Innovations

Effect of Field-Independent and Field-Dependent Cognitive Styles and Gender on Students' Academic Achievement in Basic Technology in the Basic Secondary School Level in Lagos State, Nigeria

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Abstract: *The study investigates the effect of Field-Independent and Field-Dependent Cognitive Styles and gender on Students' Academic Achievement in Basic Technology in the Basic Secondary School Level in Lagos State, Nigeria. Out of 353 public schools across 20 Local Government Areas (LGAs) in Lagos State with population of 374,717, Nigeria. A quasi experimental design was used for the study. Using multistage random sampling techniques involving stratification and purposive random sampling. Four hundred and sixty-eight (468) Basic 8 (JSS 11) students which comprised 213 males and 255 females in the three selected schools participated in the study. Three classes were selected Basic 8A ,8B and 8C in each school. Two research questions were posed and two hypotheses were formulated and tested at the 0.05 level of significance. The instrument used for data collection was the* Cognitive Style Test (CST).*The CST was validated by Siegel (1967) which was modified ,validated and used by Onyejiaku (1982). The reliability of the Cognitive Stle Test using Pearson Product moment correlation coefficient techniques was 0.98. Data collected were analyzed using mean and standard deviation to answer the research questions, while ANOVA was used to test the hypotheses. The findings revealed that Field Independence (FI) students significantly outperformed their Field Independence (FD) peers in Basic Technology, Also, cognitive style is gender sensitive. The students' academic achievement employing cognitive style method in basic technology was in favour of the males. In the whole, there a significant effect of cognitive style and gender on students' academic achievement in Basic Technology. Based on the findings, it was recommended among others that there is need for teachers to recognize and respond to individual learning styles especially in supporting FD learners through structured feedback and differentiated instruction. It also encourages curriculum developers to design more inclusive strategies that foster independence and engagement across learning styles. By moving beyond gender stereotypes and focusing on cognitive diversity, educators can unlock greater potential in every student. It was also recommended adopting mixed instructional strategies and strengthening teacher training to meet diverse cognitive needs.*

Keywords: *Basic Technology, Cognitive Styles, Field Independence-Field Dependence Styles, Gender, Academic Achievement.*

Introduction

Education today is a transformative force, shaping individuals not just intellectually, but socially, emotionally, and technologically. It goes beyond the traditional delivery of knowledge to involve the development of critical thinking, creativity, and digital competence needed to function effectively in an increasingly complex and interconnected world (UNESCO, 2021; Biesta, 2020) Learning has expanded beyond classroom walls, encompassing formal, non-formal, and informal experiences, and involving interaction with teachers, technologies, communities, and global systems (Anderson & Dron, 2014; OECD, 2023). Recognized as vital tool for global development, education is central to achieving sustainable goals. The United Nations Sustainable Development Goal 4 (SDG 4) emphasizes inclusive, equitable, and quality education as a means to foster gender equity, economic empowerment, and innovation (UNESCO, 2021). In line with this, Nigeria's 9-3-4 education system offers nine years of Basic Education—six years of primary and three years of junior secondary (FRN, 2012). It is during this Basic Education phase that Basic Technology is taught at the junior secondary school level.

Basic Technology is a foundational subject designed to blend theoretical knowledge with practical skills. It exposes students to mechanics, electronics, energy systems, materials, and introductory digital tools, and serves as an early platform for Science, Technology, Engineering, and Mathematics (STEM) engagement (Okorie & Uche, 2021; Iwuanyanwu & Nwachukwu, 2022). It also aligns with national objectives to promote employability, innovation, and entrepreneurship among youth (FRN, 2013; Eze & Eze, 2021). As the global economy evolves, curriculum reforms in Nigeria now emphasize integrating emerging technologies such as coding, robotics, and computer-aided design (CAD) into the Basic Technology syllabus. These innovations are meant to strengthen digital literacy and ensure that education responds to the realities of modern work and life (Aina & Ogunlade, 2023; Audu, Idris, & Bawa, 2019). However, for these reforms to succeed, learners' individual cognitive differences must be acknowledged especially their cognitive styles.

Cognitive style has long been recognized as a critical factor in shaping how learners perceive and interact with their environment (Siegel, 1967). In the Nigerian context, Onyejiaku (1982) emphasized that adolescent learners bring distinct psychological and developmental traits to the classroom, which influence their academic engagement and learning outcomes. As Sternberg (2014) explains, students differ in how they perceive and solve problems, and these differences often affect how well they perform in different subjects. One key model of cognitive style is the Field Dependence–Field Independence (FD/FI) theory developed by Witkin (1977). It describes learners who are Field-Independent (FI) as those able to separate details from a surrounding context, while Field-Dependent (FD) learners rely more on external cues and are more socially oriented (Blanton, 2004). FI learners typically thrive in tasks that require analysis and self-direction. They are more autonomous, competitive, and perform better in loosely structured learning

environments—especially in science and technical subjects (Joseph, 2015). In contrast, FD learners prefer structure, collaboration, and teacher support. They may struggle when required to organize or interpret complex information independently but tend to do well in group-oriented and highly structured instructional settings. Understanding these cognitive styles is critical for improving students academic achievement. Therefore, Cognitive style can be refers to the consistent way individuals process, organize, and respond to information.

Another variable that was considered for investigation is gender. It is a short form of complex variable system of social differential between male and female found in a society or community. Gender is a socially constructed concept that encompasses the roles, behaviors, identities, and relations attributed to individuals in society. Unlike biological sex, gender is dynamic, context-dependent, and may exist beyond the male–female binary (Canadian Institutes of Health Research [CIHR], 2020; Westbrook & Saperstein, 2015).

Steinmayr et al., (2014) defined academic achievement as the extent to which students meet established learning goals . According to Eze (2014), academic achievement includes students' acquisition of knowledge and skills needed for further education or vocational may underperform. In a subject like Basic Technology, where both theoretical understanding and hands-on problem-solving are essential, cognitive style can significantly affect learning outcomes. FI students may naturally excel due to their analytical and independent approach. FD students, however, may require more teacher guidance and supportive learning environments to thrive. The goal is to provide insights that help educators and curriculum planners tailor instruction to accommodate diverse learning needs, promote equity, and enhance overall student performance in technical education.

This study investigate the effect of Field-Dependent (FI) and Field-Independent (FD) cognitive styles and gender on students' academic achievement in Basic Technology at the junior secondary level in Lagos State.

Review of Related Literature

The Field Dependence–Independence (FD/I) cognitive style theory, introduced by Witkin, Moore, Goodenough, and Cox (1977), remains an influential framework in understanding how students perceive and process information. In today's increasingly digital and learner-centered classrooms, exploring how FD/I styles impact academic performance especially when intersecting with genderhas become vital for inclusive and effective instruction (Zhang & Sternberg, 2020; Chen, 2021). Field-Independent (FI) learners are often analytical, self-directed, and comfortable with abstract reasoning and complex tasks that require minimal guidance. Field-Dependent (FD) learners, by contrast, are more socially attuned and perform better in structured, collaborative settings where external cues support their learning (Scharf & Cornoldi, 2020). These cognitive orientations shape how students engage with different subjects and learning environments.

Research shows that FI learners tend to perform better in STEM and logic-intensive areas. Aydin and Yildirim (2022) found that FI students in Turkish science classrooms outperformed their FD peers in critical thinking tasks. Similarly, Chen and Hung (2021) reported that FI learners excelled in digital math platforms due to their self-regulation and problem-solving skills. These findings reinforce the cognitive advantage of FI learners in independent, tech-driven environments. Nonetheless, FD learners exhibit strengths in communication-heavy and socially interactive contexts. Bakare and Ogundele (2023) observed that FD students in Lagos secondary schools performed better in literature and oral communication tasks, likely due to their interpersonal learning preferences. Saeed, Hussain, and Ahmed (2020) also found that FD students thrived in cooperative learning, particularly in humanities and social sciences.

With the rise of digital education accelerated by the COVID-19 pandemic, cognitive style has gained even greater relevance. Zhang and Zhan (2023) noted that FI learners adapted more easily to remote learning, while FD students struggled with reduced peer interaction and guidance. Yusuf and Ajayi (2022) stressed the importance of blended learning in Nigerian schools, where both cognitive styles are supported through a mix of autonomous and collaborative methods. Technological advancements have also introduced adaptive learning platforms powered by artificial intelligence, which tailor content to students' cognitive styles. Liu, Ma, and Zhang (2023) demonstrated that such platforms significantly improved engagement and academic performance by adjusting instructional pace and structure to match learners' FD/I profiles. These innovations signal a shift toward more personalized education.

Gender also plays a crucial role in shaping academic outcomes, often intertwined with cognitive style. While boys tend to excel in mathematics and technical subjects, girls generally perform better in language-based disciplines is a pattern driven more by cultural norms and access disparities than by ability (UNESCO, 2021; Chen, 2022). Aina and Olayemi (2021) confirmed these trends in Nigerian schools, where boys outperformed girls in Basic Technology, and girls led in English and Social Studies. The interaction of gender and cognitive style further influences learning outcomes. Musa and Salihu (2021) found that male FI learners achieved higher results in technical education, especially in hands-on design and fabrication. In contrast, Obi and Alabi (2022) reported that female FD learners performed best in cooperative assessments within the social sciences.

Overall, the literature emphasizes the importance of recognizing and addressing cognitive and gender-based differences in instructional design. Doing so will help foster equity, engagement, and meaningful learning outcomes in an increasingly complex educational landscape.

Statement of the Problem

Despite the Federal Government of Nigeria's directive in the National Policy on Education (FRN, 2013, revised), which designates Basic Technology as a core subject in junior secondary schools to foster critical thinking and technological innovation, students' performance in the subject remains alarmingly low. Basic Technology was intended to nurture problem-solving skills and a mindset capable of supporting Nigeria's technological development. However, this vision is undermined by declining academic achievement across the education system. Recent statistics from WAEC and NECO (2020) reveal widespread underperformance, with only 28% of candidates in Lagos State passing Basic Technology with higher grades in the 2020 Basic Education Certificate Examination (BECE). This persistent underachievement raises concerns about the effectiveness of current teaching strategies. Relying solely on conventional methods may overlook the diversity in how students perceive and process information. Ndudi and Mkpa (2003) argue that instruction must align with students' cognitive styles to enhance learning outcomes. By recognizing Field-Independent and Field-Dependent learners' unique needs, teachers can tailor instruction more effectively. Therefore, this study investigates the effect of Field-Independent and Field-Dependent cognitive styles on students' academic achievement in Basic Technology at the junior secondary level in Lagos State, aiming to offer strategies for more inclusive and effective pedagogy.

Significance of the Study

The study will help basic technology teacher to be more aware of the students' cognitive style so that they can be able to differentiate between field independence and dependence students and helps the field dependence student through feedback. Also, the study would help curriculum planners and administrators develop better instructional methods to help field dependence students to become independent.

Purpose of Study

The purpose of the study is to investigate the effect of Field-Independent and Field-Dependent Cognitive Styles and gender on Students' Academic Achievement in Basic Technology at the Junior Secondary School Level in Lagos State, Nigeria.

Specifically, the purpose of the study is to:

- Determine the effect of field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology?
- Find out if gender have effect on field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology

Research Questions

- What are the effect of field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology?

- What effect does gender have on field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology?

Hypotheses

The following hypotheses were formulated and tested at 0.05 significance level:

H_{01}: There is no significant effect of field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology.

H_{02}: There is no significant effect on basis of gender in field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology.

Research Methodology

Research Design

The study used a quasi- experimental design. It investigated the effect of Field-Independent and Field-Dependent Cognitive Styles and gender on Basic 8 Students' Academic Achievement in Basic Technology in Lagos State, Nigeria. Specifically, it made use of 2x2x2 non-randomized pre-test, post-test design.

Area of the Study

The study was conducted in Lagos State, because demography of Lagos State plays a vital role in the Nigerian economy and as a nation's commercial nerve centre, remains the economic, financial and commercial centre of Nigeria and the ECOWAS. Lagos economy, with an estimated population around17.2million is larger than any other economy in the ECOWAS sub-region. It is also the hub of Nigeria and West Africa's regional financial system, which is dominated by mega banks, insurance firms, micro-finance/community banks; discount houses; and the capital market. Lagos state houses people of diverse culture and ethnic background. It was expected that data (information) from children of multi-cognitive background and different perspective reason will be gather because the state accommodates school of different philosophical projections and academic objectives that would produce students of varied academic background. The study deem suitable to be conducted in a state housing multi cognitive background.

Population of the Study

The population of the study consists of 374,717 Basic Secondary schools students in Lagos State, which comprises184330 boys and 190387 girls. All the students in Basic 8 (JSS 11) classes use the National Basic Technology Curriculum produced by Federal Ministry of Education (2020).

Sample and Sampling Techniques

The researchers used stratified random sampling and purposive random sampling for the study. From the population of 374,717 Basic Secondary schools students in

Lagos State, a total of 468 Basic 8 (JSS 11) basic technology students were selected for the study. Three co-educational Basic secondary school were selected. First, the school were stratified according to their geographical locations in the Two Local Government Areas (Ojo and Badagry LGAs). One school from the south, one from west part of OJO LGA and one from East part of Badagry LGA. In each school,156 Basic 8 students offering basic technology were selected. In all the school selected, the Basic 8A ,8B and 8C were purposively selected from the school respectively. In all a total of 228 males and 240 females students who study basic technology were sampled. All the school selected operate the same scheme of work provided by Lagos State Ministry of Education. The subjects of the study were one intact class of Basic 8A ,8B and 8C Basic Technology students with average age of 9-11 years. Three classes in each school were selected and assigned for the experimental.

Instruments for Data Collection

Two research instruments were used for the study. These are:

1. Pre-Test (Pre CST)

The test was to measure how students choose a set of drawing of common objects for the purpose of classifying them. The cognitive style test comprised of 20 sets of triad familiar pictures. The students were made to match any two of the pictures in each set. For instance a bus, pick-up car and a standing man (Fig. 1). An analytic subject may group bus and pick-up car together because both have four wheels or inferential subject may group and label as a means of transportation. Relational subject may group man & pick-up car or bus, here the two stimuli are not conceptually independent as the subject uses the whole stimuli (a man can drive a pick-up car or be a passenger in the bus) and another object to make an independent functional relationship instead of the formation of concept. Also, a wristwatch, a man and a ruler (Fig. 2). The students were required to look at the pictures carefully and select two items that belong together. The students were expected to write down the reason for grouping them. The subjects (respondents) were labeled as either field dependent or field independent depending on the pairing of the set of pictures.

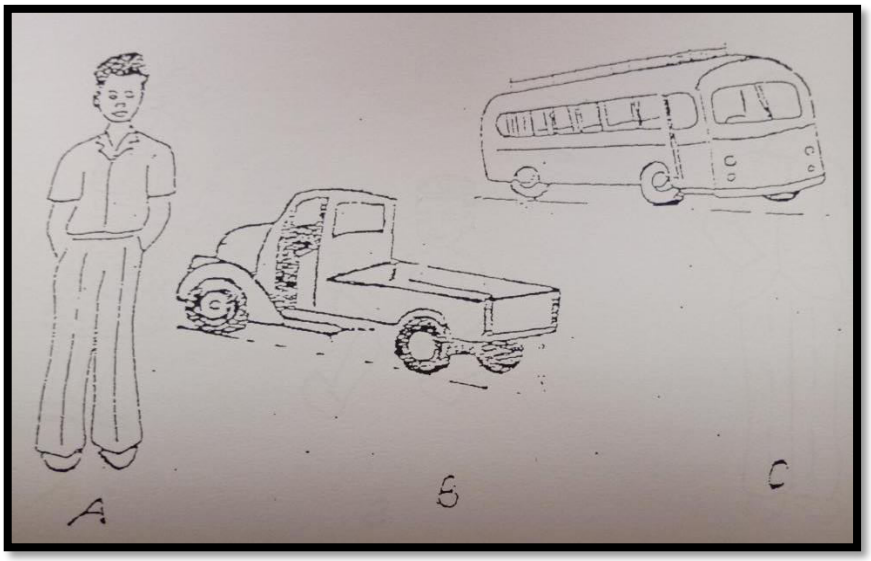

Fig. 1

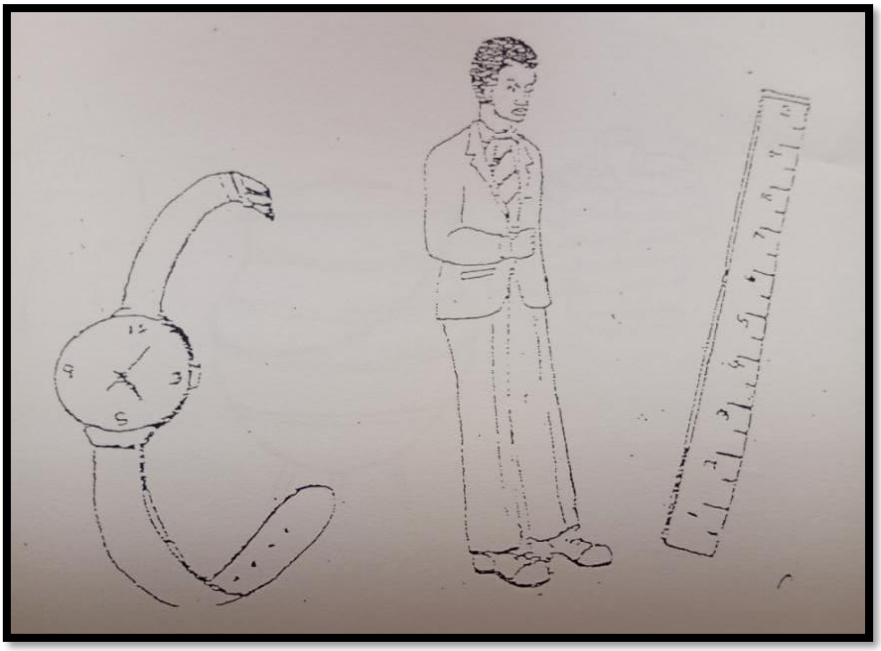

Fig. 2

2. Post-Test (Post CST)

The students were classified as Field Independence and Field Dependence according to the matching of the 20 triad pictures presented after shuffling of the test materials. The time allowed for the test items was 40 minutes for CST. The test materials will be given to the student. The test item will be collected exactly 40

minutes. The students were required to observe the pictures carefully and select the items that belong together and were expected to write down the letters that are under the items group together and then write down the reason for grouping them. The cognitive style test will be used to classified the students as either Field Independence (FI) or Field Dependence (FD) depending on he pairing of the set of pictures. The test was used to measure how students choose and analyse a set of drawings of common objects.

Validation of the Instrument

The Cognitive Style Test was validated by Siegel (1967) which was modified ,validated and used by Onyejiaku (1982).

Reliability of the Instrument

In establishing the reliability of the Cognitive Stle Test using Pearson Product moment correlation coefficient techniques was employed and coefficient reliability estimate of r= 0.98 was established for the cognitive style test..

Experimental Procedure

Permission was obtained from the authorities of the schools involved to allow the participation of their students and teachers in the study. In the first week, the researchers visited the schools to explain the purpose of the study and how it would be conducted. In the second week, a pretest was administered with the help of research assistants to determine the students' initial abilities before the experiment. In the fifth week, a posttest was administered by the students' regular class teachers, to maintain familiarity and comfort for the students. To effect and provoke cognition ability of the students, the number of the pictures was re-shulfffled and pictures position changed. This was done to authenticate on the students knowledge avoiding simple recall. This provided posttest data for each dependent variable. Research assistants supervised the test, marked the scripts, recorded the scores, and made the results available to the researchers.

Scoring of Cognitive Style Test

Each student scored a maximum of 1 mark for each triad as Field Independent and Field Dependent. In this case, each student would have a score as Field Independent or a score separately for Field Dependent depending on the reason for grouping of the objects. With these scores, students grouped under analytical/inferential are labelled Field Independent (FI) and those group under relational are Field Dependent (FD).

Control of Extraneous Variables

In other to minimize influence of memory and forgetfulness, the researcher made sure the time lag between pretest and posttest on cognitive style test is average of four weeks. This help to reduce the effect of history and also control the pretest sensitization. The items were re-shuffled and the numbers of the instrument were re-

arranged before using for posttest to avoid the students feeling they were being retested.

Method of Data Analysis

The data were generated on 468 (213 males and 255 females) basic 8 basic technology students in Lagos state. Data collected were analyzed using mean and standard deviation to answer the research questions, while ANOVA was used to test the hypotheses at 0.05 level of significance.

Results and Discussion

RQ1: What is the effect of field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology?

Table 1: Mean and Standard Deviation of the effect of field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology?

Method	N	Pretest mean	Standard Deviation	Posttest mean	Standard Deviation	Mean Gain	Remarks
Field Independent	468 (Male = 213 and Female = 255	9.85	3.13	12.75	3.41	2.90	Positive effect
Field Dependent Cognitive Styles		9.15	3.02	10.29	3.21	1.14	

Source: Field Survey, 2025.

Table 1 shows pretest mean score of 9.89 and posttest mean score of 12.75 with a mean gain of 2.90 and corresponding standard deviation of 3.13 and 3.41 respectively for Field Independent. The dependent cognitive style in their parts had a mean achievement score of pretest mean score of 9.15 and posttest mean score of 10.29 with a mean gain of 1.14 and corresponding standard deviation of 3.02 and 3.21 respectively. The result reveals positive effect of cognitive style on the academic achievement of basic technology of junior secondary school students.

RQ2: What effect does gender have on field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology?

Table 2: Mean and Standard Deviation of gender effect on field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology?

Sourses Variation	N	Pretest mean	Standard Deviation	Posttest mean	Standard Deviation	Mean Gain	Remarks
Male Students	213	19.34	4.40	24.02	4.90	4.88	Positive effect
Female Students	255					2.34	
Mean Difference		21.43	4.63	23.77	4.87	2.54	
Total	468						

Source: Field Survey, 2025.

The results from Table 2 reveal notable gender differences in students' academic achievement in basic technology based on field-independent (FI) and field-dependent (FD) cognitive styles. It shows pretest mean score of 19.34 and posttest mean score of 24.02 with a mean gain of 4.88 and corresponding standard deviation of4.40 and4.90 respectively for Field Independent. The dependent cognitive style in their parts had a mean achievement score of pretest mean score of 21.43 and posttest mean score of 23.77 with a mean gain of 2.34 and corresponding standard deviation of 4.63 and 4.87 respectively. The result reveals positive effect of gender on the academic achievement of basic technology of basic secondary school students. Indicating that male students outperformed their female counterparts in tasks requiring autonomy and self-directed learning. On the other hand, female students achieved a higher dependent mean score suggesting that female students performed better in structured and guided learning situations. This descriptive trend highlights that while males tend to excel under independent learning conditions, females show greater achievement when learning is scaffold or collaborative.

Hypothesis 1: There is no significant effect of field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology.

Table 3: ANOVA Test on there is no significant effect of field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology.

Model	Sum of Squares	Df	Mean Squares	F-cal	Ftab	Sig	Decision
Regression	573.903	2	286.952	12.884	3.06	0.000	H_{01}Rejected
Residual	3407.655	153	22.272				
Total	3981.558	155					

Source: Field Survey, 2025.

Table 3 shows that the F- calculated 12.884 which was significant at 0.000 in both tests are found to be greater than F-tabulated 3.06 at df 2/153 at probability level 0.05, thus, the hypothesis that states there is no significant difference in the academic achievement of field-independent and field-dependent students in Basic Technology is rejected. This result implies that field independent and field dependent cognitive style has significant effect on Basic secondary school (JSS II) students' academic achievement in basic technology with field independent students' out performing their field dependents counterparts.

Hypothesis 2: There is no significant difference on basis of gender on field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology.

Table 4: ANOVA test of there is no significant difference on basis of gender in field-independent and field-dependent cognitive styles on Basic 8 students' academic achievement in Basic Technology.

Model	Sum of Squares	df	Mean Squares	F	Sig	Decision
Regression	7.823	2	2.608	0.122	0.947	Ho2 Rejected
Residual	3245.170	153	21.350			
Total	3252.994	155				

Source: Field Survey, 2025.

Table 4 shows that the f-value = 0.122 at df 2/153 at which significant Value of 0.947 was determined at P= 0.05. Thus, the hypothesis 2 of there is no significant difference in the academic achievement of field-independent and field-dependent students' in Basic Technology based on gender is rejected. This implies that there is difference but slightly in the field independent and field dependent cognitive style and gender on academic achievement of basic technology students' in basic secondary school in Lagos State.

Discussion

The results of Hypothesis 1 revealed a clear and significant difference in the academic performance of field-independent (FI) and field-dependent (FD) students in Basic Technology, with FI learners outperforming their FD counterparts ($F = 12.884$, $p = 0.000$). This finding reflects existing research showing that FI students excel in tasks that require independent thinking, problem-solving, and cognitive flexibilityskills that align well with the technical demands of Basic Technology (Aydin & Yildirim, 2022; Chen & Hung, 2021; Witkin et al., 1977).

FI learners' ability to work independently and process abstract concepts gives them an edge in environments where self-direction is key. This is especially relevant in Nigeria's transition toward digital and competency-based curricula in secondary schools (Yusuf & Ajayi, 2022). Technologies that require minimal collaboration, like AI-driven platforms, tend to favor these learners (Liu, Ma, & Zhang, 2023).

However, FD learners bring different strengths to the table. Research shows they perform better in collaborative settings and socially rich tasks, such as group discussions and contextual learning (Saeed, Hussain, & Ahmed, 2020; Bakare & Ogundele, 2023). Unfortunately, Basic Technology tends to be more individually structured, which may not fully support FD learners' strengths, contributing to their lower achievement.

The analysis of Hypothesis 2 indicated no statistically significant difference in achievement between FI and FD learners based on gender ($F = 0.122$, $p = 0.947$). This suggests that while gender-related differences exist, they are not strong enough to meaningfully affect outcomes. Scholars like Chen (2022) and UNESCO (2021) argue that gender gaps in academic achievement often stem from social and environmental influences like stereotypes or unequal access to learning tools rather than ability.

Although boys are often seen leading in STEM, this study shows that cognitive styleplays a more critical role than gender in shaping student success in Basic Technology. For example, Musa and Salihu (2021) found male FI students excelled in practical tasks, while Obi and Alabi (2022) reported success among female FD learners in cooperative learning environments.

In the final analysis, the real issue lies not in gender, but in how well teaching methods align with students' thinking styles (Zhang & Sternberg, 2020; Zhang & Zhan, 2023). Recognizing and addressing this cognitive diversity is key to improving learning outcomes for all students

Conclusion

This study reveals that cognitive style specifically field-independence (FI) or field-dependence (FD) significantly influences students' academic achievement in Basic Technology. FI learners outperformed their FD counterparts, likely due to their

ability to engage in abstract thinking and independent problem-solving, which aligns well with the demands of the subject. FD learners, who excel in structured, collaborative settings, may struggle unless instructional approaches are adjusted to fit their learning preferences. Although gender differences were observed, they were not statistically significant, indicating that cognitive style, rather than gender, plays a more critical role in academic performance. This finding challenges traditional assumptions and emphasizes the importance of aligning teaching strategies with how students process information.

Educators are thus encouraged to shift focus from gender-based generalizations to recognizing cognitive diversity in the classroom. Supporting both FI and FD learners can foster more inclusive, effective learning environments. Ultimately, understanding and responding to students' cognitive styles is key to unlocking their academic potential, regardless of gender

Recommendations

- **Integrate Mixed Teaching Methods**: Teachers should combine independent activities (for FI learners) with group-based and contextual tasks (for FD learners), creating a balanced learning environment that benefits all students (Scharf & Cornoldi, 2020; Zhang & Sternberg, 2020).

- **Enhance Teacher Training**: Pre-service and in-service training should include modules on cognitive style awareness and differentiation strategies, helping educators to better tailor instruction to students' learning needs (Chen, 2021).

- **Adopt Adaptive Learning Technologies**: Schools should invest in AI-powered platforms that adapt content delivery to students' cognitive styles. These systems improve outcomes by personalizing instruction (Liu, Ma, & Zhang, 2023).

- **Break Free from Gender Stereotypes**: Teachers and policymakers should avoid gender-based assumptions in subject delivery. Both boys and girls should be encouraged to explore and excel in STEM and technical disciplines (UNESCO, 2021; Adekunle & Musa, 2023).

- **Diversify Assessments**: Schools should design assessments that reflect both individual performance and collaborative skills. Including oral presentations, group projects, and hands-on tasks can better accommodate both FI and FD learners (Bakare & Ogundele, 2023).

Conclusively, bridging academic gaps in Basic Technology education requires an understanding of the interplay between cognitive style and instructional methods, rather than a narrow focus on gender differences. Inclusive, adaptive, and

cognitively aware teaching practices are key to ensuring that all learners FD or FI, male or female have equal opportunities to excel.

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