

Cognitive Style as A Correlate of Senior Secondary School Students Achievement in Physics at Sokoto State, Nigeria

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Abstract

This study examined cognitive style as a correlate of senior secondary school students' achievement in physics in Sokoto State, Nigeria. This study adopted ex post facto research of the co-relational type. The population for the study was S. S. II students' in Sokoto State. The sample consisted of seven hundred and thirty-one (731) senior secondary school students (SSS II) offering physics proportionately selected from senior secondary schools across the three senatorial districts in Sokoto State, Nigeria. Research instruments employed to elicit data for the study were the Students' Cognitive style Inventory (SCSI), and Physics Achievement Test (PAT). Pearson-product moment correlation coefficients (PPMC), Fishers' transformation (Z-test) statistic were employed to analyse data at .05 level of significance. The results revealed that there was no significant relationship between students' cognitive style and their achievement in physics; there was no statistically significant difference in the strength of correlation between students' cognitive style and their achievement in physics, based on gender amongst others. It was recommended that students should be trained on cognitive style to be able to predict correctly their achievement in physics.

Keywords: Cognitive Style, Students, Achievement and Physics.

1. Introduction

Science as an agent of development plays an important role in bringing about the national growth and development of any nation through technological advancement, national wealth enhancement, health improvement, and industrialization (Mankilik & Ofodile, 2015). This is why scientific and technological breakthrough is usually the goal of any developing nation like Nigeria.

Abimbola (2013) defined science as a body of knowledge, a way of investigation or method, and a way of thinking in the pursuit of an understanding of nature. Science is defined as a multidisciplinary human activity that involves a planned systematic investigation and understanding of the world, nature, and the universe (Olorundare, 2014). Science is classified into Physical, Life, Medical and Technical Sciences. Physical science has a dual nature; it is a body of knowledge and the process of acquiring and refining knowledge. Examples

of subjects under physical sciences are Chemistry and Physics; why life sciences are Biology, Botany, and Zoology. Medical sciences are Medicine, Pharmacy and Medical Laboratory Science. Technical science, on the other hand, is primarily concerned with finding solutions to practical problems that confront man. Examples are Engineering, ICT and so on. Observation of the above meaning of science suggests the inquiry nature of science (Physics in particular) as it emphasizes the practical nature of science since the subject cannot be meaningfully understood without the students' active participation which necessitates laboratory activities.

Physics is a major branch of science, concerned with the laws that govern the structure of the universe, the forms of matter, energy, and their interactions (Bello & Akinfesola, 2015). Physics is a branch of science that is concerned with energy and their interaction (Omosewo, 2009); and it is the most basic of the sciences because its concepts and techniques corroborate the progress of all branches of science (Ekee, 2010). Physics is a cross-cutting discipline that has been implemented in many sectors of economic advancement which includes health,

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agriculture, water, energy, and information technology (Mankilik & Ofodile, 2015).

Physics being a branch of science is crucial for effective living in the modern age of science and technology. Given its applications in industry and many other places in society, it is necessary that every student is allowed to acquire its concepts, principles, and skills (Nigeria Education Research and Development Council [NERDC], 2009). Despite the importance of Physics to the scientific and technological development of our nation, students' performance and understanding of the subject have fluctuated over the years. This is evidenced by the low enrolment and under-achievement of students in physics. Researchers such as Gambari (2010); Bello and Akinfesola (2015) believed that students' performance in the subjects was poor. Ho and Boo (2007) observed that in many countries, there has been a decline in the number of students wishing to continue with physics at a higher level of education. The way an individual perceives, organizes, and interprets information is a function of his/her cognitive style. Human cognition, including cognitive styles, is highly relevant to many important educational concerns involving teaching and learning.

Katrina (2006) defined cognitive style as the ability to carry out abstract thinking. Tella (2008) was of the view that cognitive style is sine-qua-non to the evaluation of students' achievement in learning and a significant predictor of future achievement. Kumar (2011) defined cognitive style as a holistic process of cognition that begins with the perception, and is mediated by information processing, and the resultant retrieval; it varies from person to person and it is affected by various personality factors, such as, previous information, heredity, and environment, interest, thinking, attitude, value system, intelligence, creativity, social and economic status and so on.

Cognitive style is the underlying construct for information processing regardless of the situation in which it is applied (Furnham, 1995). Cognition is an act or process of knowing and a collection of mental processes that includes awareness, perception, reasoning, and judgment. The study of cognitive processes has its roots in the Gestalt psychology of Kohler, Koffka, Vygotsky, and Wertheimer and the studies of cognitive development in children by Piaget during the 19th century. Teachers are expected to do a lot of work in terms of helping learners to overcome the glaring obstacles that make learning tedious and uninteresting. In doing this, teachers must consider the fact that individuals perceive, process, and interpret information differently. In other words, human beings

have different ways in which they encode and decode information.

There are various labels of cognitive styles which include amongst others field dependent or field-independent; analytic or non-analytic; divergent or convergent, and impulsive or reflective cognitive styles (Riding & Cheema, 1991). The field dependence/field independent (FDI) construct is among the most widely studied constructs. Field independent individuals as analytic thinkers are more reflective, more independent of others, more concerned with mastery, more cautious, and less easily distractible in the classroom.

Cognitive styles have been identified to influence students' academic achievement (Jantan, 2014). Students' cognitive styles have been identified to influence student's achievement in mathematics (Theen & Melissa, 2008). Kirk (2000) investigated the relationship of cognitive style to achievement in chemistry and found that field independence has significantly correlated with academic achievement in chemistry.

Many studies (Jantan, 2014; Oludipe, 2014) have shown that gender differences exist between cognitive styles and achievement. The study by Jantan (2014) investigated the relationship between students' cognitive styles with student's achievement in mathematics among year 6 students from selected primary schools in Selangor (Malaysia). The finding revealed a significant difference in cognitive styles between boys and girls in the school. Oludipe (2014) analyzed cognitive style profiles and physics achievement of senior secondary school students in Ogun State, Nigeria. No significant difference between the physics achievement of analytic and non-analytic girls was reported.

The study by Jantan (2014) investigated the relationship between students' cognitive styles and student's achievement in mathematics among year 6 students from selected primary schools in Selangor (Malaysia). The methodology of the study was a survey. Data was collected using the Group Embedded Figures Test (GEFT). A total of 150 students in year 6 from selected schools were selected as participants of the study. Data were analyzed using SPSS version 17.0. The finding of the study 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 there was a low positive correlation between students' cognitive styles and their mathematics achievement. There was also a significant difference in cognitive styles between boys and girls in the school.

Oludipe (2014) analyzed cognitive style profiles and physics achievement of senior secondary school students

in Ogun State, Nigeria. The sample consisted of 107 Senior Secondary III physics students from four co-educational secondary schools in Ogun State. The students' were categorized as analytic and non-analytic learners based on their performance on the Sigel's Cognitive Style Test (SICOST). Results revealed that most of the students (69%) were analytic, and a significant difference in physics achievement in favour of analytic students was found. Also, a significant difference in favour of analytic boys (as against non-analytic boys) was found. However, there was no significant difference between the physics achievement of analytic and non-analytic girls. It was recommended that teachers should endeavour to find out students' cognitive styles and use strategies consistent with them.

Theen and Abdullah (2008) determined the effect of gender, ethnicity, and cognitive styles on achievement of form six students in General Paper. The sample comprised 152 upper six students (60 boys and 92 girls) from a selected school in Perak. The GEFT test (Group Embedded Figures Test) was used to measure students' cognitive styles. The finding showed that 69 (45.39%) students were from field-dependent cognitive style and 83 (54.61%) students were from field-independent cognitive style. The result of the t-test revealed that girls' achievement was significantly higher than boys'. The result of ANOVA showed that Chinese students score significantly higher than Malays and Indians. Findings also showed that there was a positive correlation between students' cognitive style and achievement in the general paper.

Ahiauзу (2017) conducted a correlational study to examine relationships among field-dependent/Independent, convergent/divergent cognitive styles and academic achievement of secondary school students in Rivers State- Nigeria. A sample of 1048 JSS3 students in secondary schools in Rivers State participated in the study. The instruments for data collection were Group Embedded Figures Test and Convergent/Divergent Test. The data generated from these instruments were subjected to analysis using SPSS. The results revealed that there was no significant relationship between field-dependent/independent cognitive style and students' academic achievement among secondary school students in Rivers State, Nigeria.

Musya (2015) conducted a study on cognitive styles and academic achievement in chemistry among secondary school learners in Kenya. The study employed a descriptive quantitative research approach. 200 form three students taking chemistry responded to questionnaires. Sampling was done using stratified and systematic random sampling. The data collected was

subjected to data analysis using a statistical package for social sciences (SPSS). The correlation coefficients were computed using the Pearson Product Moment Correlational Analysis. The results showed that both field-independent and field-dependent cognitive styles are evident among secondary school students. The 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. According to the research results, the study shows that cognitive styles could have a significant influence on student's academic achievement in chemistry and that there could be a difference in the type of cognitive styles between boys and girls.

From the literature reviewed so far, it appears that findings on the relationship between cognitive style and students' achievement appear inconclusive. Researchers such as Janta and Marsan (2007); Theen and Abdullahi (2008); Janta (2014) and Musya (2015) in their different studies reported that a significant correlation exists between cognitive style and students' achievement. While Oludipe (2014) and Ahiauзу (2017) had all reported that no significant correlation existed between cognitive style and students' achievement. Hence there is a need for such kind of research to be conducted in physics. Therefore this study is out to investigate cognitive style as a correlate of senior school students' achievement in physics in Sokoto State, Nigeria.

2. Method

This research adopted ex post facto research of correlational type. The justification for adopting ex post facto research was that the researcher had no direct control on independent variables, testing of the relationship between independent and dependent variables were observed. In this study, cognitive style was independent variable while students' achievement in physics was a dependent variable. Students' gender and school type were moderating variables. The population covered by this study was all senior secondary school students (45,991) offering physics in Sokoto State, Nigeria. The target population for the study was all the senior secondary school students' two (SSS II) offering physics in both public and private schools. The sample for this study was seven hundred and thirty-one (731) senior school students (SSS II) offering physics proportionately selected from senior secondary schools across the three senatorial districts in Sokoto State, Nigeria. Table 1 presents the school distribution across the three senatorial districts.

Two instruments were employed in this study namely: Students' Cognitive style Inventory (SCSI), and Physics

Achievement Test (PAT). In developing the Students' Cognitive Style Inventory (SCSI), Robert's (2002) Field Independence/Dependence Questionnaire was adapted and modified. This inventory comprised of nine (9) corresponding statements for Field independent and Field dependent cognitive styles. It is structured along a 3 point Likert scale.

The second instrument, Physics Achievement Test (PAT) was a researcher-designed test with items structured to test students' knowledge, comprehension, and application based on Bloom's taxonomy of educational objectives. These tests consisted of 25 structured multiple-choice questions on Physics topics. Each question has a maximum score of one (1) mark.

3. Result and Discussion

The result revealed that out of the 731 students that completely participated in the study, 449 students representing (61.4%) were male students, while 282 students representing (38.6%) were female students. The implication is that more male students participated in this study. 478 students representing (65.4%) were from public secondary schools, while 253 students representing (38.0%) were from private schools. This indicated that a greater percentage of respondents were from public secondary schools.

The result of Pearson Product Moment Correlation (PPMC) shows that there was no significant correlation ($r = -.072$, $p > .05$, $df = 729$) between students' cognitive style and their achievement in physics with a p-value greater than .05 (.53), indicating significance, thus, hypothesis 1 was not rejected. It implies that the relationship between students' cognitive style and students' achievement in physics is weak, thus, having a negative impact on their achievement is largely minimal. Subjected students' gender to Z-test to determine if truly there was a significant difference in the relationship between students' cognitive style and their achievement in physics, the result shows that there was no statistically significant difference in the strength of correlation between students' cognitive style and their achievement in physics in favour of female with a higher correlation ($r = -.09$) compared with that of male with correlation ($r = -.06$) as the Zobs - value (-.33) is in-between -1.96 and +1.96 boundary. Hence hypothesis 2 was not rejected; therefore there was no significant relationship between students' cognitive style and their achievement in physics, based on gender. This implies that female students did not perform better than their male counterparts. Having subjected students' school type to Z-test to determine if truly there was a significance difference in the relationship between students' cognitive style and their achievement in

physics, the result shows that there was no statistically significant difference in the strength of correlation between students' cognitive style and their achievement in physics in favour of public schools with a higher correlation ($r = -.08$) compared with that of private school with correlation ($r = -.06$) as the Zobs (.19) is in-between -1.96 and +1.96 boundary. Hence hypothesis 3 was not rejected; that is there was no significant relationship between students' cognitive style and their achievement in physics, based on school type. This implies that public school students did not perform better than their private school counterparts.

It was found in this study that:

1. There was no significant correlation between students' cognitive style and their achievement in physics.
2. There was no statistically significant difference in the strength of correlation between students' cognitive style and their achievement in physics, based on gender.
3. There was no statistically significant difference in the strength of correlation between cognitive style and students' achievement in physics, based on school type.

It was found in this study that there was no significant correlation between students' cognitive style and their achievement in physics. Thus, hypothesis 1 was not rejected. It implies that there was no relationship between students' cognitive style and their achievement in physics, thus, having negative impact on their achievement was largely minimal. This may be due to the fact that students had the right cognitive style but were limited in terms of instructional resources and environmental factors. This is in line with the work of Ahiauzu (2017), and Oludipe (2014) who had reported no significant correlation between students' cognitive style and their achievement. Whereas Janta (2014), Musya (2015) and Theen and Abdullahi (2008) had reported significant correlation between cognitive style and students' achievement. Thus, findings on the relationship between students' cognitive style and achievement in physics appear inconclusive.

After having subjected students' gender to Z-test to determine if truly there was a significant difference in the relationship between students' cognitive style and their achievement in physics, the result shows that there was no statistically significant difference in the strength of correlation between students' cognitive style and their achievement in physics, based on gender. Hence, hypothesis 2 was not rejected. This implies that, although no relationship existed between students' cognitive style and their achievement in physics as observed in hypothesis 1 results, female students did not

perform better than their male counterparts. This implies that being a male or female does not influence their cognitive style and achievement in physics. The reason could be added to the fact that both the males and females appreciated their active roles in the learning process, and as such, contributed to better understanding and the enhanced achievement. This finding contradicts that of Jantan (2014) and Theen and Abdullah (2008) who reported a significant difference in cognitive styles between boys and girls as girls' achievement was significantly higher than that of boys.

Having subjected students' school type to Z-test to determine if truly there was a significant difference in the relationship between cognitive style and students' achievement in physics, the result shows that there was no statistically significant difference in the strength of correlation between cognitive style and students' achievement in physics, based on school type. Hence, hypothesis 3 was not rejected. This implies that, even though no relationship existed between students' cognitive style and their achievement in physics as observed in hypothesis 1 results, public school students did not perform better than their private school counterparts. The finding of this study agrees with that of Eme (2014) who reported no significant difference in the performance of students of public and private schools. Contrarily, Olasehinde and Olatoye (2014) reported a significant difference between the performance of public and private schools students' science achievement in favour of private schools students.

4. Conclusion

Based on the findings of this study, it was concluded that senior secondary school physics students exhibit a different levels of cognitive style which could improve or mar their learning outcome, particularly, in physics. Therefore, this study concludes that, students' cognitive style cannot predict their achievement in physics.

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