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Effect Of Cognitive Styles And Gender On Mathematics Interest Of Senior Secondary School Students In Nsukka Education Zone, Enugu State

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ABSTRACT
The study investigated the effect of cognitive styles and gender on mathematics interest among senior secondary students in Nsukka Education Zone. The study adopted Quasi-experiment design: Pre-test-posttest nonequivalent group design. 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. 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 Witkin, Oltman, Raskin & Karp (1971) Group Embedded Figures Test (GEFT) to test students' cognitive style and Mathematics Interest Scale (MIS). First the Group Embedded Figures Test (GEFT) was used to classify participants into field dependent and field independent cognitive styles. 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. The study findings showed that, field dependent and field independent are the cognitive styles patterns among the senior secondary school students. There was a statistical significance difference in the mean interest scores of students with field dependent and field independent cognitive styles in mathematics. Male students had higher mathematics interest score than female students. There was also a statistical significance difference in the mean interest scores of male and female students with field dependent and field independent cognitive styles in mathematics in senior secondary schools in Nsukka Education Zone of Enugu State. Field dependent and field independent increase students' interest in mathematics. The study recommended that, Mathematics teachers should adopt cognitive styles patterns (field dependent and filed independent) in teaching and learning mathematics in senior secondary schools among others.
Keywords: Cognitive styles, Gender, Mathematics Interest, Secondary Students, field independent, field dependent.

INTRODUCTION

Mathematics is a foundational science for comprehending other fields and an important part of the global culture. Mathematics provides students with a remarkable collection of tools for comprehending and changing the world. Mathematics is critical in speeding a country's social, economic, and technological development. Today's world, which is increasingly reliant on science and technology, necessitates a greater understanding of mathematics on the part of its citizens. As a result, it is critical to provide a strong mathematical foundation for children in order to equip them to handle the problems of today's technology society.

Mathematics is the science that governs the reasoning of shapes, amounts, and game plans. Everything we do is surrounded by mathematics. It provides the foundation for everything in our daily lives, including cell phones, design (both historical and contemporary), money, engineering, and even gaming. It also refers to a person's ability to think and think consistently. Et cetera, it is the investigation of examples, and of proverbial proofs involving those examples. According to Zieglar and Loos (2014), mathematics is a science that is derived from the study of mathematical figures and the computation of numbers. They went on to say that mathematics is a science that studies dynamic structures that are created by utilizing consistent definitions and rationale to explain its qualities and instances. Mathematics is a human activity that involves the resolution of problems (Godino, Batanero & Font, 2007).). Mathematical objects reformist emerge and develop in the process of finding responses or solutions to these external and internal difficulties. Khan (2015) considers mathematics to be something that depends on deductive reasoning.

The importance of mathematics cannot be overstated, as mathematics is the universal language. Evans (2013) stated that, one of the key factors that makes mathematics such a valuable tool, as well as basic fundamental abilities, is its ubiquitous use. A mathematical equation should not be translated into another vernacular so that it can be understood by someone on another planet. A mathematical law does not change because someone has a different religion than you or speaks a different language than you; 2+2=4 in every location on the planet. She went on to say that mathematics is not only important for success in everyday life, but it is also all around us. The laws of mathematics may be found all around the globe, even in nature, and the problem-solving skills acquired from mathematics homework can be used to help and solve problems in various areas of life. While many people complain that mathematics is boring or confusing, Evans points out that life without mathematics means we are seeing the world on a far lower level than we could be. According to Edwards and Ward (2004), the role of mathematics definition allows one to understand the basic relevance of mathematics in the metaphorical structure that depicts mathematics. As a result, definition plays a role in students' experiences in mathematics classes, as definition is frequently used as a given notion. According to Godino (2014), mathematics is important because it helps people solve difficulties.

As important as mathematics is, there have been public outcries from the government, parents, teachers, and students for more than a decade against the results recognized by examination boards such as WAEC and NECO due to huge disappointments in kids' mathematics performance. This is clear from WAEC and NECO Chief Examiners report of years (2013, 2014-2015, 2017-2018). This is Worrisome for a nation that aspiring to be among the twentieth economics on the planet and first in African continent. The decline in students' performance in internal and external examinations might be due to their interest in mathematics.

Students' interest towards learning Mathematics and their implications for Mathematics instruction have long been a common concern among Mathematics educators (Oluyemo, Musbahu, Kukwil, Anikweze & Shaluko, 2020). Students' Interest towards learning and understanding Mathematics is seen as an indispensable factor influencing participation and success in the subject. Mathematics is made up of a set of concepts, facts, principles, and operations that are fundamentals to the existence of every individual (Hafiz & Hina, 2016). In an empirical study, Leder & Forgasz (2018) found out that students' poor learning interest is the major causes of low academic performance in internal and external examinations.

It is imperative to examine if cognitive style of students has effect on their level of interest in mathematics.

Cognitive style is a personality trait that affects mentalities, personality traits, and social interactions. Cognitive abilities are multifaceted. 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. Similarly, Tella, as cited in Oludipe (2014), believed that cognitive styles are a pre-requisite for improving students' learning accomplishment. This implies that cognitive style might also influence secondary school students' interest in learning mathematics. Jayanthn (2014) and Oluikpe (2014) in their respective studies found 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 as mathematics. Apart from cognitive style, gender can also be a major factor.

Gender can be defined as the socially constructed roles, behaviour, activities and attributes that a particular society considers for men and women (World Health Organization, WHO, 2014). To Woolfolk (2010) gender usually refers to traits and behaviours that a particular culture judges to be appropriate for men and women. Gender has also been reported to play a role in students' interest in mathematics (Oluyemo, Musbahu, Kukwil, Anikweze & Shaluko, 2020). According to Eccles and Wang (2015) females express less interest in Mathematics than their male peers.

From the going, it become urgent and timely to examine if cognitive style and gender has any effects on secondary school students' interest in mathematics in Nsukka Education Zone, Enugu State.

Purpose of the study

The main purpose of this study is to investigate the effect of cognitive styles and gender on mathematics interest among senior secondary students in Nsukka Education Zone. Specifically, the study seeks to:

1. Examine the cognitive styles pattern of senior secondary school students.
2. Ascertain the Interest score of students that exhibit field depended and field independent cognitive styles in mathematics
3. Ascertain the interest score of male and female students that exhibits field dependent and field independent cognitive styles in mathematics.

Hypotheses

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

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

Literature Review

Cognitive styles are an individual's continuing or standard technique of perceiving, remembering, reasoning, and problem solving. Pitcher (2002) describes cognitive style as the moderately consistent procedures, proclivities, and mentality that determines an individual's typical means of perceiving, remembering, and problem solving. Bruno (2015) expands on this definition. This implies that each understudy has a preferred cognitive style that is influenced by such variables. Furthermore, according to Wang (2008) cognitive styles refer to an individual's characteristics and preferred technique of gathering, interpreting, organizing, and thinking about information. Educators who understand their students' cognitive types and implement them through flexible instruction and evaluation are more likely to produce confident pupils with important mathematics number and reasoning abilities.

Gender differences in arithmetic instruction, learning, and accomplishment have also been linked to gender differences in cognition and brain lateralization (Ajai and Imoko, 2015). According to Mutemeri and Mygweni (2005), the fact that mathematics is for young men may lead to low interest in young

women, widening the gender gap in math interest for young men. According to Asante (2010), schools create representational oppositions among male and female students by gathering information and classifying particular courses as masculine, referencing Collins, Kenway, and MacLeod (2000) female students, on the other hand, are socialized to believe that mathematics is a male-dominated subject and thus dropping it is acceptable.

Students' interest in learning mathematics is another indispensable factor in students' performance. According to Abande (2010), interest is a state of being interested in or concerned about something, or paying attention to something. Magnus (2008) went on to say that curiosity encompasses the pleasant, enticing sentiments that a person experiences when attempting to investigate a topic. Furthermore, Adeleye (2011) defines interest as a desire to achieve something. Based on the above definition, it is reasonable to assume that interest governs our feelings and mentality toward a particular subject or action. Godpower-Echie & Ihenko (2017) stated that interest is a crucial aspect that aids learning. If a student exhibits a greater interest in a subject, this will encourage him or her to devote more time, effort, and energy to learning, resulting in higher or better grades.

On the same note, Chanq and Chenq (2007) conceptualize interest as the cognitive and affective relationship of a student and a particular subject matter/course. The cognitive aspect of this definition includes the learner's schematic and motivational structures or mental disposition which pushes the learner to want to be involved in task relating to a particular subject matter; or to put more effort to such. The affective aspect of the definition refers to interest as a force of attraction between the learner and the task causing the learner to act proactively towards task relating to a particular subject matter. According to Onah (2013) interest affects the learners learning through determining how they select and persist in processing certain types of information in preference to others. So, students with little or no interest cannot stretch their understanding of a given subject matter. Such learners' interest is aroused by stirring up the environment through linking the subject matter to the object of interest with the learners' experiences and their basic needs.

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 Witkin, Oltman, Raskin & Karp (1971) Group Embedded Figures Test (GEFT) to test students' cognitive style and Mathematics Interest Scale (MIS). 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 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 Interest Scale, that contains two sessions A and B. Section A contains the personal data of the respondents while section B contains 30 items structured in likert scale type of strongly agree (SA=4) agree (A=3). Disagree (2)

strongly disagree (SD=1). According to Witkin, Oltman Raskin, and Karp (1971), the GEFT has satisfactory reliability of 89 on test-retest over a three-year period. While, the reliability index for MIS is 0.82.

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 Interest Scale (MIS). 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 the Mathematics Interest Scale (MIS) was administered again Also, after the three weeks meant for the study the students in the control group were also given the Mathematics Interest Scale (MIS). 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 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 interest 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 interest scores of students with field dependent and filed independent in mathematics among senior secondary school students in Nsukka Education Zone

Groups	N	Pre-test		Post-test		Mean Gain Scores	Mean Gain Difference
		Mean	SD	Mean	SD		
Field dependent	67	19.52	3.85	25.83	5.57	6.31	0.47
Filed independent	39	20.21	3.38	26.05	6.70	5.84	

Result in Table 2 shows the mean interest 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 interest scores of 19.52 with standard deviation of 3.85 at pre-test and 25.83 with standard deviation of 5.57 at post-test. The mean gain score of students exposed to field "dependent was 6.31. On the other hand, students who were exposed to field independent cognitive style had mean interest scores

of 20.21 with standard deviation of 3.38 at pre-test and 26.05 with standard deviation of 6.70 at post-test. The mean gain scores of the students exposed to field independent was 5.84. The mean gain difference of 0.47 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 – 6.70; 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 interest scores of male and female students with field dependent and field independent cognitive styles in mathematics?*

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

Gender		Pre-test		Post-test		Mean Gain Scores	Mean Gain Difference
	N	Mean	SD	Mean	SD		
Male	48	28.11	7.52	68.07	15.64	40.96	2.20
Female	57	28.10	6.94	60.86	13.61	38.76	

Result in Table 3 shows the mean interest scores of male and female students with field dependent and field independent cognitive styles in mathematics The male students had mean interest score of 28.11 with standard deviation of 7.52 at pre-test and 68.07 with standard deviation of 15.64 at post-test. The mean gain score of male students was 40.96. On the other hand, female students had mean interest score of 28.10 with standard deviation of 6.64 at pre-test and 60.86 with standard deviation of 13.61 at post-test. The mean gain scores of the female students was 38.76. The mean gain difference of 2.20 was recorded for the two groups in favour of the male students. The standard deviation of each group from the mean ranged from 6.94 – 15.64; 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 Hypotheses

$H0_1$: There is no statistical significance difference in the mean interest 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 interest 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	426.515[a]	4	106.629	3.996	.008
Intercept	957.981	1	957.981	35.901	.000
Pretest FdFi	75.065	1	75.065	2.813	.101
Treatment	295.083	1	295.083	12.041	.002
Gender	14.577	1	14.577	.546	.464
Treatment *	3.751	1	3.751	.141	.710
Error	1147.4	235	26.684		
Total	33504.000	240			
Corrected Total	1573.917	239			

Result of the analysis in Table 4 revealed that field dependent and field independent cognitive styles as a factor in the study has a significant effect on the mean interest scores of secondary school students in mathematics. This is because the calculated F-valve of 12.041 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 interest. Therefore, the null hypothesis of no significance difference in the mean interest scores of 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 interest 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 interest 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 interest 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 Int	75.065	1	75.065	2.813	.101
Treatment	295.083	1	295.083	11.059	.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 interest scores of secondary school students in mathematics. This is because the calculated F-valve of 11.059 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 gender influence students' interest in mathematics. Therefore, the null hypothesis of no significance difference in the mean interest 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 interest 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 revealed that field dependent and field independent are the cognitive styles 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 out 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 as mathematics. In line with the above, Atavi and Hosein (2009) through study expressed that cognitive styles (field dependent and field independent) could be very useful if adopted in teaching subject perceived to be difficult like mathematics. This present study therefore identified field dependent and filed independent as the cognitive styles of students in senior secondary schools in Nsukka Education Zone, Enugu State.

The findings of the study revealed that there is a statistical significance difference in the mean interest scores of students with field dependent and field independent cognitive styles in mathematics in senior secondary schools in Nsukka Education Zone. This finding corroborates the earlier findings of Njagi

(2015) and Godpower (2017) who found out in their respective studies that innovative teaching technique such as cognitive styles enhance students' interest in mathematics. Similarly, Asante (2010) established that the application of field dependent and filed independent in teaching and learning mathematics increases students' interest 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' interest in mathematics and the findings of the study have been able to prove that field dependent and field independent cognitive styles enhances students' interest in senior secondary schools in Nsukka Education zone, Enugu State.

The findings of the study revealed that there is statistical significance difference in the mean interest scores of male and female students with field dependent and field independent cognitive styles in mathematics in senior secondary schools in Nsukka Education Zone. This finding is in line with the earlier findings of Njagi (2015) and Godpower (2017) who found out in their respective studies that gender has influence on students' interest when taught using innovative teaching technique in some specific classrooms as mathematics. Similarly, Asant (2010) established that gender plays significant role in shaping students' interest in science related subjects such as mathematics especially when a new teaching technique such as field dependent and filed 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' interest in mathematics and the findings of the study have been able to prove that gender has significant influence on students' interest in senior secondary schools in Nsukka Education zone, Enugu State.

CONCLUSION

The study examined the effect of cognitive styles and gender on mathematics interest among senior secondary students in Nsukka education zone. Based on the findings, the study concluded that, field dependent and field independent are the cognitive styles patterns among the senior secondary school students. It was also concluded that, there was a statistical significance difference in the mean interest scores of students with field dependent and field independent cognitive styles in mathematics. Male students had higher mathematics interest score than female students. This implies that male are more interested in mathematics than female. The study also concluded that, there was a statistical significance difference in the mean interest scores of male and female students with field dependent and field independent cognitive styles in mathematics in senior secondary schools in Nsukka Education Zone of Enugu State. Field dependent and field independent increase students' interest in mathematics. The implication of the finding is that continuous application of field dependent and filed independent in teaching and learning mathematics will continue to enhance students' interest in mathematics which is the first step to improved performance.

RECOMMENDATIONS

The study made the following recommendations:

1. Mathematics teachers should adopt cognitive styles patterns (field dependent and filed independent) in teaching and learning mathematics in senior secondary schools.
2. Mathematics teachers should focus more attention on female students to improve their interest in mathematics since male students have more interest than female.
3. Teaching environment should be gender sensitive so as to accommodate both gender and make ground for improved interest in mathematics.

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