

Relationships among Field Dependent/Independent, Convergent/Divergent Cognitive Styles and Academic Achievement of Secondary School Students in Rivers State-Nigeria

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Abstract

This correlational study particularly investigated the relationships among field dependent/independent and convergent/divergent cognitive styles and students' academic achievement. A sample of 1048 JSS3 students in secondary schools in Rivers State participated in the study. Three research questions and three hypotheses were designed to guide the study. The instruments for data collection were Group Embedded Figures Test and Convergent/Divergent Test. The Group Embedded Figures Test is a standard instrument used to measure field dependent/independent cognitive style. It has a coefficient of correlation of 0.75 which was established using test-retest method and Pearson product moment correlation technique. Convergent/Divergent Test is also a standard instrument for measuring convergent/divergent cognitive style of the students. Its coefficient of correlation established by test-retest method and Pearson product moment correlation technique is 0.86. The data generated from these instruments were subjected to analysis using SPSS. The results of the study revealed that (1) There was no significant relationship between field dependent/independent cognitive style and students' academic achievement ($r= 0.062$; $P>0.05$). (2) Significant relationship between convergent/divergent cognitive style and students' academic achievement existed ($r=0.886$; $P<0.05$). (3) There was a significant joint influence of field dependent/independent and convergent/divergent cognitive styles on the academic achievement of students ($r=0.886$; $P<0.05$). It was therefore recommended that teachers should recognize the cognitive styles of the students which impact on their academic performance with a view to tailoring their instructions in line with the students' cognitive styles for optimum performance.

Keywords: Field dependent/independent, convergent/divergent, cognitive, learning styles, mode of information processing, academic achievement.

1. Introduction:

The rate at which the academic achievement of secondary school students in Nigeria especially those in Rivers State is declining is really alarming (Ozordi, 2010). In spite of all the measures put in place by all tiers of government in Nigeria to ensure that there is improvement in the academic achievement of students, not much change has been done in recent times (Ozordi, 2010). This has raised a lot of questions among parents, curriculum planners, teachers, the governments and all who are in one way or the other involved in our educational system. Some researchers such as Mellet (2000) and Peterson, Louw and Dumont (2009) argued that low intelligence quotient and lack of interest in academic work among the students and little or no efforts by the students are responsible for underachievement of students.

Human cognition, including cognitive styles, is highly relevant to many important educational concerns involving teaching and learning. A variety of motivational and environmental factors influence learning, and cognition represents the core of learning process. Compared to variables such as the affective and physiological factors, cognitive styles seem to be the most relevant to those associated with academic achievement (O'Brien and Wilkinson 1992). 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. Woolfolk, (2006) refers to these differences in the mode of information processing as cognitive styles or learning styles.

Bassey, Umoren and Udida (2009) defined cognitive style as the process which is self-generated, transient, situationally-determined conscious activity that a learner uses to regulate, receive and transmit information and ultimately behaviour. It is an individual's preferred way of perceiving, processing and interpreting information. Cognitive style influences how people look at their environment for information, how they organize and interpret this information, and how they use these interpretations to guide their actions (Hansen, 1995).

Existing studies have identified or indicated various labels of cognitive styles. Notable among them are field dependence/field independent, perceptual modality preferences, divergent/convergent, and impulsive/reflective. This study was delineated to field dependence/ field independent and divergent/convergent cognitive styles. The field dependence/field independent (FDI) construct is among the most widely studied constructs. The FDI describes two contrasting ways of information processing. This cognitive style depicts individuals as being positioned along a continuum running from extreme field-dependence (FD) to extreme field-independence (FI). Those located towards the FD end of the continuum have difficulty in separating information from its contextual surroundings whereas FI individuals have less difficulty in accomplishing the same task (Ghonsooly & Eghtesadee, 2006). Field independent individuals have less difficulty in separating the most essential information from its context, and are more likely to be influenced by internal than external cues, and to be selective in their information input (Riding & Cheema, 1991).

Those with field independent trait are often thought to process information more analytically, and are sometimes more typically found in males (Liu & Ginther, 1999). Ghonsooly & Eghtesadee (2006) pointed out that students with field-independent cognitive style tend to have penchant for science disciplines, while students with field-dependent cognitive style tend towards humanitarian disciplines. Rollock (1992) also pointed that students with field-independent cognitive style have higher academic achievement than students with field-dependent cognitive style. 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. A study conducted by Bahar and Hansell (2000) on Biology students revealed that field-independent subjects have a higher working memory capacity than those who are field dependent. They also found that field-independent students could more readily sort "signal" (relevant) information from "noise" (incidental) information.

In an experimental study on the relationship of cognitive style and instructional style to the learning performance of the undergraduate students”, MacNeil (1980) investigated the relative effects of two different instructional modes, of discovery and expository, on the change in learning performance of subjects of contrasting cognitive styles, field dependent and field independent. The result of the study showed that cognitive styles (field dependence/independence) and instructional modes (expository and discovery) do not jointly interact to impact on the achievement scores of the subjects.

Blanton, (2004) worked on the influence of students’ cognitive style on a standardized reading test administered in three different formats. The data showed that no significant mean difference was found between the timed multiple-choice test scores and the constructed response test scores for field dependent and field independent students.

Lucas-Stanard (2003) investigated the nature of field dependence/field independence construct against academic achievements as well as against the thinking style construct as defined in Sternberg’s theory of mental self-government. The result of the study showed that field dependence-field independence scores were related only to students’ achievement in geometry and not in general mathematics.

Convergent thinkers score highly in problems requiring one conventionally accepted solution clearly obtainable from the information available (as in intelligence tests), while at the same time obtaining low scores in problems requiring the generation of several equally acceptable solutions. On the other hand, divergent thinking deals with the capacity to generate responses, to invent new ones, to explore and expand ideas (Child and Smithers, 1979). Convergent thinking thus demands close reasoning, fluency and flexibility (Child and Smithers, 1979).

A divergent learner is one who tends to look for unique methods and unique solutions. Such thinkers are noted for creativity or lateral thinking. This is one who tends to look for unique way of solving problems in his environment. The divergent learning style is dependent mainly on the dominant learning capacities of active experimentation and abstract conceptualization. This learning style is believed to have great advantages in decision making, problem solving, traditional intelligent tests, and practical applications of theories. Knowledge is organized in a way of hypothetical–deductive reasoning. Therefore, people with this type of cognitive style are superior in tasks and problems that are technical (Kolb, 1984). However, they are found to be inferior in matters that are social and interpersonal. Hence, students who have divergent learning style tend to prefer physical science and related disciplines where they apparently excel. They avoid social sciences and related disciplines as in these areas they do not usually do well. They tend to be superior in adapting themselves to changing immediate situations in which the plan or theory does not fit the facts. Furthermore, they also tend to be intuitive. The convergent learning style has opposite advantage to divergent learning style discussed above. This cognitive style depends on concrete experience and reflective observation. Its importance lies in imaginative abilities and awareness of meaning and values attributable to divergent thinkers and hence, it has great advantages over divergent cognitive style in this regard. People with this type of cognitive style tend to have a special capacity to organize concrete situations from different perspectives and to structure their relationships into a meaningful

whole. Rather than focus on adaptation by action, they focus on adaptation by observation. They are superior in generating alternative hypotheses and ideas, and tend to be more imaginative, people-or-feeling-oriented. They tend to make career choice in liberal arts and humanities.

Pixton (2010) conducted a study to investigate the effect of convergent/divergent cognitive style on the academic achievement of 301 Malaysian undergraduate students. The data generated were subjected to statistical analysis and the results of the study showed that divergent students had a mean academic achievement which was significantly higher than that of convergent students. Again, there was no significant interaction in academic achievement between the cognitive style (convergent/divergent) and gender.

1.1 Statement of the problem

Promotion of success in academic endeavour is the ultimate aim of any educational system. To accomplish this task, all hands must be on deck. Cognitive styles have been suggested as one of the contributing factors to students' academic success. In this era of dwindling academic fortunes of Nigerian students, it becomes imperative for secondary school teachers to understudy the students' cognitive styles with a view to tailoring their instructions in line with students' cognitive styles to enhance learning. As a contribution to the growing body of research on cognitive styles, this present study investigated the relationships among field dependent/independent, convergent/divergent cognitive styles and students' academic achievement of secondary school students in Rivers State.

1.1.1 Research questions and hypotheses

The following research questions were answered and hypotheses tested in this study. The hypotheses were tested at the requisite degrees of freedom and 0.05 level of significance.

RQ₁: What is the relationship between field dependent/independent cognitive style and students' academic achievement?

RQ₂: What is the relationship between convergent/divergent cognitive style and students' academic achievement?

RQ₃: What is the joint influence of field dependent/independent and convergent/divergent cognitive styles on the academic achievement of students?

HO₁: There is no significant relationship between field dependent/independent cognitive style and students' academic achievement

HO₂: Significant relationship between convergent/divergent cognitive style and students' academic achievement does not exist

HO₃: Significant joint influence of field dependent/independent and convergent/divergent cognitive styles on the academic achievement of students does not exist

1.1.2 Methods

This is a correlational study involving 1048 JSS3 students in Rivers State of Nigeria. The 845 registered private schools and 1139 public schools totaling 1,984 (Bureau of Statistics, Rivers State Ministry of Education, 2013)

were placed into 23 clusters based on the existing local government areas in Rivers State. Two schools were drawn from each cluster using simple random sampling technique giving a total of 46 schools. Then through the use of proportional stratified random sampling technique, 1048 JSS3 students were drawn from the schools. Two instruments including Group Embedded Figures Test (GEFT), published by Witkin, Oltman, Raskin and Karp (1971) and The Convergent /Divergent Test (Bahar, 1999) were used in this study. Group Embedded Figures Test is a standard instrument which measured field dependent/field independent cognitive style of the students. The Convergent /Divergent Test was used to determine convergent/divergent cognitive style of the students. The coefficients of correlation for both instruments were established through the use of test-retest method and Pearson product moment correlation technique. The coefficient of correlation for Group Embedded Figures Test was 0.75 while that of Convergent /Divergent Test was 0.86. The students' academic achievement consisted of junior WAEC results of the students. The data obtained were subjected to analysis using SPSS.

1.1.3 Results

RQ₁: What is the relationship between field dependent/independent cognitive style and students' academic achievement?

HO₁: There is no significant relationship between field dependent/independent cognitive style and students' academic achievement.

Table 1: Correlation coefficient between FID cognitive style and students' academic achievement

N	Df	Alpha	r _{-calculated}	r _{-critical}	Decision
1048	1046	0.05	0.062	0.007	Ho accepted

Table 1 shows that the number of student respondents is 1048. The value of calculated coefficient of correlation (r_{cal}) is 0.062. This r-value shows that there was a very low positive relationship between field dependent/independent cognitive style and students' academic achievement. The value of critical coefficient of correlation (r_{crit}) at 1046 degrees of freedom and 0.05 alpha level is 0.007. Since the calculated r-value is less than the critical r-value, the null hypothesis was therefore accepted. This implies that there was no significant relationship between field dependent/independent cognitive style and students' academic achievement.

RQ₂: What is the relationship between convergent/divergent cognitive style and students' academic achievement?

HO₂: Significant relationship between convergent/divergent cognitive style and students' academic achievement does not exist.

Table 2: Correlation coefficient between CONDIV cognitive style and students' academic achievement.

N	Df	Alpha	r _{-calculated}	r _{-critical}	Decision
1048	1046	0.05	0.886	0.062	Ho rejected

Table 2 shows that 1048 students participated in the study. The value of the calculated coefficient of correlation is 0.886. This value was an indication of high positive relationship between convergent/divergent cognitive style and students' academic achievement. The critical r-value at 1046 degrees of freedom and 0.05 level of

significance is 0.062. As the calculated r-value is greater than the critical r-value, the null hypothesis was therefore rejected. This implies that significant relationship between convergent/divergent cognitive style and students' academic achievement existed.

RQ₃. What is the joint influence of field dependent/independent and convergent/divergent cognitive styles on the academic achievement of students?

HO₃: Significant joint influence of field dependent/independent and convergent/divergent cognitive styles on the academic achievement of students does not exist.

Table 3 RQ₃: Multiple regression analysis of joint influence of FID & CONDIV on acad. Achievement.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.886	.785	.784	5.944

Table 3 shows the results of the multiple regression analysis of joint influence of field dependent/independent and convergent/divergent cognitive styles on the academic achievement of students. The obtained r-value is 0.886. This value indicates a high positive joint influence of field dependent/independent and convergent/divergent cognitive styles on the academic achievement of students. However, the joint r-value is the same as the r-value for the influence of convergent/divergent cognitive style on the academic achievement of students alone. This means that field dependent/independent cognitive style had little or no contribution on the influence of the cognitive styles on the academic achievement of students. The r-square value is 0.785. This value shows that 78.5% of variance in students' academic achievement is accounted for by or is due to the joint effect of field dependent/independent and convergent/divergent cognitive styles.

Table 4 Ho₄: ANOVA associated with multiple regression analysis

Model		Sum of Squares	Df	Mean Square	F-cal	F-crit.
1	Regression	134720.223	2	67360.111	1906.339	2.99
	Residual	36924.861	1045	35.335		
	Total	171645.084	1047			

Table 4 shows that regression mean square is 67360.111 while the residual mean square is 35.335. The calculated F-value is 1906.339 while the critical F-value at 2 and 1045 degrees of freedom and 0.05 alpha level is 2.99. The calculated F-value is greater than the critical F-value. Therefore, the null hypothesis was rejected. This implies that there was a significant joint influence of field dependent/independent and convergent/divergent cognitive styles on the academic achievement of students. The relationship between the dependent variable and independent variables is given by the model; Academic achievement=13.035- 0.006GEFT+2.483CONDIV.

1.1.4 Discussion of the Results

It was found that there was a very low positive insignificant relationship between field dependent/independent cognitive style and students' academic achievement. This finding is in line with the finding of Altun and Cakan (2006) who investigated the field dependent/independent cognitive style achievement scores and attitude towards

computer among university students using a sample of 130 undergraduates. The results obtained showed that there was no significant correlation between participants' academic achievement and their cognitive styles ($r = 0.14$; $P > 0.15$) implying that cognitive style had no significant relationship with the participants' achievement scores and that students' attitudes towards computer were not associated with their cognitive styles. The finding of no significant relationship between field dependent/independent cognitive style and students' academic achievement can be explained from the fact that field dependent/independent cognitive style is a continuum. Rating low on field dependent/independent cognitive style scale does not necessarily mean low cognitive ability, rather it may suggest low ability in science subjects but high ability in art or social science subjects. Similarly, rating high on field dependent/independent cognitive style scale does not necessarily mean high cognitive ability. It may rather suggest high ability in science subjects but low ability in art or social science subjects.

It was found that there was a high positive and significant relationship between convergent/divergent cognitive style and students' academic achievement. This finding agrees with the finding of Danili and Reid (2006) who found that convergent/divergent cognitive style correlated with pupils' performance. Divergent individuals are more critical thinkers and problem-solvers than the convergent individuals. Divergent individuals are also better in information processing. Hence, they achieve a greater academic feat than the convergent individuals.

It was also found that field dependent/independent and convergent/divergent cognitive styles had a significant joint influence on students' academic achievement. This finding can be explained from the fact that convergent/divergent cognitive style alone had a very high positive and significant correlation on students' academic achievement. The insignificant influence of field dependent/independent cognitive style was not sufficient to render the joint influence of both cognitive styles insignificant.

1.1.5 Conclusion

This study explored the relationship between each of the cognitive styles of field dependent/independent and convergent/divergent cognitive styles and students' academic achievement. It also explored the joint influence of field dependent/independent and convergent/divergent cognitive styles on the students' academic achievement. While convergent/divergent cognitive style correlated significantly with students' academic achievement, field dependent/independent cognitive style did not show much correlation with students' academic achievement, both cognitive styles had a significant joint influence on the students' academic achievement.

1.1.6 Recommendation

In view of the findings of the study, it is imperative that secondary school teachers should recognize the existence of various cognitive styles among the students. This is necessary so to select appropriate instructional methods and materials to make majority of the students to derive optimum benefits from their instructions. Cognizance should be taken of the cognitive style that correlated with the students' academic achievement with a view to tailoring instructions to match students' cognitive styles for maximum academic gains.

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