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DIRECT AND INDIRECT EFFECTS OF PERSONALITY TYPE AND LEARNING STYLE PREFERENCES ON STUDENTS' ACHIEVEMENT IN SENIOR SECONDARY SCHOOL BIOLOGY IN OSUN STATE, NIGERIA

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Abstract:
Poor performance of students in Biology has been attributed generally to factors relating to the home, school and the students themselves. Previous studies have investigated personality type and learning style preferences in relation to students' achievement in tertiary institutions rather than at the secondary school level. This study was therefore conducted to examine the effects of Myer's Briggs personality type- ESTJ (Extroversion, Sensing, Thinking, Judging) and VAK (Visual, Auditory, Kinesthetic) learning style preferences on students' achievement in Biology at the Senior Secondary School (SSS) level. Three instruments [Cognitive Type Inventory (CTI), VAK Learning Style Indicators (VLSI), and Biology Achievement Test (BAT)] were administered on 1,480 SSS II Biology students. The results were presented using path analysis and multiple regressions. It was established that five hypothesized predictor variables (age, extroversion, sensing, thinking and kinesthetic) had direct effects on Biology achievement. On the other hand, only three hypothesized predictor variables (gender, age and thinking) had indirect effects on Biology achievement. However, sensing and kinesthetic preferences had the most significant direct effects on Biology achievement. Also, sensing had the highest total causal effect on Biology achievement. Students

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should be encouraged to develop, improve and exhibit sensing and kinesthetic preferences when learning Biology.

Keywords: personality type preferences, learning style preferences, students' achievement in Biology, Senior Secondary School in Osun State

1. Introduction

Biology is one of the subjects which a student requires before he/she can pursue a carrier in such disciplines as medicine, pharmacy, genetic engineering, biotechnology and nursing. Many students wish to pursue these courses especially now when the demand for the services of experts in these fields are on the increase globally. Ezeazor (2003) remarked that Biology exposes the students to the world of self-knowledge and knowledge of the immediate and distant environment.

Ali (2013) defined academic achievement as the outcome of education that indicates how well a student or class of students is doing academically. Furthermore, Ganai and Muhammed (2013) referred to academic achievement as knowledge attaining ability or degree of competence in school tasks usually measured by standardized test and expressed in grade or unit based on students' performance. Therefore, one can say that it is the academic achievement of students in a course of study that determines whether the students have learnt or not, and the degree at which the learning has taken place.

Despite the role which Biology stands to play in the development of individuals and the nation, and the importance of academic achievement to all stakeholders of education, the performance of students in Biology at the senior secondary school level over the years has been generally poor. This is confirmed by Olatoye (2004) who found that, in Nigeria, students' performance in science, both at the internal and the external examinations has been consistently poor. Also, the study of Ezeazor (2003) showed continuous poor performance of students in Biology. Incidentally, WAEC Chief Examiners Report regrettably affirmed that candidates performance in Biology were poorer by the year 2012 (WAEC Chief Examiners' Reports (Nigeria), 2013).

Many factors have been associated with students' poor performance in school subjects. Some of these factors are: type of text books used (Keeve, 1995); teaching methodology (Adeyemi, 2002); parental involvement (Edeh and Vikoo, 2013), Student's ability and motivation, age, gender, class size, school location, teacher expectations and behaviours (Ganai and Muhammed, 2013). This implies that the factors associated with students' poor academic performance are multi-dimensional in nature.

Inspite of this, it is the students that directly continue to be at the receiving end of the outcomes of both internal and external examinations. These students have little or no control over major stakeholders of education (parents, government, and the teacher) but, they have reasonable control over themselves. In the view of this, there may be need to pay special attention to learner personal variables such as student personality type and student learning style preferences which may have influence on their learning outcomes. Felder and Brent (2002) found that students learn more if they are aware of how they learn and how to use their strengths and develop their weak areas. Similarly, Romanelli, Bird, and Ryan, (2009) observed that students with knowledge of their own preferences are empowered to use various techniques to enhance learning, which in turn may impact overall educational satisfaction. Sanni and Emeke, (2014) stated that, for a student to learn effectively, he/she may need to be aware of his/her personality type and learning style preferences. Also, he/she needs to develop and exhibit the expected learning styles which the effective learning of a particular subject or topic requires (Sanni and Emeke, 2014)

Leonard (1997) found that students not only have a learning style but they also tend to have a preferred learning style (the result of being an individual and being unique). This implies that students have a preferred learning style under which they learn better. For instance, Briggs & Briggs-Myers (1998), Felder, Felder & Dietz, (2002) reported that students who were classified as extroverts on the Myers-Briggs Type indicators seem to learn better in learning environment that allows for group work and interactive activities. On the other hand, according to them, sensors like to work with concrete ideas and processes, thinkers prefer objective conclusions based on concrete evidence while judgers like planned and organised information.

However, the type of learning styles a student exhibits may depend on the type of topic or subject he/she is being exposed to. The above assertion is supported by Leonard (1997), who observed that the demands placed upon the student determine the style of learning the student chooses. Thus, for a student to learn Biology effectively, he/she may need to exhibit learning styles that would allow for group work and interactive activities, working with concrete ideas and processes, preferring objective conclusions based on concrete evidence, planning and organisation of information. This implies that such a student may need to exhibit personality type – that comprises extroversion, sensing, thinking, and judging preferences. With the context of the reviews made so far, it seems that personality type may influence learning styles which may in-turn determine the level at which students learn.

Personality type constitutes a fairly stable phenomenon in the life of an individual. Emeke (2012) said that the characteristics patterns of thoughts, feelings and

behaviours that make a person unique define that person's personality. Phares (1991) is of the opinion that personality type is that pattern of characteristic thoughts, feelings and behaviours that distinguish one person from another and that which persists over time and situation. Whereas, personality type preferences are the characteristics thoughts, feelings and behaviours which learners tend to exhibit in a learning situation and which takes a discontinuous approach (Phare, 1991). Several models of personality type have been developed and used to measure personality. Some of these models, are – Myers-Briggs personality model, the Big Five Factor Personality model, Cattell's 16PF model, Saville & Holdsworth's OPQ (Occupational Personality Questionnaire) model, and Belbin 'team role' personality model. Myers and Caulley (1986) confirmed that the only commonly used among these models to measure personality type is Myers-Briggs Personality Model. Other personality models measure personality traits.

According to Myers and Caulley (1986), Myers-Briggs personality model was developed in the early 1950's by Isabel Briggs Myers and Katherine Cooks Briggs. In the Myers-Briggs Personality model, it is proposed that an individual's personality profile can be factored into four dimensions. These dimensions are Orientation to life (Extroversion/Introversion), Perception (Sensing/Intuition), Decision making (Thinking/Feeling), and Attitude to the outside world (Judging/Perception).

Considering the four dimensions of personality, it implies that an individual's personality can be described by two major personality types. They are; personality type – ESTJ and personality type – INFP. The preferences for personality type – ESTJ are extroversion, sensing, thinking, and judging whereas, the preferences for personality type-INFP are introversion, iNtuition, feeling, and perception.

John (2006) identified the characteristics that students exhibit for Myers-Briggs Personality Type-ESTJ (Extroversion, Sensing, Thinking, and Judging) as:

Extroversion Preference: Students who have extroversion preferences learn best through quick trial – and – error thinking. They have an easier and more effective learning experience when they verbalise their learning as it is happening.

Sensing Preference: Sensing types tend to trust information that is perceived directly by the senses, i.e. vision, audio, touch (manipulation), taste, and smell. They are always comfortable with facts and past events when studying in a group.

Thinking Preference: Thinkers tend to trust their logic to evaluate the facts and possibilities. They are impersonal and objective in their analysis. Thinking types draw attention to the "correctness" of relationship and the clarity of thinking when studying in a group.

Judging Preference: Students who have judging preference tend to organise their time around a plan. They are motivated to obtain closure by completing their plan

or checking off items on their task list. They tend to sacrifice learning additional information if that learning will prevent them from completing their schedule. When studying in a group, they keep the group on task and help it to be more efficient. Examining the four preferences of Myers – Briggs Personality Type-ESTJ and the characteristics that students tend to exhibit for each of them , it seems that they are relevant to teaching –learning situation in the field of biology. In view of this, Myers-Biggs Personality type-ESTJ was the focus of this study.

Considering learning styles, Giles, Pitre and Womack (2003), said that the term "learning styles" is commonly used throughout various educational fields and therefore, has many connotations. In general, learning style refers to the uniqueness of how each learner receives and processes new information through his/her senses. In his own contribution, Milgram (2000) referred to learning style as the unique complex of conditions under which an individual concentrates on, obtains, processes, retains and applies new and difficult information. Therefore, in sum, one may say that all stable learner personal characteristic conditions under which an individual learns best make up his/her learning style.

However, James and Gardener, (1995) defined learning style preferences as the manner in which, and the conditions under which, learners most efficiently and effectively perceive, process, store, and recall what they are attempting to learn. This implies that, the ways and manner in which learners learn best when being exposed to any learning situation describe learning style preferences. Several models of learning styles have been developed and used by researchers to explain learning style. Some of these learning style models are: David Kolb's Learning Style Model, Felder-Silverman Learning Style Model, Grasha–Riechmann Learning Style Model, Anthony Gregorc's Learning Style Model, Gardener's Multiple Intelligences and VAK Learning Styles Model.

VAK learning style model was developed by Dunn and Dunn (Dunn and Griggs, 2003). In VAK learning styles model, three learning styles were identified by Dunn, and Dunn (Dunn and Griggs, 2003). These learning styles are:- Visual learning style, Auditory learning style, and Kinesthetic learning style.

Visual Learning Style: It involves the use of seeing to observe things, including pictures, diagrams, demonstrations, displays, handouts, films, flip-chart, etc.

Auditory Learning Style: This involves the transfer of information through listening: to the spoken word, of self or others, of sounds and noises.

Kinesthetic Learning Style: It involves physical experience- touching, feeling, holding, doing, practical hands-on experiences. The word "kinesthetic" describes the sense of using muscular movement – physical sense. Kinesthetic therefore describes a

learning style which involves the stimulation of nerves in the body's muscles, joints and tendons.

According to Chislett and Chapman (2005), student preferences identified for each of the VAK learning styles are:

Visual: Visual learners have preferences for seeing, for reading diagrams and maps, for expressing their feelings and moods through art, for thinking and imagination. They remember much of what they read. They prefer instructions to be written.

Auditory: Auditory learners have preferences for listening, for verbal explanation, for talking over their notes, for discussions, for repeating words and key points in their head. They remember things they hear. They are good listeners.

Kinesthetic: Kinesthetic learners have preferences for making things, for learning by trial and error, for demonstration, for sport activities, for practical work. They remember best through their own experiences.

Looking critically at VAK learning styles model, the indicators (visual, auditory, kinesthetic) seem relevant to the explanation of student learning styles in the teaching and learning of sciences especially Biology. Also, Chislett and Chapman (2005) reported that the Visual-Auditory-Kinesthetic Learning Styles Model or 'Inventory', usually abbreviated to VAK, provide a simple way of explaining and understanding individual learning styles. According to Coffied, Moseley, Hall, and Ecclestone (2004), VAK learning style model is widely used in schools in the United States, and 177 articles have been published in peer-received journals. In view of this, VAK learning styles was used in this study.

Apart from personality type and learning style preferences, students' gender and age were also considered in this study. The influence of gender on students' achievement has continuously been a thing of concern to researchers. For instance, Owolabi and Ekuk-Irien (2009), Zember and Blume (2011) reported that age and gender have effect on academic achievement of students in science. However, Abubakar and Adegboyega (2012) found that gender did not have any significant effect on the students' academic achievement. Therefore, investigation into the relationship between gender and achievement still needs the attention of researchers.

1.2 Statement of the Problem

Poor performance of students in Biology over the years poses a serious problem to stakeholders of senior secondary school education. Previous studies on students' achievement in Biology have focused only on variables such as teacher, government, and parent factors. They have also focused on how students' personal variables such as

personality type [(Extroversion, Sensing, Thinking, Judging (ESTJ)], and learning style preferences [Visual, Auditory, Kinesthetic (VAK)] influence students' achievement in tertiary institutions. However, this study examined through path linkages how personality type and learning style preferences determine students' achievement in Biology at Senior Secondary School level.

1.3 Research Question

Based on the stated problem the study provided answers to the following questions.
RQ1: What are the estimated,

1. direct,
2. indirect, and
3. total causal effects among the variables (gender, age, extroversion, sensing, thinking, judging, visual, auditory, kinesthetic, and Biology achievement)?

2. Methodology

2.1 Research Design

The study used a survey research design. In this study, the independent variables had occurred much earlier in the population. Therefore, random assignment and manipulation of variables were not carried out by the researcher.

2.2 Population of the study

The target population comprised all the SSS II Biology students in the thirty one local government areas of Osun State.

2.3 Sample

Purposeful sampling technique was used to select 20 SSS II students (male and female) from each of the seventy four Senior Secondary Schools in 15 selected Local Government Areas. Thus, total of one thousand, four hundred and eighty (1,480) SSS II students were randomly selected.

2.4 Instrumentation

Three instruments were used to collect data.

- Cognitive Type Inventory (CTI;
- VAK Learning Style Indicator (VLSI);
- Biology Achievement Test (BAT).

A. Cognitive Type Inventory (CTI)

CTI was an adapted instrument from Reinhold (2006). The instrument contained twenty four (24) items. The instrument measured the respondents' personality type-preferences (extroversion, sensing, thinking and judging). A three point scale of Very True of Me [VTOM (3)], True of Me [TOM (2)], Not True of Me [NTOM (1)] was used for the respondents to select which statement best fits their personality type preference. Section A of the instrument contained four items on bio-data and school background information of the student. The content validity index of CTI was established at 0.71. The estimated reliability of CTI was 0.52 Cronbach coefficient alpha value. The indices show that the instrument is valid and reliable.

B. VAK Learning Style Indicators (VLSI)

VLSI was adapted from Chislett and Chapman (2005). It was a 22-item instrument. The instrument elicited information on the preferred learning style preferences of the respondents in terms of visual, auditory and kinesthetic. A three point scale of To a large extent (3), To a moderate extent (2), To a low extent (1) was used for the respondents to rate the extent to which they prefer the three learning style preferences. Section A of the instrument contained four items on bio-data and school background information of the student. The content validity of VAK was 0.75. The estimated reliability of VAK was 0.65 Cronbach coefficient alpha value. The indices show that the instrument is valid and reliable.

C. Biology Achievement Test (BAT)

This consists of two sections. Section A focused on the demographic data of the students that is: Name, School Name, Sex, Class, and Age. Section B focused on 7 topics. The topics are: Biology and living things, Plant and animal nutrition, Ecological concepts and functioning ecosystem, Ecological management and conservation, Micro-Organisms and better health, The cell and its environment, Tissue and supporting system. The total numbers of test items is 60. The items were developed based on Blooms Taxonomy learning outcomes i.e learning domains. The cognitive domain involves knowledge and the development of intellectual abilities and skills. This includes the recall or recognition of the specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills. Three major categories or levels are considered. They are: knowledge, comprehension, and application. The test achievement blue print in table 1 presents the distribution of items over different topics. The estimated Reliability coefficient of BAT using Kuder Richardson 20 (KR-20) was 0.75. Meaning that 75 percent variance in student achievement score in biology is measurable by BAT.

Table 2: Test Blue Print for a 60 Multiple Choice Items on Biology

S/N	Topics	Knowledge	Comprehension	Application	Total %
1.	Biology and Living Things	3, 4, 5, 6, 7, 8, 10, (07) 11.7%	2, (1) 1.7%	1, 9, (2) 3.3%	(10) 16.6%
2.	Plant and Animal Nutrition	12, 14, 15, 18, 19, (5) 8.3%	11, 16, 17, (3) 5%	13, 20, (2) 3.3%	(10) 16.6%
3.	Ecological Concepts and Functioning Ecosystem	22, 28, (2) 3.3%	26, 27, (2) 3.3%	2, 23, 24, 25 (4) 6.7%	(08) 13.3%
4.	Ecological Management and Conservation	29, (1) 1.7%	30, 31, 32, 34, 35, 36, (6) 10%	33, (1) 1.7%	(08) 13.3%
5.	Micro-Organisms and Better Health	37, (1) 1.7%	39, 40, 43, (3) 5%	38, 41, 42, (3) 5%	(07) 11.7%
6.	The Cell and It's Environment	44, (1) 1.7%	45, 47, 48, 49, 50, (5) 8.3%	46, 51, (2) 3.3%	(08) 13.3%
7.	Tissue and Supporting System	55, 56, 57, 60, (4) 6.7%	52, 53, 59, (3) 5%	54, 58, (2) 3.3%	(09) 15%
Total		(21) 35%	(23) 38.3 %	(16) 26.6%	(60) 100%

2.5 Data Collection

The researcher engaged four research assistants who were trained for two days on how to handle the administration of the research instruments effectively. The researcher himself monitored the data collection exercise. The administration of the instruments in each school was in a sequence of CTI and VLSI coming up the first day, and BATS the second day. Data collection exercise lasted for seven weeks.

2.6 Data Analysis Procedure

Path Analysis and Multiple Regression were used to analyze the data collected for the study to test the research questions:

3. Results

RQ1: What are the estimated,

i. direct,

ii. indirect, and

iii. total causal effects among the variables (gender, age, extroversion, sensing, thinking, judging, visual, auditory, kinesthetic, and Biology achievement)

Table 3: Summary of Causal Effect for Re – specified Model (Biology Achievement)

Outcome	**Determinants**	**Causal effect**		
		Direct	**Indirect**	**Total**
Extroversion (Z_3)	Gender (Z_1)	-.154	—	-.154
	Age (Z_2	—	—	—
Adj: R^2 = .023				
Sensing (Z4)	Gender (Z_1)	-.120	—	-.120
	Age (Z_2)	.062	—	.062
Adj: R^2 = .017				
Thinking (Z_5)	Gender (Z_1)	—	—	—
	Age (Z_2	.094	—	.094
Adj: R^2 = .008				
Judging (Z_6)	Gender (Z_1)	-.125	—	-.125
	Age (Z_2)	.064	—	.064
Adj: R^2 = .018				
Visual (Z_7)	Gender (Z_1)	.109	.044	.153
	Age (Z_2)	—	-.018	-.018
	Extroversion (Z_3)	-.287	—	-.287
Adj: R^2 = .194	Sensing (Z_4)	—	—	—
	Thinking (Z_5)	-.187	—	-.187
	Judging (Z_6)	—	—	—
Auditory (Z_8)	Gender (Z_1)	.070	0.49	.119
	Age (Z_2)	-.067	—	-.067
	Extroversion (Z_3)	-.317	—	—
	Sensing (Z_4)	—	—	—
	Thinking (Z_5)	—	—	-.090
	Judging (Z_6)	-.090	—	—
Adj: R^2 = .164				
Kinesthetic (Z_9)	Gender (Z_1)	.107	.045	.152
	Age (Z_2)	—	-.017	-.017
	Extroversion (Z_3)	-.292	—	-.292
	Sensing (Z_4)	—	—	—
	Thinking (Z_5)	-.184	—	.-184
	Judging (Z_6)	—	—	—
Adj: R^2 = .198				
Biology	Gender (Z_1)	-.058	-.017	-.017
Achievement (Z_t)	Age (Z_2)	-.113	.011	-.067
	Extroversion (Z_3)	-.284	—	—
Adj: R^2 = .279	Sensing (Z_4)	.109	—	.284
	Thinking (Z_5)	—	.064	.173
	Judging (Z_6)	—	—	—
	Visual (Z_7)	—	—	—
	Auditory (Z_8)	-.347	—	—
	Kinesthetic (Z_9)	—	—	—

Note: Direct effects are significant at P> .05 levels

Table 3 shows the direct, indirect, and total effects of the eight endogenous variables.

3. Discussion of Findings

In this study, it was revealed that extroversion, sensing, and thinking had direct effects on Biology achievement. Also, sensing had the highest total causal effects on Biology achievement. These findings are consistent with the findings of Adele et al, (2007); Terrance et al, (1998) who established that extroversion, sensing and thinking are predictor variables to achievement. The positive effects of these variables on Biology achievement are not unexpected because the types of attributes which extroverts, sensors, and thinkers naturally possess are those that can make them learn Biology effectively.

Also, the study established that kinesthetic had the highest direct effect on Biology achievement. This result is in line with the findings of Ebel (1999); Cavanaugh (2002) who reported that kinesthetic was a predictor of students' achievement. This may be so because Biology as a science subject requires learners who have zeal for practical activities. However, in most of our senior secondary schools, practical classes and field trips are often neglected by many Biology teachers. This can hinder the zeal students may have for practical work which may in turn affect their achievement in Biology negatively. This implies that kinesthetic as a learning style is a strong factor that needs to be given due attention in order to bring about desirable improvement on Biology achievement.

It was established in this study that, it is only thinking that had both significantly direct and indirect effects on Biology achievement. This agrees with the findings of Adele et al, (2007) who found that thinking had a high significant relationship with academic performance. This could be so because the way an individual thinks may affect the way he/she processes new and difficult information which in turn may affect his/her level of achievement.

The findings also showed that gender had no direct effect on Biology achievement. What this suggests is that there was no remarkable relationship between gender and achievement in Biology. This finding disagrees with the findings of Dijkstra (2006); Rossiter (1992) who reported that males performed better than females in sciences. The reason for this disagreement could be associated with the provision of equal educational opportunity for all children by Nigerian government. Similarly, it could be linked with the welcome development among many parents to give equal attention to the education of their male and female children. However, this study revealed direct and indirect effects of gender on visual, auditory, and kinesthetic. This is confirmed by the findings of Cavanaugh (2002), Ebel (1999) who established that

males tend to be more kinesthetic and visual than females. Also, Pizzo (2000) found that females more than male tend to be auditory.

4. Conclusion

In the light of the findings of this study, it is clear that significant direct effects existed between extroversion, sensing, thinking and Biology achievement. It is revealed that a strong statistically significant direct effect existed between sensing and Biology achievement.

5. Recommendations

Based on the discussion on the findings of this study, the following recommendations are offered to develop personality type and learning style preferences in students in order to enhance high or great achievement.

1. Students should develop and exhibit personality type preferences (extroversion, sensing, thinking), and learning style preference (kinesthetic) to learn Biology effectively.
2. It is advocated that teachers should adopt and combine right approaches that could encourage and allow students exhibit these learner personal variables (extroversion, sensing, thinking, and kinesthetic) when teaching Biology.
3. Since students spend most of their time at home with their parents, thus, parent should keep watchful eye on their children with a view to encouraging them each time they exhibit extroversion, sensing, thinking, and kinesthetic preferences.

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