

EFFICACY OF VAN HIELES INSTRUCTIONAL STRATEGY ON STUDENTS' ACHIEVEMENT IN GEOMETRY

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Abstract

The study set out to find out how the Van Hieles method of instruction affected the geometry proficiency of both male and female students. A quasi-experimental, non-equivalent control group design was employed in the investigation. The Enugu State Education Zone hosted it. Two research questions and two null hypotheses served as the study's compass. The population of the research consisted of 4559 SS1 mathematics students from 31 senior secondary schools in the Enugu education zone of Enugu State, Nigeria. A sample of 368 students was selected, comprising 180 men and 188 females. The normal mathematics teachers, who had already received training in this area, taught the topics separately to the experimental and control groups, which were randomly assigned by balloting to the intact classrooms. For each group, there were pre- and post-tests. The thirty multiple-choice Geometry Achievement Tests (GAT) were administered to both the experimental and control groups. The t-test, analysis of covariance (ANCOVA), mean, standard deviation, and other methods were used to examine the data. The results showed that there is no appreciable variation in the mean accomplishment scores of male and female students based on Van Hieles' instructional strategy. Furthermore, there is no connection between the Van Hieles teaching method and students' gender or achievement in geometry.

Introduction

The important research issue of gender differences in mathematics education requires more examination. Studies indicate that pupils' academic performance in geometry may be influenced by the interaction of gender. Gender in this context denotes a person's sex. Previous research indicates that male students do better than female students in mathematics, particularly geometry.

Mathematicians who research geometry focus on figures, shapes, proportions, patterns and locations. Mukati (2016) defines geometry as a discipline of mathematics that deals with the characteristics, measurements, and connections between surfaces, solids, angles, lines, and points. Salami and Popoola (2016) stated that low student achievement in geometry is frequently reported for both internal and external exams. Additionally, a study conducted by Dalu (2016) found that female students had a more favourable attitude toward mathematics, particularly geometry, than did male students. Nwafor (2012) stressed that the teaching of geometrical content as practiced by today's mathematics teachers, is ineffective, resulting in poor students' achievement. According to Immassuen and Omorogbe, (2016), there is lack of gender equity in some areas of education including mathematics, especially geometry. Okan and Zakari (2017) discovered that female students are more brilliant and achieve higher grades in geometry than their male counterparts. On the other hand, Mwalya (2017) stressed that male do better on tasks involving measuring and problem-solving, whereas female perform noticeably better on tasks requiring computing abilities. According to Abdu-Reheen (2014), the distinctions between male and female anatomy's arithmetic proficiency have an impact on and can actually explain the disparities in personalities between the sexes.

The author emphasized that in order to close the gap, math teachers must take action. Thus, this study looked at the impact of the Van Hiele's teaching technique on gender-based student accomplishment. Dangpe (2015) opined that if provided an atmosphere that supports their learning of mathematics, females are just as capable as boys in terms of performance. The author also mentioned that girls' ability to understand mathematics may be hampered by the presence of boys. Adeniji (2018) reported that at mixed-sex secondary schools, female students outperform their male counterparts, but in single-sex secondary schools, male students outperform their female counterparts. Onuekwusi and Ogomaka (2013) believed that children's brains are wired differently for learning in male and female brains. Therefore, the goal of this study was to close this gap by presenting the Van Hiele's instructional technique. The work of Pierre Van Hiele and Diana Van Hiele-Geldof led to the development of the Van Hiele's Instructional Strategy (1986). Van Hiele's advocated for five instructional practices that help pupils progress from one level to the next, communicate, and interact. Inquiry, guided orientation, explication, free orientation, and integration are the instructional strategies. Male students do better in mathematics than female pupils, according to Mwaya's (2017) findings. Gender significantly affects the mean achievement scores of males and females in geometry, according to Sugiyone (2017). Furthermore, Usman, Yem, and Saleh (2019) found that the mean achievement scores of male and female geometry students differ significantly from one another.

Statement of the Problem

Despite the importance of mathematics, gender issues have been a major problem for researchers due to their achievement based on the stereotypical nature of the subject as a male domain. It was based on this gender issues that this work sought to examine the gender differences in secondary school geometry achievement between male and female students in Enugu Education Zone in Enugu State.

Purpose of the Study

Examining the effect of the Van Hiele's instructional technique on students' achievement in geometry based on gender was the primary goal of the study. The study's specific objectives were to find out the:

1. effect of Van Hiele's instructional technique on students' achievement in geometry.
2. find out how students' achievement in geometry is affected by the interaction between gender and the Van Hiele's instructional style.

Research Questions

In line with the stated objectives, the following questions were posed for the study:

1. What is the effect of Van Hiele's instructional strategy on students' achievement in geometry?
2. What is the interaction effect of treatment and gender on students' achievement in geometry?

Hypotheses

1. The mean achievement scores of students who were taught geometry utilizing Van Hiele's instructional technique did not change significantly.
2. There is no correlation between students' achievement in geometry, gender and the Van Hiele's instructional style.

Methodology

The study used a pre-test, post-test group design, which is a quasi-experimental methodology. A study using a quasi-experimental design modifies the level of an independent variable before measuring the result. There are two groups in the design: the experimental group and the control group. The researchers designed the Geometry Achievement Test (GAT), a 30-item multiple-choice test with four options labeled A-D. Experts from the University of Nigeria, Nsukka verified the test. A pilot study was out in one of the secondary schools inside the state but outside the research areas determined the reliability coefficient of the instrument to be 0.81. Kuder Richardson formula 20 (K-R 20) was used to calculate the dependability coefficient based on the outcome of the pilot study. Because the formula is applied to

tests with different tough questions that were evaluated dichotomously, it was deemed appropriate (Nworgu, 2015). Van Hieles' instructional strategy was applied to the experimental group, while the lecture method was used with the control group. Two days before the study's commencement, a pretest and a post-test utilizing the same instrument, the GAT, were given to the participants six weeks after therapy. The mean, standard deviation, t-test, and analysis of covariance (ANCOVA) were used to examine the gathered data.

Research Question 1

What is the mean achievement scores of male and female students taught geometry using Van Hieles instructional strategy?

Table 1: mean and standard deviation of the geometry mean scores for male and female students.

GENDER	N	POSTTEST (MEAN)	SD	MEAN DIFFERENCE
Male	180	75.90	9.57	0.41
Female	180	75.49	10.54	

Based on the analysis presented in Table 1, male and female geometry students received mean achievement scores of 75.90 and 75.49, respectively, with standard deviations of 9.57 and 10.54. According to the analysis, male students' mean accomplishment score in geometry is somewhat greater than that of female students. The standard deviation for both the male and female students suggests that there is little variation in the geometry achievement scores of the two groups of students.

Hypotheses 1

When geometry is taught using Van Heiles' instructional technique, the mean achievement scores of male and female students do not differ significantly.

Table 2: T-test comparison of the mean achievement scores of the geometry post-test for male and female students who were taught the subject using Van Hieles.

GENDER	N	MEAN	SD	α	Df	t-cal.	t-crit.	Decision
Male	180	76.12	10.89	H_{01} (0.05)	148	0.93	0.43	Accepted $t_{cal} > t_{crit}$
Female	188	76.10	9.33					

According to the above table, $t_{crit} = 0.43$ and $t_{cal} = 0.93$. Acceptance of hypothesis 1, which claims that there is no significant difference in the mean achievement scores of students by gender, occurred because of the t_{cal} was greater than the t_{crit} Value. Students were taught geometry utilizing the Van Hieles instructional technique.

Research Question 2

What is the interaction effect of gender and the Van Hiele's instructional strategy and gender on geometry achievement among students?

Table 3: mean and standard deviation of interaction between gender and the Van Hiele's instructional strategy on geometry achievement.

GENDER	N	MEAN	SD
Pretest			
Male	180	43.55	9.04
Female	188	42.23	7.89
Differences		1.32	1.15
Posttest			
Male	180	75.90	10.44
Female	188	75.49	9.54
Differences		0.41	0.90

The posttest mean achievement scores for male and female students who were taught geometry utilizing Van Hiele's instructional technique are displayed in the above table at 75.90 and 75.49, respectively, with standard deviations of 10.44 and 9.54. The standard deviation for both male and female students suggests that there is little variation in the geometry achievement scores of the students. Given the small mean change between the pretest and posttest scores, the analysis's findings do not support the hypothesis that the Van Hiele's instructional technique has an interaction effect on students' academic performance.

Hypotheses 2

There is no interaction effect of Van Hiele's instructional strategy and gender on students' achievement in geometry.

Table 4: ANCOVA summary on interaction effect of gender and the Van Hiele's teaching strategy students' geometry achievement.

Source	Type III Sum of squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	772.525 ^a	3	257.525	22.410	.000	.180
Intercept	95568.842	1	95568.842	8316.530	.000	.964
Pretest	6471.447	1	6471.447	196.535	.000	.852
Strategy	699.537	1	699.537	60.875	.000	.165
Gender	71.647	1	71.647	6.235	.013	.020
Gender * Sex	6.461	1	6.461	.562	.454	.002
Error	3527.870	307	11.491			
Total	115737.000	311				
Corrected Total	4300.444	310				

a. R Squared = .180 (Adjusted R Squared = .172)

The result in Table 4 demonstrates that there is no discernible relationship between gender and the Van Hiele's instructional tactics and students' accomplishment scores in geometry. According to the outcome, $P(0.454) > 0.05$ and $F(1, 307) = 0.562$. The null hypothesis is therefore accepted. As a result, there is no discernible connection between gender and Van Hiele's instructional tactics and students' geometry achievement.

Findings

1. When geometry is taught utilizing Van Hiele's instructional technique, the mean achievement scores of male and female students do not differ significantly.
2. Students' achievement in geometry is significantly impacted by the relationship between gender and the Van Hiele's instructional technique.

Conclusion

The geometry achievement of students was considerably enhanced by the Van Hiele's instructional technique. The mean achievement scores in geometry for male and female students differ significantly. Regardless of gender, the teaching tactics improve students' performance.

Recommendations

The study's conclusions lead to the following suggestions being made:

1. Van Hiele's instructional technique should be incorporated into curriculum design by curriculum planners.
2. When teaching and studying geometry, math teachers should implement Van Hiele's instructional technique.
3. To help math instructors successfully implement Van Hiele's instructional technique in the teaching of geometry, professional bodies and the government should host workshops and seminars.
4. Appropriate mathematics textbooks need to be reconstructed with emphasis on activities which will not give room for gender disparities in relation to their achievement in geometry.

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