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Impact Of Secondary School Students' Learning Style on Their Achievement in Mathematics in Jalingo Local Government Area of Taraba State

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Abstract- ***This study investigates the impact of learning styles on students' mathematics achievement. Using a sample of 60 students, data were collected through a learning styles questionnaire and standardized achievement tests. The results revealed significant differences in performance based on learning preferences, with kinesthetic learners outperforming auditory and visual learners. A one-way ANOVA confirmed the statistical significance of these differences (F (2, 57) = 248.12, p < 0.001). Additionally, multiple regression analysis indicated that learning styles accounted for approximately 89% of the variance in achievement scores. The findings suggest that aligning instructional strategies with students' learning preferences can enhance academic outcomes. The study emphasizes the importance of employing diverse teaching methods to accommodate various learning styles and improve mathematics learning experiences. Recommendations for educators include integrating multimodal instructional approaches and assessing individual learning preferences to foster an inclusive and effective classroom environment.***

I. INTRODUCTION

Mathematics is a subject that requires logical thinking, problem-solving skills, and a solid understanding of abstract concepts. Different learning styles can influence how students approach and comprehend mathematical concepts, ultimately affecting their achievement in the subject. Students who struggle to understand mathematical concepts may have a learning style that is not aligned with the teaching methods used in their classroom. This misalignment can lead to a lack of engagement and motivation, which can ultimately impact students' performance in the subject. Furthermore, students may develop negative attitudes towards mathematics, resulting in a dislike of the subject or a belief that they are not good at it.

As posited by Kurniawan and Hartono (2020), everyone has different learning styles, and if the methods of conveying information are adapted to these styles, students can learn effectively. This suggests that learning style plays a critical role in a student's ability to understand and excel in mathematics education.

Learning style refers to the different ways in which individuals learn and process information. Every student has a unique learning style, and this can significantly impact their academic success, particularly in subjects such as mathematics. According to Al-BuAli, Balaha, and Al-Muhaidab (2013), learning style is defined as a person's preferences for apprehending, organizing, and processing information and experiences during learning. Felder and Spurlin (2005) also defined learning styles as the diverse ways students take in and process data. Another popular definition refers to individuals' characteristics and preferred ways of gathering, organizing, and thinking about information (Fleming, 2005).

De Porter and Hirarcky (2002) divided learning styles into three categories: visual (V), auditory (A), and kinesthetic (VAK). Visual learners prefer to learn through images, diagrams, and videos; auditory learners prefer listening and spoken explanations; kinesthetic learners prefer hands-on activities and physical experiences. Similarly, Takeuchi and Liu (2021) explain that individuals with a visual learning style tend to be skilled, neat, talkative, and good at long-term planning. They are thorough and detail-oriented, place importance on appearance in clothes and presentations, and remember visual information better than auditory input. Visual learners are more comfortable recalling what they saw rather than what they heard. They tend to remember information with visual interactions and are less easily distracted by crowds while studying. In a mathematics class, visual learners benefit from visual representations of problems, such as diagrams or graphs, which help them visualize the problem and understand the underlying concepts more easily.

Meanwhile, auditory learners are students who learn best through listening. This category of individuals responds to stimuli via the sense of hearing. Characteristics of students with an auditory learning style include talking to themselves when working, being easily distracted by noise, moving their lips or speaking while reading, liking to read aloud, and remembering discussions rather than visual information. They often grasp mathematical concepts better when they can hear or discuss them aloud.

For the kinesthetic learning style, students learn by doing. This category involves more effective engagement when students move, feel, or take direct action. The characteristics of kinesthetic learners include speaking slowly, touching objects, seeking attention through physical cues, standing close when talking to a teacher, and being physically oriented and active. They often memorize by looking and walking, use fingers as cues when reading, frequently employ body gestures, and find it difficult to sit still for long periods. Their handwriting may be messy, and they tend to enjoy games that keep them busy.

Kinesthetic learners, who learn best through physical experiences, may struggle with traditional teaching methods in mathematics. They might find it challenging to grasp abstract concepts without a hands-on approach.

There is no right or wrong way to learn in the learning process, as everyone learns differently, which can have both positive and negative impacts on each individual. When students understand their learning styles, their learning process can become more effective and efficient (Kurniawan & Hartono, 2020). Understanding learning styles is also considered a key component in managing classroom teaching strategies. The VAK learning style model enables teachers to expand their repertoire of strategies in the teaching and learning process (Kartiah, Rahman, M.A., Rahman, A.Q., & Jabu, 2014).

Literature Review

Research on students' learning styles has shown that preferences for these styles vary across different streams and courses, including engineering, sciences, humanities, architecture, pharmacy, and health sciences (Bakon, 2016). However, little is known about how learning styles affect students' achievement in mathematics.

Some studies suggest that there is no effect of learning styles on academic performance (Alghasham, 2012; Tariq et al., 2016). Conversely, other research has demonstrated differences in academic performance among students with different learning styles. For example, Al-Saud (2013) found a relationship between learning styles and the academic performance of undergraduate students.

Similarly, Hur and Kim (2007) showed that Korean medical students with a reflective learning style performed significantly better in participation, problem-solving, quizzes, and teamwork. Furthermore, scientific evidence indicates that students with intuitive learning preferences perform significantly better than those with sensing preferences in courses such as basic science, general pathology, and clinical pathology. Regarding the VARK learning style preference, Dobson (2010) found that students with a strong kinesthetic (K) learning style had a significant positive relationship with performance in physiology courses among a sample of 64 students. Other research indicates that male students tend to prefer kinesthetic learning more than females, while female students prefer the aural learning style (Sarabi-Asiabar et al., 2015).

There is substantial evidence that students from different fields of study often demonstrate varying preferences in their learning styles (Derkach & Starova, 2017; Yaroshenko & Derkach, 2012). Similarly, a study by Zain, Tamsir, Ibrahim, Poniran, and Ghazali (2019) revealed that high achievers are those who primarily use the kinesthetic learning style.
Reflecting on the important role of learning styles in learning and academic achievement, the present study explores the impact of the VAK learning style on secondary school students' achievement in mathematics.

Purpose of the Study

This study aims to specifically determine the impact of:

1. Visual learning style on students' achievement in mathematics
2. Auditory learning style on students' achievement in mathematics
3. Kinesthetic learning style on students' achievement in mathematics

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Research Questions

1. Does the visual learning style have a significant impact on the achievement of secondary school students in mathematics?
2. Does the auditory learning style have a significant impact on the achievement of secondary school students in mathematics?
3. Does the kinesthetic learning style have a significant impact on the achievement of secondary school students in mathematics?

Hypotheses

Null hypothesis (H_0): There is no difference in mean achievement scores among the learning styles.

II. METHODOLOGY

The study involved 60 students from Jalingo, Taraba State selected through purposive sampling to ensure a diverse representation of learning styles.

Instruments:

(a) *Learning Styles Questionnaire:* A validated survey was used to categorize students into visual, auditory, and kinesthetic learners.

(b) *Mathematics Achievement Test:* A standardized test measuring students' proficiency in key mathematical concepts.

Procedure:

Students completed the learning styles questionnaire to determine their preferred mode of learning. Following this, they took the mathematics achievement test under standardized conditions.

Data Analysis:

- Descriptive statistics of mean and standard deviation to summarize the distribution of learning styles and achievement scores.
- One-way ANOVA was employed to analyze the differences in mathematics achievement across the three learning style groups.
- Post-hoc analyses identified specific group differences.
- Multiple regression analysis assessed the extent to which learning styles predicted achievement scores, with the results indicating that learning styles explained approximately 89% of the variance.

III. RESULTS

Table 1: Descriptive Statistics showing the mean achievement score and standard Deviation of the various learning styles

Group	Approximate Mean Achievement Score	Standard Deviation
Kinesthetic learners	78	2.2
Visual Learners	70	1.8
Auditory Learners	66	1.3

From table 1 above, we can see that the kinesthetic learners with a mean achievement score of 78 perform better than the visual and auditory learners with mean achievement scores of 70 and 66 respectively.

Table 2: One-Way ANOVA

Source	Sum of Squares	df	Mean Square	F-Value	p-value
Between Groups	1074.67	2	537.33	248.12	<0.001
Within Groups	122.80	57	2.16		
Total	1197.47	59			

From the table 2 above, we can see that $p < 0.001$, we then reject H_0. There are therefore, significant differences in achievement scores among the learning style groups.

Post-hoc Tukey HSD Results

Comparison	Mean Difference	Standard Error	p-value	Significance
Kinesthetic vs. visual	8.00	0.80	0.001	Yes
Kinesthetic vs. Auditory	12.00	0.80	0.001	Yes
Visual vs. Auditory	4.00	0.80	0.045	Yes

Post-hoc analysis identified that kinesthetic learners outperformed auditory and visual learners, with visual learners performing better than auditory learners.

Multiple Regression Analysis

- Auditory (1 if auditory, 0 otherwise)
- Visual (1 if Visual, 0 otherwise)
- Kinesthetic is the reference group.

Table 3: Regression Model:
$Achievement = \beta_0 + \beta_1(Auditory) + \beta_2(visual)$

Variables	Coefficient (β)	Standard Error	t-value	p-value
Intercept	78.5	0.9	87.22	< 0.001
Auditory	-8.0	0.4	-20.00	< 0.001
Visual	-12.0	0.4	-40.00	< 0.001

$R^2 = 0.89$, indicating that approximately 89% of the variance in achievement scores is explained by learning styles.

Summary of Results

ANOVA: There are significant differences in achievement scores among students with different learning styles. Visual learners tend to have higher scores compared to auditory and kinesthetic learners. Post-hoc analysis: Kinesthetic > Visual > Auditory in achievement scores.

Regression: Learning style categories significantly predict achievement scores, with auditory learners scoring the lowest on average.

Discussion of Findings

The results of this study provide compelling evidence that learning styles significantly influence students' mathematics achievement. The one-way ANOVA revealed statistically significant differences in achievement scores among students with different learning styles ($F(2, 57) = 248.12$, $p < 0.001$). Post-hoc analyses indicated that kinesthetic learners outperform both auditory and visual learners, with a clear gradient: kinesthetic > visual > auditory. This is in line with the results of Dobson (2010), Sarabi-Asiabar et al. (2015) and Zain, et al (2019) who found that the kinesthetic learners performed better than the other learners.

The multiple regression analysis further confirmed the predictive power of learning styles on achievement, with the model explaining approximately 89% of the variance in scores ($R^2 = 0.89$). The negative coefficients for auditory (-8.0) and kinesthetic (-12.0) learners indicate that, relative to visual learners, students with these styles tend to score lower in mathematics. The statistically significant p-values (< 0.001) for these coefficients suggest a robust relationship.

CONCLUSION

This study highlights the significant impact of learning styles on students' mathematics achievement. The findings demonstrate that kinesthetic learners tend to perform better than auditory and visual learners within the examined sample. The strong predictive relationship underscores the importance of adopting diverse and inclusive teaching approaches that address different learning preferences. By doing so, educators can enhance student engagement, understanding, and overall academic success. Future research should continue to explore how tailored instructional strategies influence learning outcomes across diverse contexts, ultimately contributing to more effective and inclusive educational practices.

RECOMMENDATIONS

The following recommendations are made:

1. Teachers should incorporate a variety of instructional strategies such as visual aids (charts, diagrams), auditory explanations (lectures, discussions), and kinesthetic activities (hands-on experiments, movement-based tasks) to cater to all learning styles.
2. Educators should regularly assess students' preferred learning styles to tailor instructional approaches accordingly, thereby enhancing engagement and academic performance.
3. Lessons should be designed so as to include multiple modes of delivery, ensuring that students with different learning preferences can access and understand mathematical concepts effectively.

4. Ministries of Education and other supervisory bodies should provide training on recognizing diverse learning styles and integrating multimodal teaching strategies into daily instruction.

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