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RELATIONSHIP BETWEEN COGNITIVE LEARNING STYLES AND STUDENTS PERFORMANCE IN ALGEBRA FOR SCIENCE IN FEDERAL POLYTECHNIC DAURA, KATSINA STATE, NIGERIA

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Abstract

This study investigates the relationship between cognitive learning styles and students' academic performance in Algebra for science in federal polytechnic Daura, Katsina State, Nigeria. The study was guided with four objectives, four (4), and four (4) research questions. Co-relational Survey research design was adopted for the study. The population of the study comprised one hundred and nineteen (119) ND 11 students that offered Algebra for science in the department of Science Laboratory Technology in Federal polytechnic Daura, Katsina State, Nigeria in 2022/2023 academic session. The entire population was purposely selected as sample of the study. The instruments used to generate data for the study are Group Embedded Figures Test (Witkin, Oltman, Raskin, & Karp, (1971) cognitive Learning Styles Questionnaire was adopted and 2022/2023 first semester student's examination results in Algebra for science. Frequency and percentages was used to answer the research question, Pearson Product Moment Correlation (PPMC) was used to test hypotheses one, two, three, and T-test was used to test objective four, all the null hypotheses was tested at 0.05 level of significance. It found among other thing that field independent students perform significantly better in Algebra for science than field dependent students at Federal Polytechnics in North-West Zone, Nigeria. It concluded that cognitive learning styles significant roles in shaping academic outcomes in science laboratory technology Algebra for science that both factors play.

Keywords: Relationship, Cognitive learning styles, Students, Academic Performance, Algebra.

Introduction

The field of education is constantly evolving, with researchers and educators continuously looking for effective ways to improve learning outcomes for students. The relationship between cognitive styles and academic performance has gained considerable attention in educational research, particularly regarding mathematical discipline like algebra. Cognitive styles refers to an individual's preferred way of processing information, problem-solving, and learning. It encompasses a range of dimension including field dependent and field independent, convergent and divergent thinking, intuition versus sensing (Riding &Rayner,

2000). In the context of mathematics education, understanding cognitive styles is essential because it can influence students' approaches to learning and problem-solving, ultimately affecting their academic performance.

Algebra is foundation components of mathematics education and critical not only in higher education but also in various scientific fields. Adequate performance in algebra is often linked to greater success in science and technology education (Hersh, 2014). Consequently, identify how student's cognitive styles correlate with their performance in algebra is necessary, especially in a polytechnic setting where practical applications of mathematical principles are emphasized.

In Nigeria, the increasing emphasis on science and technology education in institutions like federal polytechnics in the North-west zone has underscore the necessity to explore the academic performance of students in subjects such as algebra (Ojo, 2016). The polytechnic system aims to develop professional skills, thus instilling a quality learning environment that can cater to diverse cognitive styles interact with their performance in algebraic concept could provide educators with insight to enhance teaching and learning methodologies and learning outcomes.

The mode and ways in which learners perceive process, organize, analyze and classify information as well as solve problems is referred to as cognitive styles. Cognitive style is a psychological concept that emphasizes the fact that individuals perceive and process information differently. In the course of learning or acquiring a new knowledge, learners come in contact with information and their cognitive style determines the most consistent way that they perceive, process, or utilize the information that they are exposed to. Learners confront learning tasks with different unique qualities or attributes which can be physical, social, and intellectual, and these qualities play very important roles in their learning. According to Zeeb (2004) cognitive style determines how individuals perceive, receive, and process information. A mismatch in learner's cognitive style and the teacher's teaching style in classroom instruction has dire implications for students' achievement and attitude. Therefore, it is important to pay attention to understanding the way people learn or process information. People learn in different ways; therefore, there are different cognitive style dimensions. Stapa (2003) posited that teaching effectiveness is incomplete without the knowledge of certain learners' traits such as cognitive style and learning preferences. Some of the common cognitive style dimensions are field divergent/ convergent, field-dependent/independent, holistic/sequential, and reflective/impulsive. However, the focus of this study is on the global/analytic cognitive style dimension. Learners with the analytic cognitive style need to break the processing of information into its component parts while global learners will have to view the task as a whole before proceeding to construct meaning.

Different categories of cognitive styles exist and some of them are, Scanning-Focusing, Verbalizer- Visualizer, Deep elaborative-Shallow reiterative, Holist-Surrealist, Divergent-Convergent, Field dependent- Field independence, Holist/Analyst-Verbal imager, Global-Analytical, Cognitive Complexity-Cognitive simplicity, Impulsive-Reflective, Simultaneous Successive, Leveler-Sharpener, Objective-Non-objective, Organizer-Non organizer, Right–Left brained, Sensitizer– repressors, Verbalizer-Imager (Shi, 2011). Field independence learners are better at learning abstract subjects; they have sequential abilities that enable them

to perceive information easily, break up organized perceptual fields, analyze things critically, articulate their experience, and prefer to be individualistic. Field dependence learners are the opposites of the field independence types. They have holistic and global approaches toward problems and have global perceptions. They have high social orientation, social interest, and favor structure and are easily influenced by negative reinforcement.

Rothesian in Hamza A.H (2021) Academic performance refers to an achievement in a particular subject area of study in a given school by professional teachers. Students' academic in is determining by students of cognitive, affective and psychomotor domains, achievement teaching and learning process.

Statement of the Problem

Algebra for science is a field of Mathematics that describes a way to think about certain relationships that will involve numbers. It is a course offered in department of the science laboratory in school of science for the attainment of National Diploma. The performances of students in Algebra for science continued to decline yearly in polytechnics. It was noted by the researcher that only few students performed well in in Algebra for science. This poor performance was a major concern of teachers, researchers, and curriculum planners, because if the trend continued unchecked and untreated, students may lose interest in Algebra for science. Vundi, Nasango, and Majanga (2011) have observed that there is a decline in students' performance in Algebra for science. In confirmation of this statement, the researcher's preliminary investigation of the performance of departments Science laboratory that offered Algebra for science in polytechnics in North-west Zone, Nigeria revealed its poor status.

One of the probable causes of students' poor performance in Algebra for science may be attributed to the learning styles adopted by the students in learning. Performance is determined by many factors and learning styles may be among them. Vaishnav (2013) established that learning styles had significant input on students' performance. However, Tight (2007) reported that students' performance had no significant relationship with their learning styles. There is, therefore, conflicting arguments in the literature on the relationship between learning styles and students' academic performance.

Based on this problem, therefore, the researchers carried out a research on the relationship between cognitive learning styles and students' performance in Algebra for science in Federal Polytechnics in North-west Zone, Nigeria.

Objective of the Study

The specific objectives were to:

1. Classify the students into field-dependent and field in dependent in federal
2. Asses the relationship between field dependent cognitive learning style and science laboratory students' performance in Algebra for science in federal polytechnic Daura, Katsina State Nigeria.
3. Asses the relationship between field independent cognitive learning style and science laboratory students' performance in Algebra for science in federal polytechnic Daura, Katsina state Nigeria.

4. Establish the difference in the performance of science laboratory in Algebra for science who adopts field dependent cognitive learning style and Field independent cognitive learning style in federal polytechnic Daura, Katsina state Nigeria.

Research Hypotheses

The following research Hypotheses were raised for the study:

H01. There is no significant relationship between field dependent cognitive learning styles And science laboratory students' performance in Algebra for science in federal Polytechnics in North-west zone Nigeria.

H02. There is no significant relationship between field independent cognitive learning styles And science laboratory students' performance in Algebra for science in federal Polytechnics in North-west zone Nigeria?

H03. There is no significant difference in the performance of science laboratory in Algebra For science who adopts field dependent cognitive learning style and Field independent Cognitive learning style in federal polytechnics in North-west Zone, Nigeria?

Methodology

Correlational survey research design was adopted for the study. The design establishes the relationship that exists between two or more variables. The population of the study comprised one hundred and nineteen (119) ND 1 students that offered Algebra for science from the federal polytechnics Daura, Katsina state Nigeria 2022/2023 academic session. The entire population were purposely selected as sample of the study. Two instruments were used for data collection. The first instrument is The Group Embedded Figures Test (Witkin, Oltman, Raskin, & Karp, (1971) cognitive Learning Styles Questionnaire. The questionnaires are used to classify students field dependent field independent and. The second instrument for the study was the 2021/2022 first semester of student's examination results in Math's 113- Algebra for science. The data obtain from the science and laboratory departmental record office of each department. In the first stage of the data collection, the researcher was administer the Group Embedded Figures Test (Witkin, Oltman, Raskin, & Karp, (1971) cognitive Learning Styles Questionnaire to the ND II students from federal polytechnics. In the next stage of the data collection, the researcher collected 2022/2023 ND 1 result federal polytechnic Daura student's academic performance in Algebra for science from the head of the general studies department in federal polytechnic Daura, Katsina state, Nigeria. The researcher employs the service of four research assistants in the data collection. The data collection lasted for a period of two (2) months. The data collected are subjected to statistical analysis. Objective one and research question was answered using frequency and percentages, while research question 2,3 and four were answered using mean and standard deviation and null hypotheses two, three will be tested using Pearson product moment correlation (PPMC) and four are tested using t-test e, all the hypothesis were tested at 0.05 level of significance.

Result

Table 1: Classification of OTM Students Based on the Cognitive Styles

Cognitive Styles	POLYTECHNIC						Frequency	Percentage
	FPDRA	FPKB	KAD POLY	HAF	FPKN	WUF		
Field Dependent	55	35	140	40	27	30	327	72.8
Field Independent	18	18	10	15	61	6	128	28.2
Total	**73**	**53**	**250**		**88**	**36**	**455**	**100**

The analysis in Table 1 indicated that 119 students (72.8%) adopted field dependent learning style, 125 (28.2%) adopted field independent learning style a. This implies that OTM students adopted all the two (2) learning style in learning word processing, with those students who adopted field independent learning style as the majority.

Table 2: PPMC Test of Relationship between Field Dependent and science Laboratory Students' performance in Algebra for science in federal Polytechnics in North- west zone Nigeria.

Variable	N	Mean	Std. Dev.	R	P value	Decision
Field Dependent	119	3.19	0.39	0.145	0.087	Not sign
Academic performance		46.09	15.15		.	

The analysis of data in Table 3 used to test null hypothesis one revealed the result of the Pearson Product-Moment Correlation showed that there was **no significant relationship** between field dependency and science laboratory students' performance in Algebra for science in federal Polytechnics in North-west zone Nigeria., $r(198) = 0.145$, $p > 0.05$. This suggests that students' cognitive style (field dependent) does not significantly influence their performance in science laboratory.

Table 4: PPMC Test of Relationship between Field Independent and science Laboratory Students' performance in Algebra for science in federal Polytechnics in North- west zone Nigeria.

Variable	N	Mean	Std. Dev.	R	P value	Decision
Field independent cognitive style	125	3.39	0.49	0.149	0.090	Retain
Academic performance		46.41	15.32			

Source: Field Study, 2025.

The analysis of data in Table 3 used to test null hypothesis one revealed the result of the Pearson Product-Moment Correlation showed that there was **no significant relationship** between field independency and science laboratory students' performance in Algebra for science in federal Polytechnics in North-west zone Nigeria, $r = 0.149$, $p > 0.05$. This suggests that students' cognitive style (field dependent) does not significantly influence their performance in science laboratory students' performance in Algebra for science.

Hypothesis Four: There is no significant in the Mean difference between field dependent and field independent on academic performance in the performance of science laboratory in Algebra for science.

Table 5: There is no significant in the Mean difference between field dependent and field independent on academic performance in the performance of science laboratory in Algebra for science

Variables	N	Mean	SD.	DF	T	P	Remark
Field dependent	119	3.19	0.90	118	3.66	<00.001	Significant
Field independent	125	3.60	0.85				

Source: Field Study, 2025.

The Table 5 presented the t-test of field dependent and field independent. From the result the t-test calculated the independent samples t-test showed a statistically significant difference between field dependent and field independent students' academic performance in Algebra for science, $t(118) = 3.66$, $p < 0.001$. This suggests that field independent students perform significantly better in Algebra for science than field dependent students at Federal Polytechnics in North-West Zone, Nigeria.

Discussion of Findings

The finding of test of null hypothesis one showed that there was no significant relationship between visual learning style and science laboratory students' performance in Algebra for science. The finding was in agreement with Adepoju and Olalekan (2023) found that field-independent learners exhibited significantly better performance in digital content creation and calculation due to their enhanced ability to concentrate and navigate software environments without external support.

The finding of test of null hypothesis one showed that there was no significant relationship between field dependent and science laboratory students' performance in Algebra for science. The finding was in agreement with the results

The finding of test of null hypothesis two showed that there was no significant relationship between field independent and science laboratory students' performance in Algebra for science. The finding was in agreement with that of Ugwu and Eze (2024) noted that cognitive learning styles significantly influence students' proficiency in Algebra applications, with field-independent students displaying stronger competence in mathematical operations like Algorithrism, where autonomy and abstract thinking are advantageous.

This suggests that both field-dependent and field-independent learners can achieve comparable outcomes in algebra for science when provided with equal access to resources and instructional support. Hence, educators should focus more on inclusive teaching strategies and hands-on learning opportunities rather than adapting instruction solely based on cognitive style distinctions.

The finding that there is a significant difference in the mean scores between field-dependent and field-independent Science Laboratory Technology (SLT) students in Algebra for science suggests that cognitive style plays a critical role in how students engage with and perform in technology-driven tasks. The finding of test of null hypothesis five showed that there was significant difference between field dependents and field independents science laboratory students' performance Algebra for science. The finding was in agreement with that this outcome aligns with prior research showing that field-independent students typically outperform their field-dependent counterparts in tasks requiring independent judgment, spatial manipulation, and calculation task tool usage. For example, a study by Adepoju and Olalekan (2023) found that field-independent learners exhibited significantly better performance in digital content creation and calculation due to their enhanced ability to concentrate and navigate software environments without external support.

Additionally, Ugwu and Eze (2024) noted that cognitive learning styles significantly influence students' proficiency in Algebra applications, with field-independent students displaying stronger competence in mathematical operations like Algorithrism, where autonomy and abstract thinking are advantageous.

These findings are significant for instructional design. They suggest the need for differentiated learning approaches that provide structured support for field-dependent learners while challenging field-independent learners with more open-ended, autonomous tasks. Integrating collaborative learning or guided tutorials could help bridge the gap in performance between the two cognitive styles.

Field-independent learners are generally more analytical, self-reliant, and better at problem-solving in structured environments such as word-processing software, where users must make decisions, format documents, and apply rules independently. In contrast, field-dependent learners tend to rely more on external cues and social contexts, which may limit their performance in highly individualized digital tasks like word processing.

Conclusion

Based on the analysis of data collected on cognitive learning styles and personality traits in relation to students' performance in Algebra for science, the study concludes that both factors play significant roles in shaping academic outcomes in science laboratory technology.

Recommendations

The following recommendations were made based on findings of the study:

1. Educators and curriculum developers are encouraged to integrate differentiated instructional approaches, including adaptive learning technologies and collaborative activities, to support both field-dependent and field-independent learner's students. Doing so

can contribute to improving learning outcomes and better preparing graduates for the demands of modern science application.

2. Policymakers and curriculum developers are encouraged to integrate differentiated instructional approaches, including adaptive learning technologies and collaborative activities, to support both introvert and extrovert students.

3. Diversify Teaching Strategies beyond Learning Style Considerations by Adopt a blended teaching approach (e.g., combining demonstration, hands-on practice, collaborative learning, and individual tasks) that benefits all learners regardless of their cognitive style. Moreover, Integrate **universal design for learning (UDL)** principles to ensure content is accessible and engaging for a broader range of learners.

4. The stakeholders in Federal Polytechnics should avoid tailoring curriculum solely around field-independent learning assumptions, and instead create a flexible, inclusive environment that supports the varied cognitive styles of all science laboratory students to improve in Algebra for science.

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