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Cognitive Style and Gender as Predictors of Students' Academic Performance in Basic Science and Technology in Mkpat Enin Local Government Area, Akwa Ibom State, Nigeria

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Abstract. This survey study investigated influence of cognitive styles on students' academic performance in basic science and technology in Mkpat Enin Local Government Area. Two main objectives guided the study. The population of this study comprised of 1679 (786 male and 893 female) junior secondary one (JSS 1) students. One school was randomly selected from schools in the study area. Convenience sample of eighty (80) students was then used. Two instruments used were- Cognitive Style Test (r=0.82) and Basic Science and Technology Performance Test (r=0.89). Two research questions were posed and answered while two hypotheses were tested at 0.05 level of significance. Data were analyzed using mean scores, T-test and ANOVA. Results showed that there was a significant influence of cognitive style on students' academic performance in basic science and technology (t=14.953; df=78; p<.05). There was significant difference in the performance of male and female Basic Science and Technology Students with reflective cognitive style and those with impulsive cognitive style {$F_{(1, 79)}$ =12.413; P< 0.05). The result also showed that more male students were found to be impulsive while more female students were reflective. This study therefore, recommended that teachers should determine cognitive styles of the learners as an integral part of lesson preparation to enhance students' overall learning outcomes in basic science and technology.

Keywords: Cognitive style, Gender, Achievement, Basic Science and Technology

1. Introduction

A Child by nature is highly inquisitive. He interacts with the natural world to derive meanings from objects, events and phenomena. This child has a unique method of understanding what he sees, smells, touches, hears and tastes. The child has a method of reasoning and making decisions based on his perception and observation. Based on his natural background, every child (learner) in a given classroom situation when exposed to a particular stimulus has a specific method of making meanings, reasoning, understanding and making decisions on the stimulus. This means that an individual child possesses different cognitive styles. Cognitive style is the specific method or way a child employs in making meanings, reasoning, understanding and making decisions (judgments) when exposed to a learning stimulus.

Höffler, Koć-Januchta and Leutner (2016) observed that individuals that possess different cognitive styles also demonstrate different behaviour when learning and this could serve as an indicator that cognitive style might be a factor to be considered in teaching. Hence, it is not been overstatement to say that cognitive style of learners prepared for any instructional activity should be identified (discovered) for effective learning.

Different researches identify different cognitive styles. Reflection-Impulsivity (R-I) (Kagan, 1965), Conveger–
Diverger Construct (Hudson, 1967), Hemispherical-Lateralisation concept (Ornstein, 1973), Field Dependence–Field Independence model (FI-FD) (Witkin, Oltman, Raskin & Karp, 1971), Adaption–Innovation Theory (Kirton, 1976), Wholist–Analytic and Verbal–Imagery Model (Riding & Cheema, 1991), verbal–visual, active–reflective and sequential–global (Lusweti, Kwena & Mondoh, 2018). This study adopted Reflective-Impulsive cognitive style.

Impulsivity means quick answers to tasks and a high number of errors while Reflection applies to subjects that respond more slowly to tasks and commit few errors (Carretero-Dios, De los Santos-Roig & Buela-Casal, 2009). This means learners that provide quick responses (answers) to a given task and make a number of errors are categorized as having impulsive cognitive style and those that respond more slowly to a given task and also make few errors are grouped as having reflective cognitive style.

This present study is based on 'Split Brain Theory' propounded by Sperry (1968). Sperry (1968) used a number of ingenious tasks. The tasks were carried out in laboratory conditions, using specialised equipment and were highly standardised. The tasks involved setting tasks separately to the two hemispheres of the brain. His results showed that when participants were presented with an image in one half of their visual field and then presented with the same image in the other half of the visual field, they responded as if they had never seen the image before. If the same image was presented in the original visual field the participants were able to recognize the image as one they had seen before.

This present study allowed the participant to use visual observation to select among the objects presented (alternatives), the one that matches the standard. The participants were not expected to think or perceive in the same way due to different functions of their visual fields. This theory is relevant to this study in terms of presenting a stimulus for a response which will require a response and a number of errors committed by the respondents. Most of the researches on cognitive style focused on adult learners/individuals with specific statistical tools appropriate to the respondents. Lusweti, Kwena and Mondoh (2018) conducted a correlational study that examined the interactive effects of cognitive styles and their power to predict academic performance in Chemistry. Cognitive styles were measured on four dimensions: concrete–abstract, active–reflective, verbal–visual and sequential–global. The study explored how cognitive styles of students and teachers interacted to influence learner performance in Mock and in Kenya Certificate of Secondary Education (KCSE) Chemistry Examinations. The study revealed that three schools had very high levels of student–teacher cognitive styles congruence while the other three had low levels of congruence, two out of the four dimensions of cognitive styles, only the sequential–global dimension was a significant predictor of performance in KCSE Chemistry.

Idika (2017) determined the influence of two major cognitive styles (Field Dependent and Field independent) and gender on students' achievement in and attitude to chemistry. The results showed that there was significant main difference between field dependent and field independent students' achievement in chemistry; students with field independent level of cognitive style obtained higher mean score of chemistry achievement than those with field dependent level of cognitive style, there was no significant main difference between male and female students' achievement in chemistry but the female students obtained higher mean achievement score than their male counterparts. Also, Tinajero, Lemos, Araújob, Ferraces and

Páramo (2012) conducted a study on the influence of cognitive style called field dependence-independence on academic achievement of Brazilian university students and the mediating effect of learning strategies on that influence. Results of a regression analysis showed that cognitive style and learning strategies significantly contributed to academic achievement. Students' cognitive styles have been found to mediate learning (Tinajero et al, 2012). This calls for its better understanding by the teacher in his/her choice and usage of teaching strategies. There had been previous (few) research which was carried out on young learners on cognitive styles.

Block and Block (1985) administered age-appropriate versions of the Matching Familiar Figures Test (MFFT) to 29 girls and 30 boys at ages 3, 4, 5, and 11years. MFFT error scores were more consistent over time than MFFT latency scores for both girls and boys. In girls, the size of the inverse relation between MFFT error and MFFT latency increased from age 3 to 5 years and then leveled off. In boys, this relationship remained unchanged between ages 3 and 5 years but increased markedly after age 5. Children about this age are found in lower, middle and upper basic education levels making the form of cognitive style under the study to be relevant.

However, the review of previous studies show that reflective-impulsive cognitive style has not really gained popularity among educational researchers especially in Basic Science and Technology, among children at basic education level. Reviewed literature (Arizmendi, 1980; Block & Block, 1985) revealed Reflective-Impulsive cognitive style was carried out in learners between age 3 and age 12 using Matching Familiar Figure Test developed by Kagan. This age range characterizes Basic Education Levels (Lower, Middle and Upper) in Nigeria. Hence, using Junior Secondary School One (JSS 1) which is the first year of the middle school (6th grade) is a choice for this study. This study therefore investigated influence of cognitive style and gender on students' academic performance in Basic Science and Technology in Mkpat Enin Local Education Committee.

2. Statement of the Problem

Researchers over the years are worried about persistent failure in both internal and external examinations. In their efforts to find solution to this disheartening problem, studies have been conducted in the areas of instructional strategies and methods, factors that affect students' learning such as attitude, interest, academic ability, and study habit among others. Basic Science and Technology remains a tap root for scientific and technological development of any nation. As important as the subject is to national development, learners are faced with learning difficulty. There are dearth of researches on cognitive styles and their influences on students' learning especially in Basic Science and Technology. The problem of this study therefore, was to examine the influence of cognitive style and gender on students' academic performance in Basic Science and Technology in Mkpat Enin Local Education Committee.

3. Purpose of the Study

The main purpose of this study was to find out the influence of cognitive style and gender on students' academic performance in Mkpat Enin Local Education Committee of Akwa Ibom State. Specifically, the study sought to:
Ascertain if any difference exists in the performance mean scores of Basic Science students with reflective cognitive style and those with impulsive cognitive style.
Find out if difference exists in the performance mean scores of male and female Basic Science students with reflective cognitive style and those with impulsive cognitive style.

4. Research Questions

The following research questions were formulated to guide the process of the study:

- Will there be any difference in the performance mean scores between Basic Science students with reflective

cognitive style and those with impulsive cognitive style?
- Will there be any difference in the performance mean scores of male and female Basic Science students with reflective cognitive style and those with impulsive cognitive style?

5. Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance to guide this study:

- There is no significant difference in the performance mean scores between Basic Science and Technology students with reflective cognitive and those with impulsive cognitive styles.
- There is no significant difference in the performance mean scores between male and female Basic Science and Technology students with reflective cognitive and impulsive cognitive styles.

6. Research Design

The study adopted descriptive survey research design

6.1 Area of the Study

This study was conducted in Mkpat Enin Local Government Area. Mkpat Enin Local Government Area of Akwa Ibom State is located in the South-South Region of Nigeria. The Local Government Area is bounded by Oruk Anam Local Government in the North, Eastern Obolo Local Government Area in the South, Onna Local Government Area in the East and Ikot Abasi Local Government Area in the West. Mkpat Enin Local Government has an Area of 322.352 square Kilometer. The total population of Mkpat Enin is 178,036 based on the 2006 census figure. The area is rich in oil and natural gas, timber and palm produce. The People of Mkpat Enin are mainly traders and farmers. Mkpat Enin Local Government Area has sixteen public secondary schools, Federal Government Girls Secondary school and a State University (Mkpat Enin Local Education Committee, Teachers-Subject Analysis, 2018).

6.2 Population of the Study

The population of this study comprised of 1679 (786 male and 893 female) junior secondary one students during 2017/2018 academic session in 16 secondary schools in Mkpat Enin Local Government Area of Akwa Ibom State Nigeria (Mkpat Enin Local Education Committee, Teachers-Subject Analysis, 2018).

6.3 Sample and Sampling Techniques

The simple random sampling method by balloting was used to select one school. The selected school has JSS 1 population of 100 students (Mkpat Enin Local Education Committee, Teachers-Subject Analysis, 2018). Convenience sample of 80 (80%) participants was then used. A convenience sampling consists of using the most readily or most convenient for the research using Taro Yamanes rule.

6.4 Instrumentation

Two instruments were used in this study. Cognitive Style Test (CST) which was used to categorize the respondents into cognitive style groups; reflective cognitive style and impulsive cognitive style. It is a 15-item cognitive test developed by the researcher and used in this study. The instrument is in line with Matching Familiar Figures Test developed in 1966 by the US psychologist, Jerome Kagan. This was a matching test to be administered individually with an average duration between 15 to 20 minutes. Every item included a model drawing (sample) and six versions of it with only one that matched exactly the sample. The subject's task was to identify the option that matched the model. It was an instrument designed to measure reflection-impulsivity by requiring the respondent to select repeatedly from several alternative figures the one that matches a standard. The number of errors and the time required to complete the test are recorded, and respondents with below-median errors and above-median response times were classified as reflective; respondents with above-median errors and below-median response times were grouped as impulsive. This test was used to group respondents into reflective and impulsive cognitive styles.

Basic Science and Technology Performance Test (BPT) was also developed by the researchers.

Section A contained the personal data of the respondent which are: Age and Gender of the Learner. Section B contains 20 multiple choice objective questions with options A-D, from which the respondents will select the correct option. 'Correct answer' attracted one mark while 'wrong answer' attracted zero (0) mark each.

6.5 Validity of Instruments

The two instruments were given out for experts' review, for face and content validation. Their suggestions were accommodated to produce the final copies of the instruments. The instruments were also tested on 20 students from a school that was not part of the study. Reliability indices were determined using Crombach Alpha. Reliability indices of 0.82 and 0.89 were obtained for Cognitive Style Test and Basic Science and Technology Performance Test respectively.

6.6 Methods of Data Collection

The researcher visited the selected schools to administer the two instruments to the respondents. The researcher sat in a very comfortable place to invite the respondent one after the other. The respondent was given instruction to respond to the first item on the cognitive test. The researcher recorded the first response time and the number of error (s) committed. Then the respondent was asked to move to the next item. The researcher did the same thing to record the first response time and the number of error committed. The respondents had the chance to commit up to five errors. If by the 5th attempt, the respondent still missed the correct answer; the researcher would tell the respondent the answer and move to the next item. For performance test, this test was administered on all the respondents tested with the cognitive style test to determine their performance in the selected concept (Living Things) in Basic Science and Technology curriculum.

6.7 Method of Data Analysis

The data collated were analysed using mean scores, Independent T-test, and Analysis of Variance (ANOVA) to answer the research questions and test the hypotheses at .05 level of significance.

7. Results

Table 1: Distribution of Respondents by Gender

Gender	Frequency	Percent
Male	44	55.0
Female	36	45.0
Total	80	100.0

Table 1 shows that 44 (55.0%) of the respondents were male, while the remaining 36 (45.0%), were female.

Table 2: Distribution of Respondents by Cognitive Style

Cognitive Style	Frequency	Percent
Reflective	39	48.8
Impulsive	41	51.3
Total	80	100.0

Table 2 shows that 39 (48.8%) of the respondents had reflective cognitive style while the remaining 41 (51.3%) had impulsive cognitive style.

Table 3: Distribution of Respondents by Cognitive Style and Gender

Gender	**Cognitive Styles**			
	Reflective	**Percent**	**Impulsive**	**Percent**
Male	18	46.15	26	63.42
Female	21	53.85	15	36.58
Total	39	100	41	100

Table 3 showed that more male students were found to be impulsive (63.42%) while more female students were reflective (53.85%).

Answering Research Questions

Research Question 1: Will there be any difference in the performance mean scores between Basic Science students with reflective cognitive style and those with impulsive cognitive style?

Table 4: Basic Science and Technology Students' Academic Performance by Cognitive Style

Cognitive Style	N	Mean	Std. Deviation	Std. Error Mean
Reflective	39	17.85	1.47859	.23676
Impulsive	41	11.07	2.43300	.37997

Table 4 showed that there was difference difference in performance mean scores of Basic Science and Technology students with reflective cognitive style and those with impulsive cognitive style. Students with reflective cognitive style had the highest performance mean score ($\bar{x}$ = 17.85) while students with impulsive cognitive style had the least adjusted performance mean score ($\bar{x}$ =11.07).

Research Question 2: Will there be any difference in the performance mean scores of male and female Basic Science students with reflective cognitive style and those with impulsive cognitive style?

Table 5: Difference in Basic Science and Technology Students' Performance by Gender and Cognitive Style

				95% Confidence Interval	
Gender	Cognitive Style	Mean	Std. Error	Lower Bound	Upper Bound
Male	Reflective	18.22	.440	17.346	19.098
	Impulsive	10.23	.366	9.502	10.960
Female	Reflective	17.52	.407	16.713	18.335
	Impulsive	12.53	.482	11.574	13.493

Table 5 revealed that there was difference in performance mean scores of male and female Basic Science and Technology students with reflective cognitive style and those with impulsive cognitive style. Male students with reflective cognitive style had the highest adjusted performance mean score ($\bar{x}$ =18.22) while male counterparts with impulsive cognitive style had the least adjusted performance mean score ($\bar{x}$ =10.23). Also, female students with reflective cognitive style had the highest adjusted performance mean score ($\bar{x}$ =17.52) while female counterparts with impulsive cognitive style had the least adjusted performance mean score ($\bar{x}$ =12.53).

Testing the Hypotheses

$H0_1$: T There is no significant difference in the performance mean scores between Basic Science and Technology students with reflective cognitive and those with impulsive cognitive styles.

Table 6: T-test Analysis of Basic Science and Technology Students' Performance by Cognitive Style

Cognitive Style	N	Mean	Std.D	df	T	P-value	Remark
Reflective	39	17.85	1.479	78	14.953	.000	Sig.
Impulsive	41	11.07	2.433				

Table 6 revealed that there was a significant influence of cognitive style on students' academic performance in basic science and technology (t=14.953; df=78; p<.05). Since the p-value is less than the 0.05 alpha level, there is a significant difference in the academic performance of Basic Science and Technology students with reflective and impulsive cognitive styles. Hence, the null hypothesis which stated that there is no significant influence of cognitive style on students' performance in Basic Science

and Technology was rejected. This means that Basic Science and Technology students' academic performance was influenced by their cognitive style.

$H0_2$: There is no significant difference in the performance mean scores between male and female Basic Science and Technology students with reflective cognitive and impulsive cognitive styles.

Table 7: Analysis of Variance (ANOVA) of Performance Scores of Basic Science and Technology Students by Gender and Cognitive Style

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	972.052	3	324.017	93.032	.000	.786
Intercept	16434.900	1	16434.900	4718.784	.000	.984
Gender	12.354	1	12.354	3.547	.063	.045
Cognitive Style	809.065	1	809.065	232.298	.000	.753
Gender x Cognitive Style	43.234	1	43.234	12.413	.001	.140
Error	264.698	76	3.483			
Total	17768.000	80				
Corrected Total	1236.750	79				

Table 7 revealed that there was significant difference in the performance of male and female Basic Science and Technology Students with reflective cognitive style and those with impulsive cognitive style {$F_{(1, 79)}$ =12.413; P< 0.05, partial η^2 = .140}. The effect size is 1.4 percent. This means that there was a significant difference in the performance of male and female Basic Science students with reflective cognitive style and those with impulsive cognitive style. Thus, hypothesis two was rejected but alternative hypothesis was upheld which stated that there was significant difference in the performance of male and female Basic Science and Technology Students with reflective cognitive style and those with impulsive cognitive style .

8. Discussion of Findings

The results from the study showed that there was difference in performance mean scores of Basic Science and Technology students with reflective cognitive style and those with impulsive cognitive style. Students with reflective cognitive style had the highest performance mean score while students with impulsive cognitive style had the least adjusted performance mean score. This difference in their mean scores was statistically significant. This means that there was significant influence of cognitive style on students' academic performance in Basic Science and Technology.

The result of this study corroborates Jantan's (2014) who examined the relationship between students' cognitive styles with students' achievement in Mathematics among year 6 students from selected primary schools in Selangor, Malaysia. The finding showed that 112 students were of Field -Dependent cognitive styles (FD) compared to 38 students of Field Independent (FI) cognitive styles. The study also showed that cognitive styles influenced students' achievement in Mathematics.

This result is also in line with Okoronka and Wada (2014) that worked on effects of analogy instructional strategy, cognitive style and gender on senior secondary school students' achievement in some Physics concepts in Mubi metropolis, Nigeria. The results showed significant main effect of treatment on achievement and significant interaction effect on achievement when cognitive style was crossed with gender. The result from this present study also lends credence to Musya (2015) who investigated cognitive styles and academic achievement among secondary school learners in Kenya. The results showed that cognitive styles were significant on students' achievement in Chemistry.

The result from this present study showed that cognitive style when crossed with gender contributed to students' performance in Basic Science and Technology. This result gains the support of previous researchers. Jantan (2014) investigated the relationship between students' cognitive styles with students' achievement in Mathematics among year 6 students from selected primary schools in Selangor (Malaysia)

and found significant difference in cognitive styles between boys and girls in the school. Okoronka and Wada (2014) examined effects of analogy instructional strategy, cognitive style and gender on senior secondary school students' achievement in some Physics concepts in Mubi metropolis, Nigeria reported analytical female students and non-analytical male students were homogeneous, while the analytical male and non-analytical females were not in the same homogeneous group. Their results also showed that more male students were found to be field dependent while more female students were field independent and that field independent individuals scored higher than field dependent individuals. Conversely, Idika (2017) conducted a study on influence of cognitive style and gender on secondary school students' achievement in and attitude to Chemistry and found that male and female students did not differ much in their achievement in Chemistry.

9. Conclusion

The results from this study showed that cognitive styles influenced students' academic performance in Basic Science and Technology. The result also further showed that cognitive styles when crossed with gender contributed to students' academic performance in Basic Science and Technology. Also, male students were more impulsive while female students were more reflective in their cognitive styles. Observation from the results of this study showed that, cognitive style could contribute to students' academic performance in Basic Science and Technology. Also, there should be an understanding that a child with impulsive cognitive style is more likely to rush in taking some vital decisions which may lead him to achieve less his educational goals than a child with reflective cognitive style which is always very careful before taking his decision. Such a reflective cognitive style based child is likely to achieve more though it may take him more time.

10. Recommendations

Based on the results of this study, the following recommendations were made:

- Teachers should determine cognitive styles of the learners as an integral part of lesson preparation to enhance students' overall learning outcomes in basic science and technology.
- Teachers should always be mindful of individual learning differences to help learners of different cognitive styles to have learning gains with minimum or no difficulty.
- Teachers and parents should be mindful of gender differences of the children based on their cognitive styles so as to understand their responses in any given situation and to avoid unnecessary castigation of learners based on gender differences.

References

Arizmendi, T.G.(1980). Preliminary Norms for the Matching Familiar- Figures Test. M.A.Thesis. Department of Psychology. The University of Arizona. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1020.4639&rep=rep1&type=pdf.

Block, J. & Block, J.H. (1985).Longitudinal Consistency of Matching Familiar Figures Test Performance from Early Childhood to Pre-adolescence. Developmental Psychology, 21(2):262-271. https://www.researchgate.net/publication/232550681_Longitudinal_Consistency_of_Matching_Familiar_Figures_Test_Performance_From_Early_Childhood_to_Preadolescence.

Carretero-Dios, H., De los Santos-Roig, M., & Buela-Casal, G. (2009).Role of the Matching Familiar Figures Test-20 in the Analysis of Theoretical Validity of the Reflection-Impulsivity: A Study withPersonality.http://revistas.usb.edu.co/index.php/IJPR/article/viewFile/873/624.

Höffler, T.N., Koć-Januchta, M. & Leutner, D. (2016). More Evidence for Three Types of Cognitive Style: Validating the Object-Spatial Imagery and Verbal Questionnaire Using Eye Tracking when

Learning with Texts and Pictures. http://onlinelibrary.wiley.com/doi/10.1002/acp.3300/full

Idika, M.I. (2017). Influence of Cognitive Style and Gender on Secondary School Student's Achievement in and Attitude to Chemistry. Advances in Social Sciences Research Journal, 4(1), 129-139. http://scholarpublishing.org/index.php/ASSRJ/article/download/2585/1492

Hudson, L. (1967). Contrary Imaginations: A Psychological Study of the English Schoolboy. Harmondsworth: Penguin.

Jantan, R.B. (2014). Relationship between Students' Cognitive Styles with Students' Achievement in Mathematics among Year 6 Students from Selected Primary Schools In Selangor (Malaysia). International Journal of Humanities Social Sciences and Education (IJHSSE), 1 (10), 88-93. https://www.arcjournals.org/pdfs/ijhsse/v1-i10/13.pdf

Kagan, J. (1965). Impulsive and Reflective Children: Significance of Conceptual Tempo, in J.D. Krumboltz (Ed.) Learning and the Educational Process, Chicago: Rand McNally

Lusweti,S., Kwena,J. & Mondoh, H. (2018). Predictive Power of Cognitive Styles on Academic Performance of Students in Selected National Secondary Schools in Kenya, Cogent Psychology, 5. https://www.cogentoa.com/article/10.1080/23311908.2018.1444908.pdf

Musya, M.N. (2015). Cognitive Styles and Academic Achievement among Secondary School Learners in Kenya. http://erepository.uonbi.ac.ke/handle/11295/93617

Okoronka, U.A. & Wada, B.Z. (2014) . Effects of Analogy Instructional Strategy, Cognitive Style and Gender on Senior Secondary School Students Achievement in Some Physics Concepts in Mubi Metropolis, Nigeria. American Journal of Educational Research, 2014 2 (9), pp 788-792. http://pubs.sciepub.com/education/2/9/13/

Ridding, R. & Cheema, I. (1991). Cognitive Styles: An Overview and Integration. Educational Psychology, 11(3 & 4), 193 – 216.

Sperry, R.W. (1968) Hemisphere Deconnection and Unity in Consciousness. American Psychologist, 23, 723-33. https://psychologyhelp.weebly.com/split-brain-theory-sperry--gazzaniga.html

Tinajero,C., Lemos, S. M., Araújob, M., Ferraces, M.J. & Páramo, M.F. (2012). Cognitive style and learning strategies as factors which affect academic achievement of brazilian university students. Psicol. Reflex. Crit, 25, (1), 105-113.

http://www.scielo.br/pdf/prc/v25n1/a13v25n1.pdf Umanah, F. (2017).