ABSTRACT

EFFECT OF COGNITIVE STYLES AND GENDER ON MATHEMATICAL ACHIEVEMENT OF SENIOR SECONDARY SCHOOL STUDENTS IN NSUKKA EDUCATION ZONE, ENUGU STATE

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The study investigated the effect of cognitive styles and gender on mathematics achievement among senior secondary students in the Nsukka education zone. The study adopted a quasi-experiment design: a pre-test-posttest nonequivalent group design. The population of the study consists of five thousand, two hundred and forty-seven (5257) males and female senior secondary school class-two (SS2) students in the fifty-nine (59) public secondary schools in the Nsukka educational zone of Enugu State. which is made up of 2410 male and 2847 female students. The sample for the study comprises of 105 senior secondary school class-two (SS2) students made up of 48 males and 57 females from four public secondary schools in the zone, drawn using a multistage sampling technique. For Oltrain, Raskin, Herman, and Witkin (1971), the Group Embedded Figures Test (GEFT) to test students' cognitive styles and mathematics achievement tests (MAT) were used for data collection. The mean and standard deviation were employed to answer the research question while analysis of covariance (ANCOVA) was used to test the null hypotheses formulated at a 0.05 level of significance. The study showed that field-dependent and field-independent are the cognitive style patterns among senior secondary school students. Students with a field-dependent cognitive style had higher mathematical achievement than those that are field-independent. There was a statistically significant difference in the mean achievement scores of students with field-dependent and field-independent cognitive styles in mathematics in senior secondary schools. Male students had higher achievement in mathematics than their female peers. Gender was a significant factor. Based on the findings of the study, certain recommendations are made.

Keywords: Cognitive styles, Gender, Mathematics Achievement, Senior Secondary Students, Field dependent, Field independent

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Introduction

Education has long been seen as a powerful tool for development all across the world. It is the most astonishing instrument for shaping what is to come since it is an apparatus for the growth of all human capabilities. The Nigerian government's mission to change school curricula was driven by two main goals: first, the country's obligation to implement international protocols such as education for all (EFA), the United Nations Millennium Development Goals (MDGS), and the Sustainable Development Goals (SDGS), as well as its own local medium-term development goals. Second, the scale of global advancement and the demands of the twenty-first century demand that pupils be exposed to a broader range of abilities and information than in the past.

As a result, every secondary school student must take the four (4) essential cross-cutting disciplines: English language, mathematics, trade entrepreneurship, and civic education, in order to achieve these objectives. (National Education Policy, 2014). Despite the strategy push, Adewale (2011) believes that mathematics is useful in all areas because it is used to solve problems and anticipate outcomes in all sectors of knowledge. According to Awofala (2000), cited in Adewale (2011), mathematics is a foundational science for understanding most other areas and an essential part of the global way of life. According to Okebuleola (2009), mathematics is the central intellectual discipline of the innovative social orders. In the same way, Osokoya (2005) thought that mathematics, as the basic science whose careful information is important for understanding all other sciences, has a key role to play in building a long-term logical tradition and making progress in Nigeria.

Because mathematics is so important, the Federal Government of Nigeria designated it as a core and required subject at the secondary school level of education in Nigeria as contained in the National Policy on Education FRN (2014). The National Policy on Education additionally expresses that the expansive goals of secondary education should be (I) preparation for helpful living within the general public and (ii) preparation for advanced education, among others. With specific reference to the points and destinations of secondary education, the overall goals for mathematics education as stated in the National Policy on Education FRN (2014) are to cultivate an interest in mathematics and to provide a strong foundation for everyday living; to create computational expertise to cultivate the desire and ability to be precise to a degree pertinent to the problem at hand; to create precise, coherent, and unique thinking; to build up the capacity to think precisely, coherently, and uniquely; to build up the capacity to think precisely, coherently, and uniquely;

The study and use of mathematics as a fundamental subject has always been an intrinsic and vital part of individual and collective life. The deliberate treatment of extent, the relationship between attributes represented symbolically, is mathematics. Mathematics is to a country what protein is to a growing human body (Zalmon and Wonu 2017). Furthermore, they stated that the subject serves as an important antecedent and precursor to the truly necessary mechanical and regular growth of the world's emerging nations as a crucial instrument for understanding and applying science and innovation. In a modern society like Nigeria, international protocols for education for all (EFA), the Millennium Development Goals (MDGS), the Sustainable Development Goals (SDGS), and the adoption of a National Economic, Empowerment, and Development Strategies

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(NEEDS) have led to an extraordinary focus on mathematics to drive industrial and innovative development.

Despite the importance of mathematics, secondary school students' achievement over the years has not been encouraging due to many factors in the Nigerian educational setting, which cognitive style and gender might be part of. According to Awofala (2011), there is frequently a disconnect between curriculum organizers' aims and what happens in a mathematics homeroom. Gbenga (2017) attributes the problems impeding students' achievement in Nigerian schools to educators' inability to assist students with learning mathematics in a meaningful manner. Other reasons include a lack of qualified instructors and effective mathematics educators (Ojo 2002 and Akinsola 2000), students' aversion to mathematics, ineffective strategies or procedures for teaching mathematics, and a lack of mathematics reading material appropriate for students at all levels in secondary schools (Ojo 2002 and Akinsola, 2000). (Onabanjo, 2014). According to the WAEC Chief Examiner Report (2019), one of the factors contributing to pupils' poor performance in mathematics exams is their lack of enthusiasm.

There is growing evidence of students' negative attitudes and beliefs about mathematics, and that different teaching and learning styles embraced by educational clinicians can help students understand, make them converse emphatically with themselves, and thus increase their inspirational disposition and confidence towards mathematics (Mekee 2002, as cited in Obute, 2019). This led Dalir and Stone (2003) to believe that kids do not adapt naturally, particularly in mathematics, and that they require guidance and direction before developing a true interest in the subject, which leads to effective learning. There is widespread agreement that how people choose to or are predisposed to approach a learning scenario has an impact on their performance and learning outcomes.

Higher student achievement must be attained.In order to improve learning results in mathematics, a shift in viewpoint from instructional system-based exploration to student-related elements such as learning styles, verbal capacity, interest, demeanor, motivation, cognitive styles, and gender is required. Nonetheless, cognitive style is an important factor to consider in this study. Students interact with information while learning or acquiring new information, and their cognitive style determines the most consistent way that they see, measure, or use the information that they are presented with. Students face learning challenges with various exceptional characteristics or properties that can be physical, social, or intellectual, and these characteristics take on significant significance.

Cognitive styles are a mental idea that emphasizes how people see and process information in an unusual way. According to Zeeb (2004), cognitive styles influence how people perceive, obtain, and evaluate information. Individual differences in the distinct subcomponents of an information-processing paradigm comprising three primary cognitive cycles: perception, memory, and cognition. While Ogan (2012), Katrina (2006), and Oludipe (2014) define it as "the ability to complete distinctive thinking." Tella, as cited in Oludipe (2014), believed that cognitive styles are a pre-requisite for improving students' learning accomplishments and are a critical predictor of future achievement. Apart from cognitive style, gender can also influence students' achievement in mathematics.

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Gender refers to the educated characteristics and behavior associated with organic sex in a certain society. Umoh (2003) defined gender as a mental term used to describe the behaviors and characteristics that people are anticipated to have based on whether they were born male or female. Betiku (2002) says that "gender" is all of the characteristics of men and women that a society has decided on and given to each group. Nonetheless, there appears to be a conflicting point of view among analysts that, when it comes to problem solving, particularly in mathematics, men will be more insightful and smart in general. Witkins' field subordinate cognitive style theory predicted that females would have a global or field subordinate cognitive style, whilst males would be more logical and field independent. This study sought to contribute to the debate by examining the role gender plays in students' achievement in mathematics.

Achievement is defined as the proportion of success in a given subject of study (Abakpa, 2011). Similarly, Collins (2014) went on to define achievement as anything that has been perfected via hard work or daring. To put it another way, it's successful completion or attainment. Abakpa (2011) argued that passing a mathematics test demonstrates a child's ability to reach a specific level of educational goals from his homeroom experience. As a result, an individual's cognitive style is the most important determinant factor in a student's accomplishment. There has been a decline in the achievement of secondary school students in mathematics over the years, those in senior secondary schools in the Nsukka Education Zone inclusive (2013, 2014-2015, 2016-2018). This is according to the WAEC chief examiner's report. This is worrisome for a nation that aspires to be among the twenty economies on the planet and the first on the African continent through development in science and technology.

In any event, the assumption is that the persistent helplessness pattern in mathematics achievement scores among Nigerian students can be attributed to the concept of cognitive styles, which has been assigned to mathematics learning for more than two decades. No effort appears to have been made to investigate the effects of two important cognitive modes used by children in schools, field-independent and field-subservient, on their achievement. To address the issue of students' helpless achievement in mathematics as it relates to their cognitive styles, effort must be made toward a balance of learning methodologies and individual cognitive styles. It is expected that the update in offset will enable kids with preferred cognitive styles to improve mathematical accomplishment. Furthermore, there is a scarcity of research on the impact of cognitive styles and gender on mathematics achievement among senior secondary school students in the Nsukka Education Zone of Enugu State. This is the gap in the literature that the present study seeks to fill.

Purpose of the study

The main purpose of this study is to investigate the effect of cognitive styles and gender on mathematics achievement among senior secondary students in Nsukka education zone. Specifically, the study intends to determine.

1. Students cognitive styles pattern among senior secondary school students.
2. The mean achievement score of mathematics students that exhibit field dependent and field independent cognitive styles.
3. The achievement scores among male and female students in field dependent and field independent cognitive styles in mathematics

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Hypotheses

The following hypotheses were formulated and tested for the study at 0.05 level of significance:

H01. There is no statistical Significant difference in the mean achievement scores of students that exhibits field dependent and independent cognitive styles in mathematics in senior secondary schools in Nsukka education zone.

H02. There is no statistical significant difference in the mean achievement scores of male and female students that exhibit field dependent and filed independent cognitive styles in mathematical in senior secondary school in Nsukka Education Zone.

A Literature Review

Mathematics is critical in speeding a country's social, economic, and technological development. According to Anderson (2016), mathematics is an umbrella term for the component of information that deals with numbers. Mathematics is the "science of numbers," and it uses numbers and factors to figure out, define, and express various concepts.According to Yadav (2017), mathematics is the study of assumptions, their properties, and applications. Mathematics, according to James and James (2017), is the science of intellectual investigation of numbers, shape, plan, amount, measure, and other related ideas. Mathematics is the Queen of Science, but students detest it, despite the fact that it is fundamental to the development of many other sciences (Carl, 2017). Mental ability is essential to the science of mathematics. It is a method of sharpening the mind and making it imaginative by increasing the thinking force and reasoning intelligence. This is why it is referred to as the "cradle of human civilization."

A cognitive style is a mental concept that describes how people perceive and cycle information in unusual ways. Students interact with information over the course of learning or relearning it, and their cognitive style determines the most consistent manner in which they observe, assess, or apply the information that they are provided with. Students are exposed to a number of distinctive qualities or traits, which might be physical, social, or intellectual in nature, and these characteristics play a significant part in their learning. According to Zeeb(2004), as quoted in Olagbaju (2020), "cognitive style influences how people perceive, collect, and measure information." In study hall instruction, a mismatch between a student's cognitive style and the instructor's teaching style has serious consequences for students' achievement and behavior. As a result, it's critical to concentrate on figuring out how people absorb and measure knowledge. Because people learn in different ways, there are numerous cognitive style variables. Stapa (2003), as cited in Olagbaju (2020), stated that teaching effectiveness is incomplete without information on certain students' qualities, for example, cognitive style and learning inclinations. Some of the most common cognitive style dimensions are field dissimilar/convergent, field-subordinate/independent, comprehensive/successful, and intelligent/incautious.

Since the 1970s, researchers have been studying cognitive styles in order to better understand how students perceive and interact with educational environments, approaches, and media. Herman Witkin's field of reliance and independence is the most widely studied cognitive type (DeTure, 2004). This dimension is determined by field dependence, or an individual's ability to discern and isolate components in complex contexts. Calcaterra et al. (2005) established that the

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field dependency dimension of classifying cognitive styles is basically the same as and linked to the insightful consecutive and holistic intuitive style dimensions. Field-subordinate pupils measure data in general and rely more on outside sources of knowledge. They thrive in circumstances with structure, and they often solve difficulties by intuition and experimentation, whereas field-independent personalities approach the environment more logically, such as identifying figures from their surroundings. The availability of this set of people is mirrored in their mental schemas. As an extensively studied cognitive style, the field reliance independence notion displays two separate styles of information processing. Individuals are placed on a scale ranging from extreme field-dependence (FD) to amazing field-independence (FI) (FI). Those near the FD end of the continuum have a limited ability to isolate information from its context, whereas those near the FI end have no trouble carrying out the same task (Guisande, Paramo, Tinajero, and Almeida, 2007). Intelligence has no bearing on cognitive styles, and field dependence or independence is more concerned with the path to learning than with capacity (Maghsudi, 2007).

In their respective studies, Jayanthn (2014) and Oluikpe (2014) found in their respective studies that field-dependent and field-independent are the cognitive styles that could be easily adapted by teachers and students in the cause of teaching and learning critical subjects such as mathematics. Also, Atavi and Hosein (2009), through their study, expressed that cognitive styles (field dependent and field independent) could be very useful if adopted in teaching subjects perceived to be difficult, like mathematics. In their respective studies, Abakpa (2011) and Collins (2014) also found out in their respective studies that innovative teaching techniques such as cognitive styles improve students' achievement in mathematics. Similarly, Ogunleye (2015) established that the application of field-dependent and field-independent in teaching and learning mathematics increases students' achievement in mathematics.

Achievement, according to Collins (2014), is defined as something that has been refined, particularly by difficult work, capacity, or chivalry. It is fruitful completion and achievement that opens the path for further development. According to Cooker(2002), achievement is the satisfaction effecting performance, production execution, implementation, completion, achievement, realization, and attainment. In an empirical study, Ezike (2007) looked into students' achievement in science; Okoruwa (2007) looked into integrated science; and Fakeye (2008) looked into English as a Second Language (ESL) students' achievement and disposition to English comprehension. Several studies found that cognitive style was a big part of how well people learned in these fields.Garton et al. (2010), on the other hand, found only a weak link between how students think and how well they do in school.Tella, as cited in Oludipe (2014), believed that cognitive style is a necessary condition for improving students' learning accomplishments and is a strong predictor of future achievement.

Gender is determined culturally rather than biologically.It is the cultural role expected of people that helps in the classification of individuals into male and female. Similarly, Kalusi (2000) views gender as a cultural construction that assigns roles, attitudes, and values considered appropriate for each sex. Gender-related differences in problem-solving abilities have generated a great deal of controversy. Zhu (2007) looked into gender differences in mathematical problem-solving patterns using secondary sources. The large body of literature reports that there are gender differences in mathematical problem solving favouring males. Gallagher et al. (2000) said

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that when it comes to finding solutions, men tend to be more flexible than women.In an examination by Witkin et al. (1971) on field reliance and field independence, he noticed that guys will, in general, speak of handling independence as their cognitive style. Compared to young men and men, young ladies and gentlemen will usually be more submissive in all age groups and cultures (Miller, 2001).

In an empirical study, Oribhabor(2020) found a significant difference in the mathematics achievement of the male and female students in favour of the males. Similarly, Oluyemo, Kukwil, Anikwezeand Shaluko (2020) found that male students excel in mathematics more than their female counterparts. Abakpa (2011) and Collins (2014) found in their respective studies that gender has an influence on students' achievement when taught using innovative teaching techniques in some specific classrooms, such as mathematics. Similarly, Ajai and Imoke (2015) established that gender plays a significant role in shaping students' achievement in science-related subjects such as mathematics, especially when a new teaching technique such as field dependent and field independent is applied in classroom teaching and learning experiences. Additionally, Mutai (2016) found out that gender was strongly associated with mathematics achievement. Male students performed better than females. On the contrary, Ajai and Imoko (2015) found out that male and female students trained in algebra using PBL didn't fundamentally contrast in achievement. Similarly, Ato and Adelaide (2015) found that gender is not a significant factor in secondary school students' mathematical achievement.

Conclusively, from extant literature review, it was shown that much has been conducted on the relationship between cognitive style, gender and academic achievement over the years among researchers. However, none of these studies was carried out among senior secondary school students inschools in Nsukka educational zone of Enugu State. This is the gap in existing literature that the present study sought to fill.

Research Methods

The study adopted Quasi-experiment design: Pre-test-posttest nonequivalent group design. According to Kerlinger (1970) Quasi-experimental situations is applied to much educational research where the random selection or random assignment of schools and classroom is quite impracticable.This design was considered most appropriate because this study seeks to examine the effect of cognitive style and gender on the achievement of secondary school students in mathematics through pretest-posttest technique. The population of the study comprise of five thousand, two hundred and forty-seven (5257) males and female senior secondary school class-two (SS2) students in the fifty-nine (59) public secondary schools in Nsukka educational zone of Enugu State. Which is made up of 2410 male and 2847 female students across the three local government areas in the education zone. The sample for the study comprises of 105 senior secondary schools class-two (SS2) students made up of 48 males and 57 females from four public secondary schools in the zone draw using multistage sampling technique.

The study adopted two instruments for collecting data. These are Oltrain, Raskin, Herman and Witkin (1971) Group Embedded Figures Test (GEFT) to test students' cognitive style and mathematics achievement tests (MAT). First the Group Embedded Figures Test (GEFT) was used to classify participants into field dependent and field independent cognitive styles. The test is a perceptual test that requires a person to locate 8 simple figures when they are embedded with the a large complex figures. The test contains three sections. The first section

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having seven items is used for practice, while the last two sections with nine items each, were scored. Each figure correctly located within the group embedded figures was scored. Scores on the GEFT reflects abilities in perceptual disembeding. The higher the score the higher the cognitive styles is field dependent. A medium point of (9) was used as cut-off point. Thus, students who score (9) and above were classified as field dependent. On the other hand, Mathematics Achievement Tests MAT contains 30 items and each question has options (A-D) to be selected from. According to Witkin, OltmanRaskin, and Karp (1971), the GEFT has satisfactory reliability of 89 on test-retest over a three year period. While, the overall reliability index for Mathematics Achievement Tests (MAT) is 0.79.

One hundred and five (105) copies of the group embedded figures test GEFT were administered to selected respondents in the two groups. Before administration the test the respondents were told that the test is not for examination but for researcher purpose. The GEFT instrument was administered first to the students to enhance the classification of the students with their various cognitive styles and students were made to comprehend the instructions very well prior to working through the items on the instrument. Then, the experiment group and control group were pre-tested using the mathematics achievement test (MAT). For the experiment group the students were exposed to some of mathematical concepts drawn from the second term curriculum of the schools. The students are taught using their regular class teacher under the supervision of the researcher. The teachers were trained for one week. The experiments were conducted using the normal school periods of lesson. The experiment lasted for a period of three weeks. At the end of the experiment post-test was administered which was a disguised pre-test to the research subjects, the pretest was disguised to avoid the test effect on the subjects. The whole exercise of teaching and testing was monitored by the researcher to ensure that there was no deviation from the specification in the guide. Also, after the three weeks meant for the study the students in the control group were also given the post-test which was disguised pre-test to the research subjects. The mean and standard deviation were employed to answer the research question while analysis of Covariance (ANCOVA) was used to test the null hypotheses formulated at 0.05 level of significance.

Results

The results of the study are presented in line with the research questions and hypotheses that guided the study.

Research Question One: What are the cognitive styles patterns among the senior secondary school students in Nsukka Education Zone?

Table 1:Mean analysis of the cognitive styles patterns among the senior secondary school students in Nsukka Education Zone.

Cognitive style	N	X	SD	Decision
Field dependent	67	21.11	2.034	Accepted
Field independent	39	29.78	2.066	Accepted

Result in table 1 showed the cognitive styles patterns among senior secondary school students in Nsukka Education Zone. The result in table 1 specifically showed that out of the 105 students

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used for the study, 67 of them with 21.11 mean score as well as 2.034 standard deviation are field dependent students while the remaining 39 with 29.78 mean score and 2.066 standard deviation are field independent students. Therefore, field dependent and field independent are the cognitive styles patterns among senior secondary school students in Nsukka Education Zone.

Research Question Two: What are the mean achievement scores of students with field dependent and filed independent in mathematics among senior secondary school students in Nsukka Education Zone?

Table 2: Pretest-Posttest Mean achievement scores of students with field dependent and filed independent in mathematics among senior secondary school students in Nsukka Education Zone

Groups	Pre-test			Post-test		Mean Gain Scores	Mean Gain Difference
	N	Mean	SD	Mean	SD		
Field dependent	67	19.93	3.73	28.56	3.38	8.63	**5.72**
Filed independent	39	19.62	3.63	22.53	6.90	2.91	

Result in Table 2 shows the mean achievement scores of secondary school students exposed to field dependent cognitive style and those exposed to field independent cognitive style. The field dependent cognitive style had mean achievement score of 19.93 with standard deviation of 3.73 at pre-test and 28.56 with standard deviation of 3.38 at post-test. The mean gain score of students exposed to field dependent was 8.63. On the other hand, students who were exposed to field independent cognitive style had mean achievement score of 19.62 with standard deviation of 3.63 at pre-test and 22.53 with standard deviation of 6.90 at post-test. The mean gain scores of the students exposed to field independent was 2.91. The mean gain difference of 5.72 was recorded for the two groups in favour of the students exposed to field dependent cognitive style. The standard deviation of each group from the mean ranged from 3.38 – 6.90; indicating that the respondents were not too far from the mean and from one another in their responses, adding further validity to the mean.

Research Question Three: What are the mean achievement scores of male and female students with field dependent and field independent cognitive styles in mathematics?

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Table 3: Pretest-Posttest Mean achievement scores of male and female students with field dependent and field independent cognitive styles in mathematics

Gender	N	Pre-test		Post-test		Mean Gain Scores	Mean Gain Difference
		Mean	SD	Mean	SD		
Male	48	18.52	4.87	26.34	5.90	7.82	.34
Female	57	17.47	3.03	24.95	5.66	7.48	

Result in Table 3 shows the mean achievementscores of male and female students with field dependent and field independent cognitive styles in mathematics. The male students had mean achievement score of 18.52 with standard deviation of 4.87 at pre-test and 26.34 with standard deviation of 5.90 at post-test. The mean gain score of male students was 7.82. On the other hand, female students had mean achievement score of 17.47 with standard deviation of 3.03 at pre-test and 24.95 with standard deviation of 5.66 at post-test. The mean gain scores of the female students was 7.48. The mean gain difference of .34 was recorded for the two groups in favour of the male students. The standard deviation of each group from the mean ranged from 3.03 – 5.90; indicating that the respondents were not too far from the mean and from one another in their responses, adding further validity to the mean.

Test of Hypothesis

$H0_1$: There is no statistical significance difference in the mean achievement scores of students with field dependent and field independent cognitive styles in mathematics in senior secondary schools in Nsukka Education Zone.

Table 4: Summary of the 2-Way Analysis of Covariance (ANCOVA) of Mean achievement scores of students with field dependent and field independent cognitive styles in mathematics in senior secondary schools in Nsukka Education Zone

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	561.076[a]	4	140.269	5.392	.001
Intercept	425.589	1	425.589	16.360	.000
Pretest FdFi	120.554	1	120.554	4.634	.037
Treatment	424.077	1	424.077	16.302	.000
Gender	1.719	1	1.719	.066	.798

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Treatment *	13.734	1	13.734	.528	.471
Error	1118.591	43	26.014		
Total	33920.000	48			
Corrected Total	1679.667	47			

Result of the analysis in Table 4 revealed that field dependent and field independent cognitive stylesas a factor in the study has a significant effect on the mean achievement scores of secondary school students in mathematics. This is because the calculated F-valve of 16.302 in respect of the treatment as main effect has a probability value of .000 and therefore significant at .05 level of significance. This implies that exposing secondary school students to filed dependent and filed independent cognitive styles significantly increased their mathematical achievement. Therefore the null hypothesis of no significance difference in the mean achievement scores of students with field dependent and field independent cognitive styles in mathematics in senior secondary schools in Nsukka Education Zoneis not accepted. Therefore, the researcher concludes that there is a significance difference in the mean achievement scores of students with field dependent and field independent cognitive styles in mathematics in senior secondary schools in Nsukka Education Zone.

$H0_2$: There is no statistical significance difference in the mean achievement scores of male and female students with field dependent and field independent cognitive styles in mathematics in senior secondary schools in Nsukka Education Zone.

Table 5: Summary of the 2-Way Analysis of Covariance (ANCOVA) of Mean achievement scores of male and female students with field dependent and field independent cognitive styles in mathematics in senior secondary schools in Nsukka Education Zone

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	426.515[a]	4	106.629	3.996	.008
Intercept	957.981	1	957.981	35.901	.000
Pretest Achiev	75.065	1	75.065	2.813	.101
Treatment	295.083	1	295.083	13.022	.002
Gender	14.577	1	14.577	.546	.464
Treatment * Gender	3.751	1	3.751	.141	.710
Error	1147.402	135	26.684		
Total	33504.000	140			
Corrected Total	1573.917	139			

Result of the analysis in Table 5 revealed that gender as a factor in the study has a significant effect on the mean achievement scores of secondary school students in mathematics. This is because the calculated F-valve of 13.022 in respect of the treatment as main effect has a probability value of .002 and therefore significant at .05 level of significance. This implies that

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gender influence students' achievement in mathematics. Therefore, the null hypothesis of no significance difference in the mean achievement scores of male and female students with field dependent and field independent cognitive styles in mathematics in senior secondary schools in Nsukka Education Zone is not accepted. Therefore, the researcher concludes that there is a significance difference in the mean achievement scores of male and female students with field dependent and field independent cognitive styles in mathematics in senior secondary schools in Nsukka Education Zone.

Discussion of the Findings

The findings of the study were discussed in line with the research questions and hypotheses that guided the study. The findings of the study with respect to research question one showed that field-dependent and field-independent are the cognitive style patterns among the senior secondary school students in Nsukka Education Zone. This finding supported the earlier findings of Jayanthn (2014) and Oluikpe (2014), who found in their respective studies that field-dependent and field-independent are the cognitive style patterns that could be easily adapted by teachers and students in the cause of teaching and learning critical subjects such as mathematics. In line with the above, Atavi and Hosein (2009), through their study, expressed that cognitive styles (field dependent and field independent) could be very useful if adopted in teaching subjects perceived to be difficult, like mathematics. This present study therefore identified field-dependent and field-independent as the cognitive styles of students in senior secondary schools in Nsukka Education Zone, Enugu State.

The findings of the study also revealed that there is a statistically significant difference in the mean achievement scores of students with field-dependent and field-independent cognitive styles in mathematics in senior secondary schools in the Nsukka Education Zone. This finding is in line with the earlier findings of Abakpa (2011) and Collins (2014), who found in their respective studies that innovative teaching techniques such as cognitive styles enhance students' achievement in mathematics. Similarly, Ogunleye (2015) established that the application of field-dependent and field-independent in teaching and learning mathematics increases students' achievement in mathematics. In line with the above findings, the present study was carried out to ascertain the efficacy of field dependent and field independent cognitive styles in students' achievement in mathematics, and the findings of the study have been able to prove that field dependent and field independent cognitive styles enhance students' achievement in senior secondary schools in Nsukka Education Zone, Enugu State.

The findings of the study revealed that there is a statistically significant difference in the mean achievement scores of male and female students with field-dependent and field-independent cognitive styles in mathematics in senior secondary schools in the Nsukka Education Zone. This finding is in line with the earlier findings of Abakpa (2011) and Collins (2014), who found in their respective studies that gender has an influence on students' achievement when taught using innovative teaching techniques in some specific classrooms, such as mathematics. Similarly, Ajai and Imoke (2015) established that gender plays a significant role in shaping students' achievement in science-related subjects such as mathematics, especially when a new teaching technique such as field dependent and field independent is applied in classroom teaching and learning experiences. In line with the above findings, the present study was carried out to ascertain if gender has any influence on students' achievement in mathematics, and the findings

of the study have been able to prove that gender has significant influence on students' achievement in senior secondary schools in Nsukka Education Zone, Enugu State.

Conclusion

The study examined the effect of cognitive styles and gender on mathematics achievement among senior secondary students in the Nsukka Education Zone of Enugu State. Based on the findings, the study concluded that field-dependent and field-independent are the cognitive style patterns among senior secondary school students. However, students with a field-dependent cognitive style had higher mathematical achievement than those that are field-independent. There was a statistically significant difference in the mean achievement scores of students with field-dependent and field-independent cognitive styles in mathematics in senior secondary schools. The study also concluded that there was a statistically significant difference in the mean achievement scores of male and female students with field-dependent and field-independent cognitive styles in mathematics in senior secondary schools in the Nsukka Education Zone. The study also concluded that male students had higher achievement in mathematics than their female counterparts.

Recommendations

Based on the findings of the study, the following recommendations were suggested:

1. Adoption of cognitive style patterns (field dependent and field independent) in senior secondary mathematics teaching and learning. This study has proved that the application of cognitive style patterns increases students' achievement in mathematics. It will be wise that secondary school mathematics teachers adopt cognitive style patterns in the mathematics classroom.

2. Gender as a factor in students' achievement in mathematics should be considered in preparation for the implementation of mathematics curriculum contents. In other words, the study recommends that mathematics teachers identify examples and illustrations that will be clearly understood by both male and female students in the mathematics classroom in order to close the gender gap in students' achievement in mathematics in senior secondary schools.

3. More attention should be given to female secondary school students as the findings revealed that male students had higher mathematics achievement.

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