COGNITIVE STYLES, LEARNING STRATEGIES AND STUDENTS' ACHIEVEMENT IN BASIC GENERAL MATHEMATICS IN COLLEGE OF EDUCATION, AFAHA NSIT.

Joyce David Eduok, Ph.D
Department of Mathematics
College of Education, Afaha Nsit
Akwa Ibom State

And

Uwem Daniel Udom
Department of Mathematics
College of Education, Afaha Nsit
Akwa Ibom State

Abstract

We report the relationship between cognitive styles and learning strategies on student's achievement in basic general mathematics in college of education, Afaha Nsit, Akwa Ibom State, Nigeria. The study adopted an experimental design. The population of the study comprised all the 1,160 Nigerian Certificate in Education (N.C.E.) 1 students in the six existing schools of the college offering Basic General Mathematics II (GSE 122) as a course of study in 2012 / 2013 academic session. The sample of the study contained 200 NCE 1 Students from three randomly selected schools in college of Education, Afaha Nsit. The sample from each school was assigned field-independent and field-dependent cognitive group for both guided-discovery and non guided-discovery learning group which represented experimental group and control group, respectively. Two researcher - developed tests "Group Embedded Figure Test (GEFT)" and "Mathematics Achievement Test (MAT)", were used for obtaining data for the study. The value of the reliability coefficient of the instrument was 0.80, which was substantially high enough to justify the use of the instrument. Three research questions guided the study, and three hypotheses were postulated and tested at .05 level of significance. Data obtained was analyzed using analysis of variance. The result indicated that the use of guided-discovery learning strategy in the teaching / learning of basic general mathematics enhances student's achievement in mathematics irrespective of the student's gender and cognitive style since it provide the basis for conceptual thinking, and facilitates better and proper understanding of mathematical concepts. The results also indicated that there is a significant *difference in the mean scores of field-independent and field-dependent students when taught mathematics using guided discovery learning strategy, while the interaction effect between the treatment and the cognitive style on students' achievement in mathematics was significant. It is recommended among others that mathematics teachers should make the teaching /learning of mathematics an interactive and activity-based for students.*

In the history of education, mathematics occupies a central place among the other school core subjects. It is the bedrock of almost all professional courses, the queen of science and the language of nature. As a theoretical discipline, mathematics explores the possible relationships among abstractions without concern for whether those abstractions have counterparts in the physical world. Nigeria as a nation recognizes the importance of mathematics and according to the National Policy on Education, the study of mathematics is compulsory for all students at primary and secondary levels, it is a subject per excellence (Federal Republic of Nigeria, (FRN), 2004). Mathematics lies on both logic and creativity, and it is pursued both for a variety of practical purposes and for its intrinsic interest. It is a necessary tool needed to be able to function effectively in the present technological age (Odili, 2010).

National council for Curriculum Assessment (2005) noted that many students view mathematics as a difficult subject and perceive higher mathematics as an elite subject for only the best students. Curriculum developers have been emphasizing on the importance of different learning strategies for learning to accommodate individual differences.

Trends have shown that in order to secure admission to higher levels of education, a credit-pass in mathematics is an advantage (Joint Admission and Matriculation Board (JAMB), 2006). This implies that the learning of mathematics in Nigeria is a basic tool needed for effective daily functioning, preparation for adult life and a gateway into a vast array of career choices. Both scientific breakthrough and technological development are facilitated by the precise language of mathematics.

Over the years, cognitive psychologists and educators have long been interested in understanding the difference in cognition and their impact on learning and instruction. There are individual differences among college students with regard to mathematics learning. They approach their academic tasks differently; these differences reflect their cognitive styles rather than their mental abilities. The fact that some students perform one single academic task differently in similar conditions demonstrates that they are different as regards the processing and organization of information and reaction to environmental stimuli. These differences are rooted in many various factors, one of which is cognitive style. Hyde and Mezulis (2001) believed that the cognitive differences between males and females have been exaggerated. Akanmu and Fajemidagha (2013) however opined that with recent interest on the effect of cognitive style, their result revealed significant difference in the performance of students categorized into field dependent and field independent when exposed to learning strategy. The outcome was in favour of field-independent students. Khodabakhsh (2012) examined the role of gender in cognitive styles and students' achievement, where differences are observed, the researcher remarked that gender differences is an area of educational research that have generated conflicting and non-conclusive finding world over. Therefore, due to the importance of academic achievement in contemporary life and the predicative power of cognitive styles and learning strategy for academic achievement, the present research intends to show the relationship between cognitive styles (field-dependence/independence), learning strategies and academic achievement of students in basic general mathematics in college of education, Afaha Nsit, Akwa Ibom State.

Statement of Problem

There is a general opinion of poor achievement in mathematics in Nigerian school system because of its perceived difficult and abstract nature. The problem always emerges whenever inappropriate cognitive styles and learning strategies are marred in the teaching and learning of mathematics. It has also been observed that the problems affecting mathematics achievement are related to teachers' method of presenting the content to students. Will the use of cognitive styles and learning strategy enhance students' achievement in mathematics?

Purpose of the Study

Generally, the purpose of this study is to assess the role of cognitive styles and learning strategy in enhancing students' achievement in mathematics learning.

The objectives were:

1. To determine the difference in the mean scores of field-independent and field-dependent students when taught using guided-discovery learning strategy.
2. To determine the difference in the mean scores based on students' gender in mathematics when taught using guided-discovery learning strategy.
3. To determine the interaction effect between the treatment and the cognitive style on students' achievement in mathematics.

Research Questions

This study will attempt to answer the following questions:

1. To what extend does students' mean scores of field-independent and field-dependent differ when taught using guided-discovery learning strategy.
2. To what extend does the mean scores based on student's gender differ in mathematics when taught using guided-discovery learning strategy.

3. What is the interaction effect between the treatment and the cognitive style on students' achievement in mathematics?

Null Hypotheses

Based on the research questions, the following null hypotheses were formulated and tested in the study.

1. There is no significant difference in the mean scores of field–independent and field-dependent students when taught using guided-discovery learning strategy.
2. There is no significant difference in the mean scores based on students' gender when taught using guided-discovery learning strategy.
3. There is no significant interaction effect between the treatment and the cognitive style on students' achievement in mathematics.

Concept of Learning Styles in Mathematics

Much pedagogical research has focused on the concept of ''learning styles.'' Several authors have proposed that the ability to typify student learning styles can augment the educational experience. As such, instructors might tailor their teaching style so that it is more congruent with a given student's or class of students' learning style. Mismatches between an instructor's style of teaching and a student's method of learning have been cited as potential learning obstacles within the classroom and as a reason for using a variety of teaching modalities to deliver instruction (De Vita, 2001; Cook, 2005 & Cook, 2005).

Learning styles are considered by many to be one factor of success in higher education.

Learning styles can tailor pedagogy so that it best coincides with learning styles exhibited by the majority of students (Lubawy, 2003). In mathematics, teachers and students have perceived the concept of figures like cone, cylinders, pyramids, triangles, rectangles, square, kite, spheres, etc as important but difficult to teach and learn respectively (Eduok, 2015). According to Sule (1997), teaching in actual practise consists of symbols, verbal and social interactions between the teacher and the students. The difficulty of teaching and learning any concept in mathematics depends among other things on the approach used in teaching such concept and the availability of learning materials in the teaching and learning process. However, the nature of the intended learning outcomes, learners' attitude change and the learning environments rather than the scope of the curriculum contents do determine the effectiveness of any given method of teaching. The researcher is of the opinion that the manipulation of concrete shapes during the teaching and learning process will provide for conceptual learning of mathematics.

As class sizes increase, so do the types and numbers of student learning styles. Given the variability in learning styles that may exist in a classroom, some authors suggested that students should adapt their learning styles to coincide with a given instruction style (De Vita, 2001).

Relationship between Cognitive Styles and Learning Strategies in Mathematics Instruction

Various authors draw a contribution between cognitive and learning styles. Learning styles is sometimes synonymous with cognitive style. Learning styles refer to ways that people learn information, and cognitive styles are more global, referring to the way that people see the world around them and interact with it. Learning style is a preferred strategy, implying that a student's learning style can change, while cognitive style is an immutable characteristic of personality (Parkash, 2013).

According to Akanmu and Fajemidagba (2013), the role of cognitive style and learning strategy in the teaching/learning process cannot be overemphasized. They viewed that there is a positive correlation between cognitive styles: field dependent-independent and learning strategy as students are actively involved in the instruction process.

Review of the related literature over the years reveals lack of attention to different cognitive styles and learning strategy in mathematics instruction. In this study, two cognitive styles namely; field-independent and field-dependent, and two learning strategies namely; guided – discovery and non-guided discovery will be examined.

Akanmu and Fajemidagba (2013) investigated the relationship among cognitive styles and learning strategy of students in mathematics. The result revealed that there is a significant difference in the performance of students categorized into field-dependent and field-independent students when exposed to guided-discovery learning style. Their outcome was in favour of field-independent student. Ford and Chen (2000) found that the level of field independency have significant impact on the ways learners organize and navigate information, prioritize content, and develop metacognitive strategies in any learning environments. Field dependent learners tend to be less successful in activities such as reorganizing and reproducing information, and structuring information than field independent learners. On the other hand, other studies have found that there is no significant difference in students' learning outcomes based on their levels of field independency (Truell, 2001; Wang, Hinn & Kanfer, 2001). Students perform equally well in various educational settings regardless of their cognitive styles. Lewis (2007) revealed no significant difference in the achievement rates of students based on their cognitive styles and learning strategy. Peterson, Deary and Austin (2005) opined that both intelligence and cognitive style will affect students' performance in a given task irrespective of the learning strategy adopted. The difference is that as intelligence increases, so does performance, while style exerts either a positive or negative effect depending on the nature of the task. According to Dwyer and Moore (2001) who investigated the effect of cognitive style on achievement in introductory education course at two universities in the United States. They found the field-independent learners to be superior to field-dependent learners on tests measuring different educational objectives, and concluded that cognitive style had a significant association with students' academic achievement.

Yunusa and Tukur (2013) investigated the influence of dependent and independent cognitive styles on achievement in mathematics among senior secondary school students, the findings reveal that significant difference does not exist in the mean scores of dependent and independent cognitive styles students as measured by participants' Cognitive Styles Questionnaire (PCSQ*)*. The result was in favour of the field independent students.

Tinajairo and Paramo (1997) which investigated the relationship between cognitive styles and student's achievement in several subjects including mathematics and English language but enjoys similarity with respect to the role of cognitive styles as predictor of achievement among mathematics learners. They concluded that cognitive style was a significant source of variation in overall performance of students. This means that field-independent students outperformed their field-dependent counterparts.

However, the gender difference in specifying intellectual abilities is obvious in school performance. The perception in areas like mathematics, sciences and engineering are for male domains and courses like home economics, typewriting and other art subjects are for female counterpart had negative effect in career choice (Eduok, 2016). Yunusa and Tukur (2013) maintained that significant difference exists between mathematics achievement of dependent and independent cognitive styles male and female students as measured by MAT in favour of the males independent students. Also, that significant difference does not exists between the mathematics achievement of dependent and independent cognitive styles male and female students as measured by MAT in favour of the males dependent students and maintained that there is no significant association between mathematics achievement of dependent and independent cognitive styles.

Swetman (1995) shows that female students' achievement and attitudes towards mathematics decline as they grow older. Initially female students have more positive attitudes towards mathematics than the males do, but as they continue in school, girls' attitude and achievement in mathematics become more negative. Teachers need to facilitate positive attitudes in females towards mathematics in order to improve their performance.

Hyde and Mezulis (2001) believed that the cognitive difference between males and females has been exaggerated. Lewis (2007) opined that with recent interest in comparing achievement of males and females in mathematics and sciences, where differences are observed, inevitably, there should be a debate in determining whether those differences are due to cognitive difference and/or social and cultural stereotyping. They concluded that gender differences are an area of educational research that has generated conflicting and non-conclusive finding world over.

Methodology

The study adopted a quasi-experimental research design as the researcher was only interested in determining the relationship among cognitive styles (field-dependence and field-independence), learning strategies (guided discovery and non-guided discovery) and students' achievement in Basic General Mathematics in College of Education, Afaha Nsit, Akwa Ibom State.

The population of the study consisted of 1,160 NCE I students in the six existing schools of the College (Matriculation programme, 2013), offering Basic General Mathematics 11 (GSE 122) as a course of study in 2012/2013 academic session. The researcher used multi-stage sampling procedure to sample from the population. The total sample of this study was 640 NCE 1 students from three randomly selected schools in College of Education, Afaha Nsit. The schools are school of Sciences, Arts and Social Sciences and Vocational & Technical Education. School of Sciences has a total of 17 course combinations from 7 departments with the population of 335 which is too large for effective experimentation. The researcher merged all the combinations together and randomly selected 100 students.

School of Arts and Social sciences has a total of 6 combinations from 3 departments with the total population of 225 students, seventy (70) students were randomly selected for the study. While school of Vocational & Technical Education had a total of 4 combinations from 4 departments with the total population of 112 students. Thirty (30) students were randomly selected for the study. A total sub-sample of 200 NCE 1 students were selected from the total sample of 640 NCE 1 students for proper experimentation and was used for this study of which the total field-independent group comprised 100 students- 55 males and 45 females, while field-dependent group comprised 100 students- 60 males and 40 females.

Two instruments were used namely: Group Embedded Figure Test (GEFT), and Mathematics Achievement Test (MAT). Group Embedded Figures Test (GEFT) was used to classify students into groups based on the fact that, the instrument is a non-verbal test and requires only a minimum level of language skill for performing the tasks (Cakan, 2003). Also, the psychometrical properties of the instrument had been investigated in cross-cultural settings and accepted as quite reasonable. GEFT was used to assign students into field-dependent and field-independent categories. GEFT contains a total of fifteen (15) items from two sections.

Mathematics Achievement Test (MAT) is the main instrument that was used after the successful classification into groups. The Mathematics Achievement Tests contains fifteen (15) objective test items with four options A-D from Basic General Mathematics of NCE 1 curriculum.

Both Group Embedded Figure Test (GEFT) and Mathematics Achievement Test (MAT) were subjected to content and face validation. The reliability coefficient of 0.80 was obtained for MAT using a test-retest approach on thirty randomly selected NCE II students from schools and departments who were not part of this investigation but exhibited the same quality as those used for the study. The test-retest carried out helped to adjudge the language suitability and comprehensibility of the items. The reliability coefficient was calculated using Pearson Product Moment Correlation (PPMC) statistics.

The Group Embedded Figures Test (GEFT) required each individual to trace a specified simple figure that was embedded within a complex design. The test consisted of 2 sections. The first section had 5 items and was earlier given for practice purposes. The second section had 10 items with 30 minutes given as the total time for completing the test. The possible scores ranged from 0 to 20. The 10 item GEFT was used to assign students into field-dependent and field-independent categories. The field-independent cognitive style involves student's ability to distinguish relevant mathematics concept from complex task situation. The ability of the students to carry out this effectively categorizes them as field-independent. The field-dependent students on the other hand, are not able to disseminate relevant mathematics concepts from a complex background. A score of zero (0) or two (2) is awarded for each item if the GEFT form is wrongly or correctly outlined respectively. A score of 0-9 indicates field dependent while a score of 10-20 represents field-independent student.

The Mathematics Achievement Test (MAT) which is the main instrument for this study consists of 15 objective questions mainly on 2 and 3 - dimensional shapes. The test was used to determine the academic ability of the field-dependent and field-independent students in mathematics.

The instructional instruments were lesson plans drawn on guided-discovery learning strategy and non guided-discovery strategy in teaching the experimental and control group respectively. The guided-discovery learning strategy was the experimental group and was student – activity centered required a lot of interaction among the researcher, students and instructional materials. However, the control group was taught using the non guided-discovery mode only; the group was exposed only to lecture method. Instructions were highly verbalized with minimum or no interaction between students and instructional materials. A period of one hour was spent each week throughout the treatment period. The study lasted for two months of four weeks teaching, the first and second week were used for preparation and pre-test while others were for post-testing respectively.

The researcher used Analysis of Variance (ANOVA) to analyze the data collected. All hypotheses were tested at 0.05 significant levels.

Results

Research Question 1

To what extent does students' mean gain scores of field-independent and field-dependent differ when taught using guided-discovery learning strategy.

Table 1: Summary of means and standard deviations for differences in field-independent and field-dependent students when taught using guided – discovery learning strategy

Cognitive Style	Mean	Standard Deviation	N
Field – independent	45.96	15.22	120
Field-dependent	29.66	12.13	80
Total	**39.44**	**16.15**	**200**

Table 1 shows that field independent and field dependent students who were taught basic general mathematics using guided-discovery learning strategy have the mean scores of 45.96 and 29.66, while the standard deviations are 15.22 and 12.13 respectively. The mean scores of field-independent students are greater than the mean scores of field-dependent student when taught using guided-discovery learning strategy. This implies that the use of guided-discovery learning strategy enhances the achievement of field-independent students than that of field-dependent students. The standard deviation shows how field independent and field dependent students' scores varied from the mean scores respectively.

Research Question 2

To what extent does the mean gain scores of students' gender differ in Mathematic when taught guided-discovery learning strategy.

Table 2: Summary of means and standard deviations for differences in students' gender in mathematics when taught using guided-discovery learning strategy

Gender	Mean	Standard Deviation	N
Male	40.24	15.99	115
Female	38.37	16.41	85
Total	**39.44**	**16.15**	**200**

The data presented in Table 2 shows that male and female students' taught mathematics with guided –discovery learning strategy have the mean scores of 40.24 and 38.37, while standard deviations are 15.99 and 16.41 respectively. This implies that the use of guided-discovery learning strategy enhances the achievement of both male and female students. The standard deviation shows how male and female students' scores varied from the mean respectively. However, male students' achievement is slightly better than the female students.

Research Question 3

What is the interaction effect between the treatment and the cognitive style on students' achievement in mathematics?

Table 3:Summary of means and standard deviation of the interaction effect of treatment and the cognitive style on students' achievement in mathematics

Cognitive Style	Learning Strategies	Mean	Standard Deviation	N
Field-Independent	Guided Discovery	48.66	14.60	100
	Non Guided discovery	32.45	10.45	20
	Total	**45.96**	**15.22**	**120**
Field-Dependent	Non Guided discovery	29.66	12.13	80
	Total	**29.66**	**12.13**	**80**
Total	Guided Discovery	48.66	14.60	100
	Non-Guided Discovery	30.22	11.81	100
		39.44	**16.15**	**200**

The data presented in Table 3 shows the means and standard deviations for differences in the interaction effect of cognitive styles and treatment (teaching methods) on students' achievement in mathematics. In field independent cognitive group, students who were taught mathematics using guided discovery and non-guided discovery learning strategies have the mean scores of 48.66 and 32.45, the standard deviation of 14.60 and 10.45 respectively, while those in field dependent cognitive group who were taught with non-guided discovery learning strategy have the mean score of 29.66 and standard deviation of 12.13. This implies that field-independent students achieve better when taught mathematics with guided discovery learning strategy. However, the use of guided discovery method enhances the achievement of field independent students more than the use of non-guided discovery method. The standard deviation shows that the scores of the interaction effect of cognitive style group and teaching methods varied from the mean respectively.

Hypothesis One

There is no significant difference in the mean gain scores of field-independent and field-dependent students when taught using guided-discovery learning strategy.

Table 4: Result of Univariate analysis of variance for difference in students achievement in mathematics in field-independent and field-dependent group when taught using guided-discovery learning strategy

Source	Type III sum of Squares	df	Mean square	F	Sig.
Corrected model	17231.55[a]	2	8615.78	48.92	.000
Intercept	19288.95	1	19288.95	109.52	.000
Pre-Scores	4484.95	1	4484.95	25.46	.000
Cognitive group	8735.90	1	8734.90	49.59	.000
Error	34697.73	197	176.13		
Total	**363032.00**	**200**			
Corrected Total	**51929.28**	**199**			

a. R Squared = .33 (Adjusted R Squared = .33)

Dependent Variable: PostScores

Mean	Standard Error	95% Confidence interval	
		Lower Bound	Upper Bound
38.05[a]	.96	36.16	39.94

a. Covariates appearing in the model are evaluated at the following values: Pre Scores = 34.37

Entries in the upper part of Table 4, show that the intercept which is the main effect is significant at .05 alpha level. At this level of significance, the calculated F-value of 109.52 is greater than the critical F-value of 3.91 with 1 and 197 degrees of freedom. Therefore, the null hypothesis that there is no significance difference in the mean gain scores of field-independent and field-dependent students when taught using guided-discovery learning strategy is rejected. The alternative hypothesis that there is a significant difference in the mean gain score of field-independent and field-dependent students when taught mathematics using guided-discovery learning strategy is retained.

Besides the R^2 of .33 imply that the total variation of cognitive style on students achievement in mathematics in guided discovery learning group is predicted by 33% of post Scores by field-independent and field-dependent students and treatment in each group.

Hypothesis Two

There is no significant difference in the mean gain scores of students' gender when taught mathematics using guided-discovery learning strategy.

Table 5: Result of Univariate analysis of variance for difference in the mean gain scores of students' gender when taught mathematics using guided – discovery learning strategy

Source	Type III sum of Squares	df	Mean Square	F	Sig.
Corrected model	8522.00[a]	2	4261.00	19.34	.000
Intercept	15583.59	1	15583.59	70.73	.000
PreScores	8351.08	1	8351.08	37.90	.000
Gender	25.36	1	25.36	.12	.74
Error	43407.28	197	220.34		
Total	**363032.00**	**200**			
Corrected Total	**51929.28**	**199**			

a. R Squared = .16 (Adjusted R Squared = .16)

Dependent Variable: PostScores

Mean	Standard Error	95% Confidence interval	
		Lower Bound	Upper Bound
39.50[a]	1.06	37.40	41.59

a. Covariates appearing in the model are evaluated at the following values: PreScores = 34.37.

Entries in Table 5 show that the intercept which is the main effect is significant at .05 alpha levels. At this level of significance, the calculated F-value of 70.73 is greater than the critical F-value of 3.91 with 1 and 197 degrees of freedom. The null hypothesis that there is no significant difference in the mean gain scores of students' gender when taught mathematics using guided-discovery learning strategy, is rejected. The alternative hypothesis that there is significant difference in the mean gain scores of students' gender when taught mathematics using guided-discovery learning strategy is retained. This implies that the use of guided-discovery learning strategy in the teaching/learning of basic general mathematics enhances students' achievement in mathematics irrespective of the student's gender. Besides the R^2 of .16 imply that the total variation of students' gender on students achievement in mathematics in guided discovery learning group is predicted by 16% of post Scores by male and female students and treatment in each group.

Hypothesis Three

There is no significant interaction effect between the treatment and the cognitive style on students' achievement in mathematics.

Table 6: Result of Univariate analysis of variance for differences in the interaction effect between the treatment and the cognitive style on students achievement in mathematics

Source	Type III sum of Squares	df	Mean square	F	Sig.
Corrected model	20376.79[a]	3	6792.26	42.19	.00
Intercept	21131.42	1	21131.42	131.27	.00
PreScores	3250.79	1	3250.79	20.19	.00
Cognitive Style	110.41	1	110.41	.69	
Learning Strategies	3145.24	1	3145.24	19.54	.00
Cognitive style * Learning Strategies	.000	0			
Error	31552.49	196	160.98		
Total	**363032.00**	**200**			
Corrected Total	**51929.28**	**199**			

a. R Squared = .39 (Adjusted R Squared = .38)

Dependent Variable: PostScores

Mean	Standard Error	95% Confidence interval	
		Lower Bound	Upper Bound
37.30[a]	1.14	32.04	39.55

a. covariates appearing in the model are evaluated at the following values: PreScores = 34.37.

b. Based on modified population marginal mean

Entries in the upper part of Table 6, show that the intercept which is the main interaction effect is significant at .05 alpha level. At this level of significance, the calculated F-value of 131.27 is greater than the critical F-value of 3.91 with 1 and 196 degrees of freedom. Therefore the null hypothesis that there is no significant interaction effect between the treatment and the cognitive style on students' achievement in mathematics is rejected. The alternative hypothesis that there is a significant interaction effect between the treatment and the cognitive style on students' achievement in mathematics is retained.

Besides, the R^2 of .38 imply that the total variation of treatment and the cognitive style on students' achievement in mathematics is predicted by 38% of post-Scores by treatment and cognitive style in each group.

Findings of the Study

The study was based on determining the relationship among cognitive styles, learning strategy and students' achievement in Basic General Mathematics. Three hypotheses were formulated and tested in the study and the findings were as follows;

1. There is a significant difference in the mean gain scores of field-independent and field-dependent students when taught mathematics using guided-discovery learning strategy.
2. There is a significant difference in the mean gain scores of students' gender when taught mathematics using guided-discovery learning strategy.
3. There is a significant interaction effect between the treatment and the cognitive style on students' achievement in mathematics.

Discussion of Findings

The purpose of the study was to determine the relationship among cognitive styles, learning strategy and students' achievement in Basic General Mathematics in College of Education, Afaha Nsit in Akwa Ibom State, Nigeria. The discussions presented below are based on the results of the hypotheses tested in the study.

The findings from Table 1 showed that field-independent students recorded the highest mean scores and standard deviation, while field-dependent students recorded a very low mean scores and standard deviation. Analysis of the null hypothesis (Table 4) states that there is no significant difference, in the mean gain scores of field-independent and field-dependent students when taught using guided-discovery learning strategy, is rejected. However, there is a significant difference in the mean gain scores of field-independent and field-dependent students when taught using guided-discovery learning strategy. This is in line with Akanmu and Fajemidagba (2013) who noted that there is a significant difference in the performance of students categorized into field-dependent and field-independent when exposed to guided-discovery learning style, their outcome was in favour of field-independent students. This finding also agrees with Ford and Chen (2000) who were of the opinion that the level of field independency has significant impact on the way learners organized and navigate information, prioritize content, and develop metacognitive strategies in any learning environments. Also, those field-dependent learners are less successful in activities such as reorganizing, reproducing information and structuring information than field-independent learners. The result of this study also corroborate the view of Dwyer and Moore (2001) who were of the opinion that field-independent learners are superior to field-dependent learners on test measuring different educational objectives, and concluded that cognitive style has a significant association with students' academic achievement. This finding also agrees with Tinajairo and Paramo (1997) who found that cognitive style was a significant source of variation in overall performance of students.

Also, noted that field-independent students out performed their field-dependent counterparts. However, the studies of Witkin, Moore, Goodenough and Cox, 1997; Cakan (2001) have shown that field-independent and field-dependent students do not differ in learning ability but respond differently to the content being presented as well as the learning environment.

The findings from Table 2 showed that male students' taught mathematics with guided-discovery learning strategy recorded the highest mean scores and standard deviation compared to their female counterparts. Analysis of the null hypothesis (Table 5) states that there is no significant difference in the mean gain scores of student's gender when taught mathematics using guided-discovery learning strategy, is rejected. However, there is a significant difference in the mean gain scores of students' gender when taught mathematics using guided-discovery learning strategy. This finding agrees with Obioma (1991) that irrespective of gender difference of mathematics learners, their interest level will respond positively to the learning strategy in teaching any concept in mathematics. This finding also corroborates the view of Eduok (2016) that both male and female student would perform equally if exposed to the same condition. This result agrees with Yunusa and Tukur (2013) who noted that significant difference exist between mathematics achievement of dependent and independent-cognitive styles of male and female students. This implies that the use of guided-discovery learning strategy enhances students' achievement in mathematics irrespective of gender.

Summary of the Findings

The findings were as follows:

1. There is significant difference in the mean gain scores of field-independent and field-dependent students when taught mathematics using guided discovery learning strategy.
2. There is significant difference in the mean gain scores of students' gender when taught mathematics using guided-discovery learning strategy.
3. There is significant interaction effect between the treatment and the cognitive style on students' achievement in mathematics.

Conclusions

Based on the findings of the study, it was concluded that the use of guided-discovery learning strategy in the teaching/learning of basic general mathematics enhances students' achievement in mathematics irrespective of the students' gender and cognitive style because it provide the basis for conceptual thinking. It also facilitates better and proper understanding of mathematical concepts.

Recommendations

Based on the findings and conclusion drawn, six recommendations were made:

1. It is recommended that mathematics teachers should make the teaching/learning of mathematics an interactive and activity-based for students.
2. Guided-discovery learning was found helpful in learners' ability to extract a simple figure from a complex one since it was more interactive. Hence, guided – discovery is recommended in addition to other methods, as it will enhance learners' achievement irrespective of the ability levels of the learners.

3. Students should be encouraged to study mathematics irrespective of their gender through the award of scholarships since males are not superior to females in mathematics class as found from this study.
4. The establishment of well equipped mathematics laboratory in each school is required for practical demonstration and involvement of learners in the development of mathematical concept.
5. Mathematics teachers should be upgraded through in-service and pre-service education, seminars, conferences, workshops and symposiums so as to improve/assess their impact of teaching methods.
6. Instructional designers and practitioners should develop better quality instructional delivery methods to help field-dependent learners to become independent as such they can process information, mode of perceiving, thinking, problem-solving and remembering and so on.

Educational Implication

In as much as education is child-centered, the success of any educational system depends, among other factors, on teacher's lesson communication ability through the use of relevant instructional materials to impart the intended knowledge and skills to learners.

The result of the study implies that the use of guided-discovery learning strategy in the teaching and learning of mathematics enhances the achievement of learners irrespective of students' gender. Also, enhances field-independent students' achievement than that of field-dependent students. Manipulation of materials by students should be encouraged in recognition of the concrete thinking of the students.
Gender stereotyping of mathematics as a male realm may be critical to female willingness to achieve in mathematics if the situation is unchecked. The direct application of this study was to encourage mathematics teachers to review and assess the impact of teaching methods in teaching mathematics. Also, to arouse the interest of students irrespective of their cognitive style and gender towards mathematics so as to improve teaching and learning situation.

References

Akanmu, M. A. & Fajemidagba, M. O. (2013). Relationship among cognitive styles, learning strategy and students performance in mathematics. *Journal of Mathematical Sciences Education*, 2(1), 246-256.

Cook, D.A. (2005). Learning and cognitive styles in web-based learning: theory, evidence, and application. Acad Med. 80:266-78.

Cook, D.A.(2005). The research we still are not doing: an agenda for the study of computer-based learning. Acad Med. 80:541-8.

De Vita GD.(2001). Learning styles, culture and inclusive instruction in the multicultural classroom: a business and management perspective. Innovations Educ Teaching Int. 38:165-74.

Eduok, J. D. (2016). Instructional Strategies, Students' Characteristics and Their Performance and Retention of Concepts in Mathematics in Senior Science Colleges in Akwa Ibom State. Unpublished Doctoral Thesis, University of Uyo.

Federal Republic of Nigeria, (FRN, 2004), *National Policy on Education;* Lagos: NERDC Press.

Ford, N., & Chen, Y. (2000). Individual differences, hypermedia navigation and learning: An empirical study. *Journal of Educational Multimedia and Hypermedia*.9(4), 281-311.

Hyde, J. S & Mezulis, A. H. (2001). Gender difference research: issues and critique. In J. Worrell. *Encyclopedia of women and gender*. San Diego: Academic Press.

JAMB (2006). UME – Guideline for Admission to First Degree Course in Nigeria Universities. Lagos: JAMB.

Khodabakhsh, R. (2012). The Relationship between primary students' field dependence / independence, and self, d.2007. The relationship among student'coping skills, stress, and their academic achievement with regards to some demographic features. *Daneshvar Behaviour Bimonthly*.11(4).

Lewis, C. (2007). The Effect of a Constructivist Teaching Approach on Student Academic Achievement, Self-Concept and Learning Strategies. *Asia Pacific Education Review*. 6(1) 9-10.

Odili, G. A. (2010). Improving Performance in Mathematical Science in Tertiary Education. *Workshop Proceeding: National Mathematics Centre*, Abuja 21-25th June, 2010.

Parkash, C. (2013). Cognitive Styles of Rural Senior Secondary School Students in Relation to their Gender and Stream. *International Journal of Education and Psychological Research (IJEPR).* 2 (4) 37-44.

Sule, A. R. O. (1997). A Survey of the Teachers and Students' Opinions on the Effectiveness of various Methods of Teaching Mathematics. Abacus. *The Journal of Mathematical Association of Nigeria, 22*(1) 26-69.

Swetman, D. (1995). Rural elementary students 'attitudes toward mathematics. *Rural Educator*.16 (3) 31 Spring, 20-22.

Truell, A. D. (2001). Student attitudes toward evaluation. *The Delta Phi Epsilon Journal.* 43(1), 40-49.

Wang, X. C., Hinn, D. M., & Kanfer, A.G. (2001). Potential of computer- supported collaborative learning for learners with different learning styles. *Journal of Research on Technology in Education.* 34(1), 75-85.

Yunusa, U &Tukur, H. A.(2013)**.** The Influence of Dependent and Independent Cognitive Styles on Achievement in Mathematics among Senior Secondary School Students in Bida Educational Zone of Niger State, Nigeria. *Journal of Research in Education and Society*.4(2)