula, organizing teacher training workshops, and developing textbooks to align with international standards. While these reforms significantly advanced mathematics education in Nigeria, challenges such as inconsistent policy implementation and inadequate resources persist. Sustained collaboration among educators, policymakers, and international organizations remains essential to ensuring continued progress in the country's mathematics education.

Learning is a dynamic process that leads to measurable changes in a learner's knowledge, attitudes, or behaviors based on experiences, ultimately enhancing future performance. Ambrose et al. (2015) emphasize that learning is not a passive process but rather an active engagement where students internalize and respond to their experiences. This concept underlines the importance of individualized teaching strategies that consider diverse learning preferences to optimize educational outcomes. Effective teaching is recognized as a deliberate process involving knowledge transfer and psychological growth stimulation. Teaching is no longer limited to the transfer of facts but involves fostering environments where students construct knowledge through active engagement and real-world applications (IGI Global, 2019). The **Visual, Auditory, and Kinesthetic (VAK) learning strategy**, is a sensory-based model, emphasizes the role of sensory preferences in learning. This strategy does not depend on inherent intelligence but rather on students' capacity to adapt their learning preferences to new information. Research by Dunn and Dunn in Killer, (2016) shows that 30% of school-aged children are visual learners, 20% are auditory, and the rest are primarily kinesthetic or a combination. In Nigeria, Alade and Ogbo (2018) found that most students in public schools prefer visual learning, which highlights the importance of visual aids in classrooms.

The dominance of specific learning modes has significant implications for educational practices. Aregbesola, (2023) suggest that learning styles are adaptable and may develop as environmental factors change. This adaptability is crucial for addressing diverse classroom needs, especially in subjects like mathematics and science, where persistent poor performance is often linked to learners' diverse cognitive styles. By integrating VAK strategies into geometry instruction, educators can better engage students with varying sensory preferences, improving both **interest** and **academic achievement.** A study by Armiruddim and Norasmah (2015) supports the idea that VAK strategies foster a stimulating learning environment, enhancing students' sensory engagement. This sensory stimulation is critical in subjects like geometry, where concepts often require spatial reasoning and hands-on learning. Similarly, Flagyl (2016) observed that learners with multiple sensory preferences develop interest in their subject, as they can flexibly adapt to various teaching methods.

Interest in learning plays a pivotal role in enhancing student motivation, engagement, and academic achievement. It is often categorized into situational and individual interest. Situational interest arises from specific environments or contexts, while individual interest is a deep-seated, enduring attraction to certain subjects (Harackiewicz & Priniski, 2018). Interest in mathematics education has been a focus of various interventions aiming to sustain long-term engagement among students, particularly females, through tailored motivational strategies (Kolne & Lindsay, 2020; Prieto-Rodriguez et al., 2020). Studies emphasize that fostering interest through dynamic learning environments not only drives immediate academic success but also encourages lifelong learning (Rosenzweig & Wigfield, 2016). In mathematics, where challenges such as gender disparities and cultural mismatches exist, interventions designed to align with students' cognitive and personal development have proven effective in maintaining their interest and participation (Liben & Coyle, 2014; Sáinz et al., 2022). The Visual, Auditory, and Kinesthetic (VAK) learning strategy, developed from the idea that individuals have different learning styles, emphasizes the importance of tailoring teaching methods to meet diverse learner needs.

Visual learners benefit from diagrams and written instructions, auditory learners thrive on discussions and verbal explanations, and kinesthetic learners excel with hands-on activities. Implementing VAK strategies can increase student interest and engagement, particularly in subjects that require a deep understanding of complex concepts, like mathematics (Prieto-Rodriguez et al., 2020). By integrating VAK strategies, teachers can create more inclusive and effective learning environments. For instance, visual aids can simplify complex theories, auditory methods can enhance understanding through discussion, and kinesthetic activities can make abstract concepts tangible. This multi-sensory approach aligns with cognitive development theories, enhancing both short-term engagement and long-term retention of information (Australian Education Council, 2019). Combining the concept of interest with VAK learning strategies offers a comprehensive approach to fostering deeper engagement in education. By addressing individual learning preferences and providing engaging, contextually relevant content, educators can enhance both interest and academic outcomes, particularly in complex subjects like mathematics. This dual approach also prepares students for real-world applications, promoting lifelong learning and innovation in various fields (Harackiewicz & Priniski, 2018; Kolne & Lindsay, 2020).

Gender is a multifaceted concept that extends beyond biological distinctions to include a range of societal and cultural roles, behaviors, and expectations assigned to individuals based on their sex. In the context of education, gender differences have been a critical area of research, particularly in understanding how they influence learning styles, engagement, and academic outcomes. Recent studies have shown that educational strategies tailored to gender-specific preferences can enhance students' motivation and achievement (Sáinz et al., 2022). One such approach is the Visual, Auditory, and Kinesthetic (VAK) learning strategy, which adapts instructional methods to students' sensory preferences, thus fostering a more inclusive and effective learning environment.

Gender influences various aspects of the learning process, including cognitive styles, motivation, and classroom interactions. Kolne & Lindsay, (2020) suggested that gender-based learning preferences can affect how students absorb, process, and retain information. For instance, female students are often found to excel in verbal and auditory tasks, favoring collaborative and discussion-based learning environments Conversely, male students tend to prefer visual and kinesthetic learning, engaging more deeply with hands-on activities and visual representations of complex concepts.

The VAK (Visual, Auditory, Kinesthetic) learning strategy provides a framework to make mathematics more accessible by tailoring instruction to diverse sensory preferences. Incorporating models that support the VAK approach can transform mathematical teaching into a multisensory experience, fostering interest. The VAK learning model is based on the premise that individuals have distinct learning preferences: visual, auditory, and kinesthetic. While all students engage with content through all three senses, one of these modalities tends to dominate their learning style. The model was first conceptualized by Neil Fleming in the late 1980s (Durojaye, 2021), but it has gained widespread acceptance in educational settings, especially for subjects that require complex cognitive processing, such as mathematics. The VAK learning strategy enhances mathematics education by aligning teaching methods with students' sensory preferences, fostering engagement and comprehension. Visual learners benefit from diagrams, graphs, and interactive tools like GeoGebra, which help them conceptualize abstract concepts such as algebra and calculus (Karpinski, 2021). Auditory learners, on the other hand, grasp mathematical concepts better through spoken explanations, discussions, and multimedia content like podcasts, reinforcing their understanding through verbal interactions (Feldman, 2020; Wright, 2021). Meanwhile, kinesthetic learners thrive in hands-on activities, using physical tools like protractors or virtual reality simulations to experience mathematical principles in a tangible way (Smith & McDonald, 2020; Karpinski, 2021). The integration of VAK strategies ensures a multimodal learning environment that caters to diverse student needs, enhancing motivation and retention (George & Rodríguez, 2021). The Three-Part Instructional Model further structures this approach by sequentially incorporating visual, auditory, and kinesthetic methods within lessons, optimizing student engagement and achievement in complex subjects like geometry and algebra.

Mathematics, as a core subject in education, often challenges students due to its abstract nature. The VAK (Visual, Auditory, Kinesthetic) learning strategy provides a framework to make mathematics more accessible by tailoring instruction to diverse sensory preferences. Incorporating models that support the VAK approach can transform mathematical teaching into a multisensory experience, fostering interest and achievement. Below are some models fitted in VAK learning strategy: Howard Gardner's Multiple Intelligences Theory recognizes diverse ways of processing information, including visual-spatial and bodily-kinesthetic intelligences, which directly support VAK strategies. Visual learners in mathematics benefit from visual-spatial representations such as graphs, flowcharts, and geometric drawings. Kinesthetic learners, on the other hand, thrive through bodily-kinesthetic activities like constructing 3D shapes or using physical tools to explore fractions (Guyman, 2021). Auditory learners find value in verbal instruction and collaborative discussions, highlighting the adaptability of this model in mathematics education. The Universal Design for Learning (UDL) framework promotes inclusivity by offering multiple means of engagement, representation, and expression, ensuring that all learners can access content through their preferred sensory modes.

Mathematics classrooms can apply UDL by incorporating visual aids like interactive graphs, auditory podcasts explaining concepts, and kinesthetic tools like balance scales for algebraic equations (Mathew, et al., 2014). This approach ensures flexibility, accommodating the diverse needs of students while adhering to VAK principles. Concrete-Pictorial-Abstract (CPA) Approach, the CPA approach is highly regarded in mathematics education for its alignment with VAK strategies. Originating from Bruner's theories, CPA moves through three stages: concrete (using manipulatives), pictorial (representing ideas visually), and abstract (symbolic representation). Kinesthetic learners benefit from the concrete stage, manipulating objects like counters or fraction tiles. Visual learners engage during the pictorial phase with diagrams or visual representations. Auditory learners can better understand the abstract stage when explanations are verbalized. This progression builds a comprehensive understanding of mathematical concepts (Dumban, 2020). Active learning models emphasize student engagement through participatory and hands-on methods. These models are especially beneficial in mathematics for integrating the VAK strategy. Techniques like peer teaching, group problem-solving, and real-world scenario analysis appeal to auditory learners who discuss their reasoning. Visual learners gain clarity from shared diagrams or digital simulations, while kinesthetic learners actively solve problems using tools like graphing calculators or interactive whiteboards (Prince, 2020).

Allahnana, Maikudi, Akande, Martina, Taiwo and Alaku (2018) carried out a research on gender and interest in Mathematics achievement in Keffi Local Government Area of Nassarawa state Nigeria. Three objectives were raised in relation to three hypotheses. The studies adopted ex- post facto research design. The population was made up 2705 male and 843 female students. The sample of the student consist of 361 SS3 students, which involved 182 male and 179 female students. The researchers developed a single Performa as instrument for data collection. Descriptive statistics of means and standard deviation were used to answer research questions while inferential statistics of biserial correlation was used to test the hypotheses at the 0.05 level of significance. The study found that male students excel in mathematics achievement more than the female counterparts. And male students have interest in mathematics than female students. The reviewed study was similar to the present study with students' interest in Mathematics achievement but the reviewed study was carried out in Nassarawa state while the present study was conducted in FCT, Abuja both studies used mathematics as a subject. The reviewed study used adopted ex-post facto research design but the present study used quasi experimental design. The reviewed used inferential statistics of biserial correlation to test the hypotheses but the present study used ANCOVA to analyze hypotheses.

Methodology

This study adopted a quasi-experimental pre-test, post-test control group research design. It is non-equivalent group research design. Ajai, et al., (2015) submitted that school permitted intact class for research purpose and selection of students at random from different classes are prohibited. The target populations of this study comprised all JSSII students offering Mathematics in FCT Abuja. The session for the study was 2024/2025 academic year FCT (UBEB) all Basic schools' enrolment statistics. Two schools were randomly selected from the 2 Basic Schools in Gwagwalada Area Council, since all the schools are operating under the same conditions. Sixty (60) students were selected from each school using systematic sampling. The two schools were assigned through balloting to experimental and control groups. The control group comprised of 38 boys and 22 girls while the experimental group comprises of 36 boys and 24 girls, giving a total of 120 Basic 2 Students. The geometry Interest Inventory (GII) was adopted form Ritter and Marris in Jekayinfa, (2019) for interest testing before and after the treatment. The researchers prepared (2) sets of lesson plans for teaching both experimental and control groups for each topic that was studied, each unit contains 4 lesson plans for 12 lessons which lasted for four weeks, one unit of set of lesson plan was prepared using VAK learning strategy. While the other unit was prepared using the conventional teaching method (CTM). The administration of the Geometry Interest Inventory (GII) to both classes was administered by the research assistants and assisted by the researcher, the scripts were collected, marked and recorded for analysis. The data collected was analyzed using mean and standard deviation to answer the research questions, while Mann Whitney was used to test the hypotheses on interest.

Data Analysis and Results

Research Question 1:

What is the difference in the mean interest ratings of students taught geometry using VAK learning strategy and those taught geometry using conventional teaching method (CTM)?

Table 1: Mean and Standard Deviation of Interest Ratings of Students Taught Geometry Using VAK Learning Strategy and Those Taught Using conventional teaching Method (CTM)

Group	N	Mean	SD
VAK	60	2.64	0.16
CTM	60	2.50	0.24
Mean difference		0.14	

Table 1 shows the mean and standard deviation interest rating scores of students taught geometry using VAK learning strategy and those taught using conventional teaching method (CTM). From the results obtained, students taught geometry using VAK learning strategy had a mean interest rating score of 2.64 with a standard deviation of 0.16 while the students taught geometry using CTM had a mean interest rating score of 2.50 with a standard deviation of 0.24. Therefore, the mean difference in interest rating scores between students taught geometry using VAK learning strategy and those taught geometry using CTM is 0.14 in favour of students in VAK group.

Research Question 2:

What is the difference in the mean interest ratings of male and female students taught geometry using VAK learning strategy?

Table 2: Mean and Standard Deviation of Interest Ratings of Male and Female Students Taught Geometry Using VAK Learning Strategy

Group	Gender	N	Mean	SD
VAK	Male	35	2.55	0.15
	Female	25	2.52	0.17
Mean difference			0.03	

Table 2 shows the mean and standard deviation of male and female students of VAK learning strategy group with respect to their interest ratings in geometry. From the results obtained, female students had a mean interest rating of 2.55 with a standard deviation of 0.15 while the male students had a mean interest rating of 2.52 with a standard deviation of 0.17. Therefore, the mean difference in interest ratings between male and female students in VAK learning strategy group is 0.03 in favour of male students.

Testing of the Hypotheses

Ho1: There is no significant difference between the mean interest ratings of students taught geometry with VAK learning strategy and those taught geometry with conventional teaching method (CTM).

Table 3: Summary of Mann Whitney Results of Interest Rating of Students Taught Geometry Using VAK Learning Strategy and Those Taught Geometry Using Conventional Teaching_Method (CTM)

Group	N	Mean Rank	Sum of Ranks	Mann Whitney U	Z	Sig@0.05	Remark
VAK	60	67.76	2978.50	1148.50	3.443	0.001	Significant
CTM	60	50.33	4281.50				

From Table 3 results of the Mann Whitney nonparametric test shows that the computed mean interest rank scores are 67.76 and 50.33 by VAK and CTM groups respectively. The computed sum of ranks scores are 2978.50 and 4281.50 by VAK and TM groups respectively. The computed Mann Whitney U value of 1148.50 is higher than the 3.443 Z scores. The calculated p-value of 0.001 is less than the 0.05 level of significant. This implies that the mean interest development of VAK and CTM groups is significantly different when both groups are taught Geometry. Consequently, hypothesis three which states that there is no significant difference between the mean interest ratings of students taught geometry with VAK Learning Strategy and those taught geometry with Conventional method, is hereby rejected.

Ho2: There is no significant difference between the mean interest ratings of male and female students taught geometry using VAK learning strategy.

Table 4: Summary of Mann Whitney Results of Interest Rating of Male and Female Students Taught Geometry Using VAK Learning

Gender	N	Mean Rank	Sum of Ranks	Mann Whitney U	Z	Sig@0.05	Remark
Female	35	29.00	1015.00	385.000	0.794	0.427	Not Significant
Male	25	32.60	815.00				

From Table 4 results of the Mann Whitney nonparametric test shows that the computed mean interest rank scores are 29.00 and 32.60 by female and male respectively. The computed sum of ranks scores was 1015.00 and 815.00 by female and male respectively. The computed Mann Whitney U value is 385.000 and the Z score is 0.794. The calculated p-value of 0.427 is greater than the 0.05 level of significant. This implies that the mean interest development by female and male students in VAK learning strategy group is not significantly different when both genders are taught Geometry using VAK learning strategy. Consequently, hypothesis four which states that there is no significant difference between the mean interest ratings of male and female students taught geometry with VAK learning strategy, is hereby retained.

Summary of Findings

The findings of this study were summarized based on the results from the data analysis.

1. The result of the study showed that the interest students taught geometry using VAK increased while the interest of those taught using conventional teaching method (CTM) declined.
2. Interest developed by both gender in VAK group is not significantly different when both genders are taught geometry using VAK learning strategy.

Discussion of Findings

The findings of this study revealed that the interest of students taught geometry using the Visual, Auditory, and Kinesthetic (VAK) learning strategy increased significantly, while the interest of those taught using the Conventional Teaching Method (CTM) declined. This finding aligns with Kebaso and Oluoch (2024), whose reported a positive and significant relationship between learning preferences (auditory, kinesthetic, and visual) and achievement in Chemistry among students. Specifically, the researchers found that self-efficacy and learning styles were strong predictors of achievement in Chemistry. While Kebaso et al.'s study focused on Chemistry, the current study extended the scope to geometry, thereby addressing a gap in understanding how VAK influences students' interest in mathematics. Both studies underscore the importance of integrating diverse learning styles in teaching to enhance student engagement and performance.

The study further revealed that the interest developed by male and female students in the VAK group was not significantly different. This finding reinforces the conclusion that VAK strategies are equally engaging for both genders. Supporting evidence can be drawn from Anyamene and Ikechukwu (2022), who found no significant difference in how male and female students responded to visual, auditory, and kinesthetic learning modalities. Similarly, the present study affirms that when instructional methods are inclusive and cater to various sensory preferences, both male and female students are likely to remain equally engaged and motivated. This result also corresponds to the findings of Farman (2023), who observed that both male and female students in the Mathematics Education Study Program exhibited similar learning preferences when taught using multimodal approaches. The present study's use of geometry as a focal subject further demonstrates that VAK strategies can bridge gaps in gender-related disparities in interest and achievement. By fostering an equitable learning environment, VAK learning strategies can be instrumental in promoting gender inclusivity in mathematics education.

Summary

The study examined the effect of VAK learning strategy on the interest of Basic school's students in Geometry in Federal capital Territory. The study focused on JS2 students in Basic schools in FCT. Two (2) research objectives were raised which were translated to two (2) research questions and two (2) null hypotheses respectively. Relevant literatures were reviewed on conceptual framework of teaching and learning mathematics, students' interest, gender, in relation to VAK learning strategy. Quasi experimental design was adopted for the study. Simple random sampling and purposive sampling techniques were used to obtain two Basic schools out of 20 Basic schools in Gwagwalada area council in Federal Capital territory. The instruments used for data collection were geometric interest inventory (GII) and lesson plan. Split half method was used to calculate the reliability of GAT and GII, an index of 0.77 was obtained. The null hypotheses were tested using ANCOVA statistical tool at 0.05 level of significance. The data collected was analyzed using mean and standard deviation to answer the research questions, while Mann Whitney was used to test the hypotheses on interest. The findings revealed that students who were taught using the VAK learning strategy showed significant improvement in their interest compared to those who were taught using conventional teaching method. The results indicated that incorporating VAK learning strategy in the teaching of Geometry can enhance students' interest and understanding. This approach caters to the diverse learning preferences of students, allowing them to engage with the material in a way that suits their individual learning styles. The findings suggest that the VAK learning strategy has the potential to positively impact the academic interest of JS 2 students in Geometry.

Conclusion

i. From the findings of this study, it concluded that the VAK learning strategy can have a positive impact on the interest of Basic schools' students in FCT.

ii. There is no significant differences between male and female students' mean interest scores when taught geometry using VAK.

iii. By embracing this approach, educators can create a more engaging and effective learning environment that caters to the diverse learning preferences of students.

iv. The study highlights the importance of incorporating innovative teaching methods to enhance student learning outcomes and improve overall academic interest.

v. Overall, the VAK learning strategy has the potential to transform the teaching and learning process in Gwagwalada and beyond, leading to improved students' interest in mathematics and a more inclusive educational experience.

Implications of Findings

The findings of this study indicated that VAK learning strategy can improve student's interest in mathematics. The implications are stated as follows:

i. The study revealed that students taught using VAK learning strategy performed better than those taught using conventional teaching method.

ii. Male students did not perform better than their female counterparts in geometry.

iii. Mathematics teachers would be motivated to teach mathematics well when they know their students dominant learning style and put them in to consideration.

iv. The learners will be motivated to learn when they know their preferred learning style.

v. The mathematics curriculum should be written in such a way that it accommodates and stresses the use of Visual Auditory and Kinesthetic learning strategy (VAK) which will enhance understanding of geometrical concept.

Limitations of the study

The limitations of this study include:

i. The study was restricted to only JS 2 students in Basic schools in Gwagwalada area council. This may make the scope of generalization narrow.

ii. The time for the lesson was clashing with the students' classes and their parents did not approve for the students to stay pass school hours, which made some students skip lessons. Students skipping lessons may have affected the results of the study

Recommendations

Based on the findings of the study, the following recommendations are proposed:

i. Teachers should consider integrating VAK learning strategies into their teaching practices to enhance students' interest in Geometry.

ii. Professional development programs should be organized to train teachers on how to effectively implement VAK learning strategies in the classroom.

iii. School administrators and policymakers should support and encourage the adoption of innovative teaching methods, such as the VAK learning strategy, to improve student learning outcomes.

iv. Students should be guided on how to identify their preferred learning style which will improve their interest and academic achievement in mathematics.

v. Further research should be conducted to explore the long-term effects of VAK learning strategy on students' interest and academic performance in other subjects and grade levels.

vi. Parents and guardians should be informed about the benefits of the VAK learning strategy and encouraged their children's learning by incorporating VAK learning strategies at home.

Contribution to knowledge

This study makes several contributions to the body of knowledge. Some of the contributions are:

i. This study revealed that, using VAK learning strategy can enhance the learning experience for students by providing them with structured interest, and engaging approach to learning.

ii. Finding indicates that VAK learning strategy can help students retain information better by incorporating the learning strategy and reinforcing key concepts.

iii. This finding shows that using VAK learning strategy, which is interactive and relevant to students' interests, their motivation to learning can increased.

iv. This study supports that VAK learning strategy that allows for individualized instruction, catering to the unique needs and abilities of each student.

v. This study demonstrates that VAK learning strategy can provide teachers with valuable insights into students understanding and progress, allowing for targeted feedback and assessment.

Suggestion for Further Study

The researchers suggest:

i. A reproduction of the study where, experimental and control group will be in the same school.

ii. Further research using another aspect of mathematics.

iii. A study that find the effect of visual, auditory and kinesthetic learning strategy in another subject area.

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