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Achievement Motivation and Students' Achievement in Secondary Biology: Is the Relationship Mediated by Cognitive Style?*

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Abstract. Scientific and technological skills are needed for survival and economic prosperity in the 21st century. However, students persistently perform poorly in science subjects at the senior secondary school level. Thus, this study determined the mediating influence of cognitive style on the relationship between academic motivation and students' academic achievement in senior School Biology in Remo North Local Government Area of Ogun State. The descriptive survey research design was adopted to conduct the research. The sample consisted of 180 students randomly selected from ten public senior secondary schools out of the 13 public schools present in the local government area. Data were collected using three instruments: Cognitive Style Questionnaire (r=0.71); Academic Motivation Scale (r=0.72); and Students' Achievement Test in Biology (r=0.82). The data collected were analysed using regression and t-test statistics at 0.05 level of significance. The findings revealed that cognitive styles significantly mediated the relationship between academic motivation and students' academic achievement in Biology. It was also found that there was no significant difference in the mean achievement scores of field-dependent and field-independent learners. The study concluded that cognitive style is a potent factor in the learning of Biology in senior secondary school. Although students can be motivated to learn, aligning instructional activities with their cognitive style by biology teachers is more important than motivation. Therefore, school counsellors should always help to classify students into their cognitive styles at the beginning of the session to enable teachers to tailor instructional activities to meet their learning needs..

Keywords: Achievement motivation, cognitive style, mediation effect, bootstrap, variants.

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1. INTRODUCTION

The fulcrum upon which the development of any nation rests is science and technology education. Science and technology can equip individuals with the knowledge and skills to navigate the hyper-connected and complex world. Organisation of Economic Co-operation and Development (OECD, 2018) argues that human capacity and wellbeing can be enhanced by acquiring scientific knowledge. It also noted that recent developments in artificial intelligence and biotechnology have put the existence of human beings to debate. The development means that science and technology are rapidly changing the world. Any nation whose citizens desire to compete favourably with the citizens of other countries in the technologically explosive 21st century needs to encourage a learning environment that promotes teaching and learning of science and technology education.

However, science teaching and learning in Nigerian schools appear to have challenges. The Federal Ministry of Education (FME, 2018) indicated that Nigeria has no solid scientific and technological backbone. It was also disclosed that students' performance in science, technology, and mathematics (STEM) subjects in external examinations have remained unsatisfactory. These examination bodies include the West African Examinations Council (WAEC), National Examination Council (NECO), and National Business and Technical Examination Board (NABTEB). Specifically, the students' pass rates in Mathematics and Sciences have always been less than 50%. The observation suggests that students' performance in subjects such as Physics, Chemistry, and Biology, which are core science subjects, apart from Mathematics, is below expectation. FME further pointed out that Nigerian citizens are not pursuing science-related courses, which also threatens the country's yearning for a 60:40 ratio in the enrolments for science and technology as against Arts and Humanities. The implication is that Nigeria's quest for scientific and technological advancement may likely be unachievable, compounding the nation's socio-economic problem.

Schools are created to equip students with skills that will enable them to shape their lives, navigate the scientifically and technologically powered society and contribute positively to the lives of others. Science education in school encourages students to make careers in science and understand science and social problems that may confront them in life and solve them (Suwono et al., 2017). Biology is one of the subjects listed in secondary school to inculcate scientific skills and attitudes in the learners due to its importance in successful living in the scientific world. According to Yaki et al. (2020), Biology is concerned with studying living things and their relationship with the environment. Meanwhile, the United Nation's Sustainable Development Goal 1 (SDG 1) admonishes experts in Biology and life sciences to develop solutions that can protect human lives in the environment they live in (de Lorenzo et al., 2018). Several solutions from Biology have been found to contribute significantly to sustainable development. For instance, synthetic biology is beneficial in electronics, energy, biomedicine, food, and agriculture. It can also address many sustainable development goals (Kolodziejczyk & Kagansky, 2017). Kitney et al. (2021) also noted that an aspect of Biology known as bio-foundries could strengthen the usefulness of Biotechnology for sustainable development.

However, the development of the biological solutions and their allied products to enable individuals to live comfortably in the rapidly changing environment due to the influence of science and technology seems challenging to realise with the present state of students' performance in Biology. Students' performance in Biology at the secondary school level is worse than their performance in other science subjects (Gbore & Daramola, 2013). The WAEC chief examiners' reports (2014-2018) in Biology also revealed that students' performance in Biology fluctuates below 50% benchmark. This abysmal performance indicates that researchers should identify factors that may enhance students' learning of the subject.

One of the factors found in the literature to be affecting students' learning is cognitive styles (Ansyah et al., 2021; Chuang et al., 2021). It reflects an individual's ways of receiving, perceiving, processing information, solving problems and making decisions (Zhang & Sternberg, 2006). It also determines how the human brain accepts, processes, converts, interprets and retrieve information for use (Oginga, 2020). Cognitive style shapes an individual's attitude, values, and interaction with others (Hooda & Devi, 2017). It also helps them understand their genetic makeup and learn without hindrances. As the complexity of the digital world demands that individuals continue to learn for survival, teachers need information about the learners' cognitive styles for effective instructional delivery (Oginga, 2020). Researchers have developed several cognitive style models to study the influence of cognitive styles on learning. These include Integrated, Intuitive, Split, Systematic, and Undifferentiated (Hooda & Devi, 2017). The most popular is the field-dependence-independence dimensions of Witkin and associates (Khodadady et al., 2016). Witkin et al. (1977) classified individuals as field-dependent (FD) and field-independent (FI). A field-dependent person likes aligning with people, participates in collaborative work, and prefers to share knowledge with others. They usually have a holistic view of a problem before solving it and prefer to make careers in Literature and History.

However, an individual with a field-independent cognitive style constantly analyses situations and takes actions to improve them. They do not like to follow the majority in their actions. FI individuals do not like group work and may not collaborate effectively (Olagbaju, 2020). The dichotomy in the learning mode between the field-dependent and field-independent individuals means that teachers need to be conversant with the students' cognitive styles to develop instructions that favour all learners. However, Schunk (2012) noted that instructional methods hardly favour students' cognitive styles. However, they learn through a self-regulation strategy by adapting their cognitive styles and preferred learning modes to instructional delivery. Thus, cognitive style is regarded as alterable individual traits which can be acquired and can change in the learning environment (Zhang & Sternberg, 2005).

Many research reports abound in the literature regarding the influence of cognitive style on students' learning in several subject areas, including Biology. Ansyah et al. (2021) examined the effect of discussion and recitation methods on learning achievement with cognitive styles as the moderating variable. The study revealed that cognitive style

significantly influenced learning achievement. Similarly, Oginga (2020) determined the distribution of science students by cognitive style and explored the influence of the variable on students' performance in science (Physics, Chemistry, and Biology) and English and History. The study found that while some students were field-dependent, others were field-independent. The report also revealed that cognitive style has a significant influence on students' performance in Mathematics, Biological Sciences but has no significant effect on their achievement in English and History. The report of the study of Setiawan (2020), which also examined the effect of cognitive style on students' problem-solving abilities and mathematical reasonings, indicated that cognitive style has a significant effect on reasoning and problem-solving abilities. It was also reported that students with FI cognitive style performed significantly better than their counterparts with FD cognitive style in reasoning and problem-solving abilities in geometry. After exposure to video games, Chuang et al. (2021) reported that field-independent students' reasoning ability improved more than the reasoning ability of their field-dependent counterparts. The researchers recommended that teachers align the instructional methods with the learners' cognitive styles to ease their adaptation to the learning environment.

In contrast, the results of Okoye (2016) on the influence of gender and cognitive styles on students' achievement in secondary school Biology in Anambra State revealed that gender and cognitive style were not determinants of students' performance in the subject. This finding is congruent to Nwanze et al. (2021) that cognitive style did not significantly impact students' achievement in science (Physics, Chemistry, and Biology) and mathematics. The findings further revealed that field-independent learners obtained significantly higher mean achievement scores than their field-dependent colleagues regarding the field-dependence-independence dichotomy. This result reinforces that of Setiawan (2020) that FI cognitive style performed better than their counterparts with FD cognitive style in reasoning and problem-solving abilities in geometry. The conflicting findings on how cognitive styles influence learning may be due to the subject areas and learning environment where such studies were conducted and the research designs. Goodenough (1976) described the cognitive style as a mediating variable, especially when the field-dependence-independence model is used. A mediating variable, a third variable, connects independent and dependent variables and explains their relationships completely. An intervening variable enables researchers to determine how the independent variable influences it and its relationship with the dependent variable (Allen, 2017). Studying a variable's mediating influence enables researchers to determine further how certain variables could strengthen or diminish the independent variables' influence on the dependent variables.

Studies on the mediating influence of cognitive style are scanty in the literature. While several descriptive research focused on the direct influence of cognitive styles on students' learning, most experimental studies were on the direct and interaction effects of cognitive styles on students' learning. Hence, this paper determined the mediating influence of the variable on the impact of academic motivation on students' learning of

Biology. Mediation analysis helps researchers understand how a variable directly influences the other and how a 'middle' variable, a mediator, also influences the relationships between variables.

Academic motivation is a drive to accomplish greatness in life. According to Rodriguez et al. (2017), academic motivation is a potent factor in students' academic achievement besides the cognitive styles. It engenders the spirit of competitiveness in individuals and urges them to do things timely and rightly (Sharma & Ranjan, 2018). Learners desire the right motivation to achieve goals, needs, and dispositions towards their studies. Learners' dispositions may be driven by either the inner force (intrinsic motivation), an external force (extrinsic motivation), or lack of motivation ("amotivation") (Amrai et al., 2011). Anderman and Koenka (2017) correspondingly argued that lack of motivation could promote examination misdemeanours and lead to unattainable educational goals. The issue of academic motivation is prevalent among secondary school students due to their urge to become independent and participate in every communal activity without hindrance (Gupta & Mili, 2017). Therefore, this study examined how cognitive styles could mediate the students' academic motivation towards effective learning of Biology in senior secondary schools. This study uses the term academic motivation interchangeably with achievement motivation.

Researchers have studied the relationship between academic motivation and students' academic achievement without mediating with the students' cognitive styles. For instance, Gupta and Mili (2017) investigated the relationship between academic motivation and academic achievement of class 6 students of Assam in India. It was reported that academic motivation had a positive and significant influence on academic achievement. Similarly, Sharma and Ranjan (2018) explored the correlation between academic motivation and academic achievement. The results revealed that the influence of academic motivation was significant on students' achievement. The same trend was reported by researchers such as Islam and Chakrabarty (2020), Karabulut et al. (2021), and Samavi et al. (2017). However, Tus (2020), who correlated academic motivation with students' academic achievement, found that academic motivation had no significant influence.

As mentioned earlier, every nation desires to develop its citizens to acquire scientific skills for competitive advantages in a technology-driven society. However, Nigerian students are not doing well in science subjects at the senior secondary school level to lay the foundation for their successful learning of science and its related disciplines in higher education. Literature evidence has shown that Biology, as one of the science subjects, is not being learned satisfactorily. This shred of evidence concurs with that of the Federal Government of Nigeria about the poor state of science education. The unsatisfactory performance means that the country may continue to trail other countries in science and technology transfer.

Meanwhile, researchers have identified cognitive style and academic motivation as potent factors in learning achievement. Also, many studies have investigated the relative and

composite influences of these two variables on students' performance. Although many such studies were conducted in science disciplines, including Biology, studies on the mediating influence of cognitive style on the relationship between academic motivation and academic achievement in biology are limited in the literature. Therefore, the objective of this work was to determine if students' cognitive style mediates the relationship between academic motivation and academic achievement in Biology. It also determined how field-dependent-independent traits influence learners' mean academic achievement scores.

The researchers raised one research question and two hypotheses to achieve the objective.

Research Question

- What is the percentage distribution of students by cognitive style?

Hypotheses

1. $H_0$1: Cognitive style does not significantly mediate the relationship between students' academic motivation on academic achievement in senior secondary school Biology.
2. $H_0$2: There is no significant difference between the mean achievement scores of field-dependent and field-independent learners in senior secondary Biology.

2. METHOD

Study Design and Mediation Model

The study adopted a descriptive survey research design to collect information from the respondents about their academic motivation, cognitive styles, and academic achievement in Biology. The mediation influence of the cognitive style in the relationship between academic motivation and academic achievement was determined using the mediation model in Figure 1.

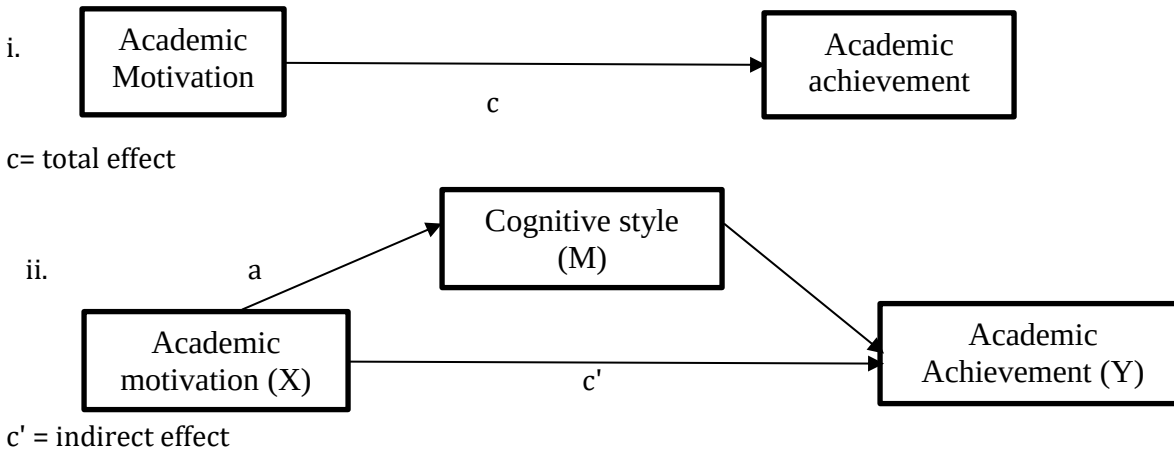


Figure 1. Mediation Model for Academic Motivation and Academic Achievement by Cognitive Style

Figure 1 indicates the model to examine the mediating influence. The academic motivation was the independent variable (X), academic achievement (Y) was the outcome, and cognitive style (M) was the mediator. According to (Abu-Bader & Jones, 2021), mediation extends the simple linear regression statistics by including more variables into the equation.

Three steps are required to determine the mediating influence of a variable on the relationship between the other two variables, X and Y. They are:

i. To examine the effect of X on Y (c path);

ii. To examine the effect of X on M (a path); and

iii. To simultaneously determine the effect of M on Y (b path) and X on Y (c' path).

The effect of academic motivation on academic achievement (c path) is called total effect, which is the combination of direct effect c' and indirect effect (ab), i.e., c=c'+(ab).

Population and Sample

The target population was all the senior secondary two (SS 2) students offering Biology in the thirteen (13) public senior secondary schools in Remo North Local Government Area (RNLGA) of Ogun State. Ogun State has 20 local government areas, and Remo North was chosen for convenience.

The sample consisted of 180 students from ten randomly selected public senior secondary schools in RNLGA. The students were selected through a proportional random sampling technique. Sixty percent (60%) of SS 2 students offering Biology in each participating school were randomly selected to participate in the study, which gave 180 students. The ethics committee approval for this study was obtained from the Ethics Committee of the Ago-Iwoye Directorate of Research, Linkages and Advancement of Olabisi Onabanjo University, dated 23/06/2021 and referenced oou/ssmthu/ec/0002/230921.

Instrumentation

The Embedded Figure Test (EFT), Academic Motivation Scale (AMS), and Students' Achievement Test in Biology (SATB) were used for data collection.

The EFT downloaded from https://pdf.exampundit.in/embedded-figures-questions-pdf-for-ssc-exams was adapted for the study. It had 18 items such that students who scored eight (8) and above in the test were classified as field-independence (Witkin et al., 1977). The remaining students were classified as field-dependent.

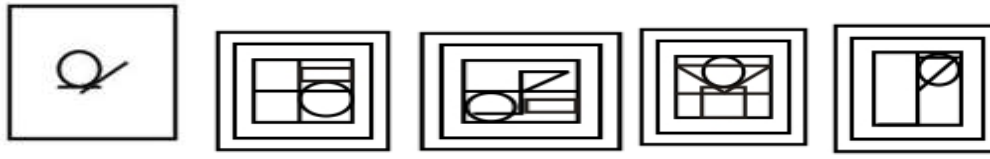
The face and content validities of the EFT were ascertained through the efforts of the two postgraduate students in Mathematics Education in the Department of Science and Technology Education (STED), Olabisi Onabanjo University. The observations and

suggestions made were effected before the instrument was administered to 25 students offering Biology in a public senior secondary school in Ijebu-North Local Government Area of Ogun State. The responses from the participants were subjected to Split-half reliability statistics, which yielded a reliability coefficient of 0.69. Examples of the items in the ETF are as shown below:

1. Select the option in which the given figure (X) is embedded.

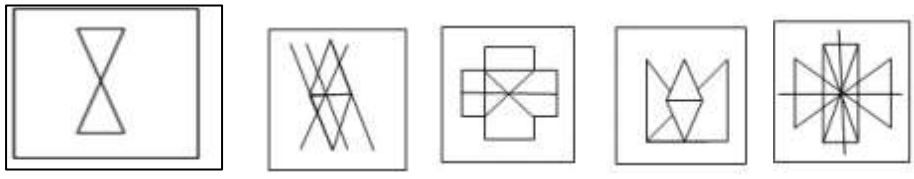
(a) (b) (c) (d)

2. From the given answer figures, select the one in which the question figure is hidden/embedded.



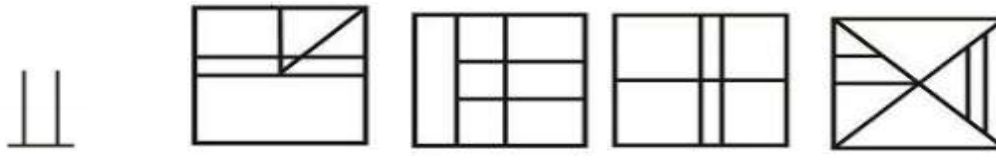
(a) (b) (c) (d)

3. From the given answer figures, select the one in which the question figure is hidden/embedded (Rotation is not allowed).



(a) (b) (c) (d)

4. From the given answer figures, select the one in which the question figure is hidden/embedded.



(a) (b) (c) (d)

Similarly, the Academic Motivation Scale (AMS) was adapted from the study of Njiru (2003). The instrument was a 4-point Likert Scale with 25 items covering students' desire to learn from others, extrinsic, intrinsic, and social rewards, and responsibility for

learning. The face and content validities were achieved through the concerted efforts of two experts in psychology in the Department of Educational Foundation, Olabisi Onabanjo University. After necessary corrections were effected, the instrument was administered to 25 students offering Biology in a public senior school in Ijebu-North Local Government Area of Ogun State. The analysis of participants' responses using the Cronbach Alpha statistics yielded a reliability coefficient of 0.72. Examples of AMS items are:

1. I show genuine interest in learning.

2. I participate in classroom discussions.

3. I take my studies as a personal responsibility.

4. I get honour and praise from my family for passing in my studies/exams.

The students' cognitive knowledge of Biology was measured using the Students' Achievement Test in Biology (SATB) adapted from the work of (Sener & Tas, 2017). The original version of SATB had 38 items covering topics listed in the second term curriculum for the senior secondary school two (SS 2) in Nigeria. The test was initially administered to 100 students in SS 2 from schools not part of the research. The item analysis reports indicated that only 25 items were appropriate for the final test. From the 25 items, twenty (20) items were selected based on advice and recommendations from two experts in science education in the Department of Science and Technology Education and a secondary school Biology teacher. The 20-item SATB was administered to 25 SS 2 from a school in Ijebu-North Local Government Area of Ogun State which was not the target Local Government. The test-retest reliability statistics yielded a reliability coefficient of 0.82. Examples of SATB items are:

1. Which of the nutrition below are the most fuel nutrients compared to the others?

A. Rice-Sugar B. Cracked wheat-Orange C. Meat-Egg D. Pasta-Spinach

2. Which nutrient group is most important as a regulator in our body?

A. Protein B. Fat C. Carbohydrate D. Water

3. What kind of nutrients do we get from our body's energy, primarily to think, talk, walk, play sports, etc.?

A. Protein B. Vitamin C. Carbohydrate D. Fat

For data collection, the researchers approached the authorities of the ten selected schools with a letter of introduction from the STED Department of Olabisi Onabanjo University, Ago-Iwoye, Nigeria, to seek approval to administer the instruments. The purpose of the study was explained, and approval was given after clarification of the grey areas. Consequently, the researchers requested to meet the Biology teachers who introduced them to the students and explained the reasons for data collection. The students initially declined participation until the researchers gave them stipends. One hundred and eighty

participants collected the instruments (EFT, AMS, and SATB), responded, and returned them the same day, which amounted to a 100% return rate.

The data collected were analysed using descriptive statistics of mean and standard deviation and inferential statistics. Descriptive statistics were used to answer the research questions, while inferential statistics were employed to test the hypothesis formulated at a 0.05 level of significance. The inferential statistics involved linear, multiple regressions analyses and Hayes SPSS Process Macro. The analyses were conducted using International Business Machine Statistical Package for Social Science 23 (IBM SPSS 23).

3. RESULTS AND FINDINGS

The results of data analyses are presented according to the research questions and the formulated hypotheses.

Research question 1: What is the percentage distribution of students based on cognitive style classification?

Table 1

Percentage Distribution of Students by Cognitive Style

	Type of cognitive style	N	% N
Academic achievement score	Field dependent	97	54
	Field independent	83	46
Total		180	100

Table 1 shows that, among the participants, the field-dependent (54%) learners are more than the field-independent learners (46%).

Research question 2: What are the students mean academic achievement scores in Biology based on cognitive style?

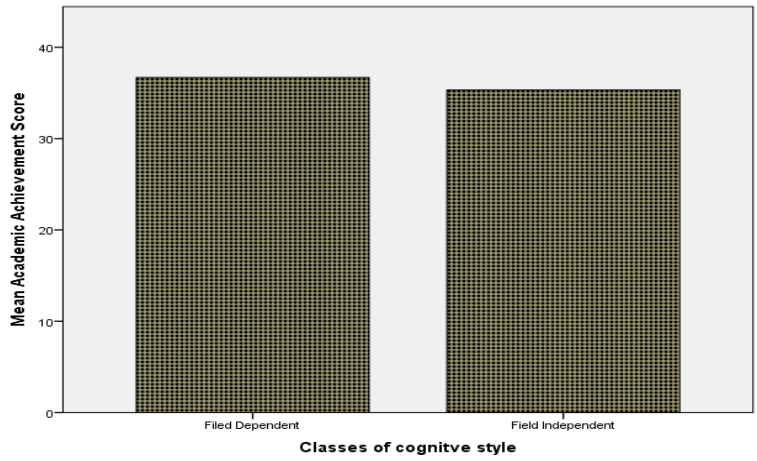


Figure 2. Students' Mean Academic Achievement Scores in Biology based on Cognitive Styles

It can be seen from Figure 2 that field-dependent learners performed marginally better compared to their colleagues with field-independent cognitive style. The mean achievement scores of both groups in Biology are between 35 and 40.

Test of Hypotheses

$H_0$1: Cognitive style does not significantly mediate the influence of students' academic motivation on academic achievement in senior secondary school Biology.

Mediating effect

The three tests necessary for the determination of mediation influence of cognitive style based on the relationship between academic motivation and academic achievement in Biology are conducted as follows:

Does academic motivation significantly influence students' academic achievement in senior secondary Biology?

Table 2

Influence of Academic Motivation on Achievement in Biology

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
1 (Constant)	21.543	1.839		11.712	0.000
Academic Motivation	0.496	0.061	0.520	8.123	0.000

R=0.520; R^2=0.270; Adjusted R^2 = 0.266, Std Error = 5.838

The results in Table 2 indicates that academic motivation significantly influences academic achievement in senior secondary Biology (t=8.123, p<0.05). This implies that the unstandardized coefficient, c'= 0.496 is statistically significant.

Does academic motivation significantly influence the cognitive styles of students offering senior secondary Biology?

Table 3

Influence of Academic Motivation on Students' Cognitive Style

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
1(Constant)	4.213	1.088		3.872	0.000
Academic Motivation	0.353	0.036	0.591	9.783	0.000

R=0.591; R^2=0.350; Adjusted R^2 = 0.346, Std Error = 3.453

The results in Table 3 indicates that academic motivation significantly influences the cognitive style of students offering senior secondary school Biology (t=9.783, p<0.05). This implies that the unstandardized coefficient, a = 0.353 is statistically significant.

Does the cognitive style of students' offering senior secondary Biology significantly influence their academic achievement when the influence of academic motivation is held constant?

Table 4

Influence of Students' Cognitive Style on Academic Achievement

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
1 (Constant)	15.325	0.936		16.367	0.000
Academic Motivation	-0.026	0.037	-0.027	-0.691	0.491
Cognitive Style	1.476	0.062	0.925	23.828	0.000

R=0.909; R^2=0.827; Adjusted R^2 = 0.825, Std Error = 2.854

Table 4 discloses that while controlling for academic motivation, the cognitive style which is the mediating variable significantly influence the academic achievement of students in senior secondary Biology (t=23.828, p<0.05). This indicates that the unstandardized coefficient, b = 1.476 is statistically significant.

After the establishment of the three conditions for mediation, Hayes Process Macro is used to examine if the mediating influence of cognitive style is statistically significant (Abu-Bader & Jones, 2021). The results are as presented in Table 5

Table 5

Bootstrap Estimates of Direct, Indirect and Total Effects of Academic Motivation on the Academic Achievement

Total effect of X on Y							
Effect	Se	T	p	LLCI	ULCI	c_ps	c_cs
0.4960	0.611	8.1234	0.0000	0.3755	0.6165	0.0728	0.5201
Direct effect of X on Y							
Effect	Se	T	p	LLCI	ULCI	c_ps	c_cs
-0.0256	0.0370	-0.6908	0.4906	-0.0986	0.0475	-0.0038	-0.0268
Indirect effect (s) of X on Y (a*b)							
	Effect	BootSE	BootLLCI	BootULCI			
Cognitive style	0.5215	0.0915	0.2601	0.6053			

The table 5 presents the results of the mediation analysis. It indicates the direct, indirect and the total effect of academic motivation on academic achievement at a 95% confidence interval using the Bootstrapping method. First, the result shows that academic motivation significantly influenced students' academic achievement in Biology (c'= 0.496, t=8.123, p<0.05). Another result revealed that, while controlling for cognitive style, academic motivation did not significantly influence academic achievement (d= -0.026, t= -0.690, p= 0.491> 0.05).

Meanwhile, based on 5000 bootstrap samples, the influence of academic motivation on academic achievement in Biology was significantly mediated by students' cognitive style (a*b = 0.5215, Bootstrap CI_{95} = 0.2601 and 0.6053). Therefore, the hypothesis which states that cognitive style does not significantly mediate the relationship between students' academic motivation and academic achievement in senior secondary school Biology is rejected. It can also be deduced from the results that cognitive style as a mediating variable contributed 95% of the total influence of academic motivation on students'

achievement in senior secondary Biology (Proportion of the effect accounted for by the mediator, P_M = (a*b)/ ((a*b) + c') i.e., the ratio of indirect effect to the direct effect. Since the direct effect of academic motivation on students' academic achievement is not significant (d= -0.026, t= -0.690, p= 0.491> 0.05), then it can be concluded that cognitive style completely mediates the influence of academic motivation on students' achievement in Biology.

$H_0$2: There is no significant difference between the mean achievement scores of field-dependent and field-independent learners in senior secondary Biology.

Table 6

Mean Difference in Academic Performance by Cognitive Style

Cognitive style type	N	Mean	S. D	df	t	Sig.
Field dependent	97	36.69	7.102	178	1.343	0.181
Field-Independent	83	35.33	6.430			

Table 6 shows no significant mean difference in the achievement scores of field-dependent and field-independent learners (t (178) = 1.343, p=0.181>0.05). Thus, the hypothesis which states there is no significant difference between the mean achievement scores of field-dependent and field-independent learners in senior secondary Biology is retained

4. DISCUSSION AND SUGGESTIONS

The crux of this work was to determine the mediating influence of students' cognitive styles on the influence of academic motivation on their academic achievement in senior secondary school Biology. The results revealed that cognitive styles significantly mediated the influence of academic motivation on students' achievement. It was a complete mediation because the direct effect of academic motivation on students' achievement was not statistically significant. This suggests that motivating students to learn without aligning teaching-learning activities with meeting their cognitive style may not improve the learning of Biology in senior secondary school. Indeed, it was inferred from the findings that 95% of the total effect (influence) of academic motivation on students' achievement was explained by cognitive style. This finding on the insignificant influence of academic motivation on students' academic achievement is in line with that of Tus (2020) who correlated academic motivation with students' academic achievement and found that academic motivation had no significant influence on academic achievement. However, it is contrary to the reports of Islam and Chakrabarty, 2020; Karabulut et al.

(2021); and Samavi et al. (2017) that academic motivation had a positive and significant influence on students' achievement.

This finding implies that teachers should, within their first meeting with the students, obtain information on their cognitive styles. This may help them to align their instructional activities to cater for different students' cognitive styles in the classrooms. The result may also be helpful to researchers to understand that another variable could mediate the predicting power of an independent variable on the dependent variable. However, this finding should not be generalized because the sample is not large enough. Hence, there is a need for further research with more participants and in different geographical locations.

Similar objective of the study is to determine if the difference in the mean achievement scores of students with field-dependent and field-independent cognitive styles significantly differs. The findings established no significant difference in the mean achievement scores of field-dependent and field-independent learners. This indicates that means that the mean scores of students in both groups were almost the same. This result does not agree with that of Nwanze et al. (2021) that field-independent learners obtained significantly higher mean achievement score than their field-dependent colleagues. It is also discordant to that of Setiawan (2020) that FI cognitive style performed significantly better than their counterparts with FD cognitive style in reasoning and problem-solving abilities in geometry. The inconsistent results suggest that more studies are needed to further confirm or refute this finding.

The plausible reason for that finding might be that the teachers assisted the students, regardless of their cognitive styles to learn. It might also be due to the presence of a substantial number of field-independent learners (46%) in the selected sample. Naturally, field-dependent learners are good in disciplines such as science and mathematics. It is, therefore, possible that they scored higher marks than their field-dependent colleagues which reduced the mean difference in their scores.

5. CONCLUSION

This study examined the mediating influence of cognitive style on the relationship between academic motivation and students' academic achievement in senior secondary Biology. It was established that the mediating influence of cognitive styles on the relationship between academic motivation and academic achievement was significant and complete. Based on this finding, it is recommended that school counsellors should always assist to determine the students' cognitive style at the end of basic education (Junior Secondary School) (JS 3) for right placement into classes that match the students' cognitive styles. In schools without counsellors, teachers, at the beginning of the term should distribute a questionnaire to the students in Biology class for familiarization with their cognitive style. This will help the teacher to hinge instructional activities on

students' preferred ways of thinking and processing information and thus ease their learning.

Hence, it is concluded that cognitive style is a critically potent factor in the learning of Biology in senior secondary school. Although students can be motivated to learn, aligning instructional activities with their cognitive style by Biology teachers is more important than motivation.

The study also explored the achievement of students based on the class of their cognitive styles. The finding confirmed that the difference in the mean achievement scores of the field-dependent and field-independent learners is not significant. This may be an indication that the teachers' teaching styles did not leave any student, irrespective of their cognitive style, behind in the learning of Biology. Thus, it is recommended that teachers should continue to use instructional approaches that will help students to learn optimally.

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