Exploring the Correlations between Learning Style Preferences and Academic Performances of Senior High School Students in Integrated Science in the Gomoa East District

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ABSTRACT

The study explored the correlation between learning style preferences of high school students and their academic performances in science in the Gomoa East district of Ghana. An exploratory survey design with quantitative approach was employed. Ontology and epistemology were the philosophical paradigms that guided the study. Stratified sampling technique was used to select a sample size of 280 students from the accessible population. The instruments used were 'VAK' Learning Styles Self-Assessment Questionnaire as well as results from Integrated Science Achievement Test (ISAT), with Cronbach's alpha values of 0.80 and 0.85 respectively. Descriptive statistics were used to analyze the data in terms of mean, frequencies, etc. Pearson's moment correlation and t-test were also employed for the analysis. The findings revealed that the most preferred learning style of high school students in the district was the visual (43.6%), followed by kinesthetic (30%), and auditory (26.4%) modes. There was a positive correlation between learning style of students and their academic performance while a statistical difference was found between learning styles first- and second-year students in the district. However, there was no statistically significant difference between the learning style preferences of male and female students. The findings of the study could enable curriculum planners as well as policy makers to suggest more a curriculum more acceptable to students. It would also suggest to school administrators to look into the development of facilities to enhance teaching and learning of the Science.

Key words: Learning styles, Integrated science, Academic performance, Senior High School students.

1 INTRODUCTION

Learning is a major component of student life. Individuals who converge in a school as students come from different environments and hence have different learning experiences. Such different experiences make them exhibit different personality traits including ways of assimilating learning materials. There are a number of learning-related concepts which have been the focus of attention when attempting to identify factors that affect diverse learning-related performance One concept in particular which has provided some valuable insights into learning in both academic and other settings is learning style. Today, there is a greater recognition of our

need to gain a deeper understanding of our students, their learning differences, learning styles, learning difficulties and their predisposition to certain types of tasks to achieve their goals successfully (Pawlak, 2012).

Scholars who promote the learning style preference approach to enhance acquisition of knowledge agree that effective instruction can only be undertaken if a learner's learning preferences are diagnosed and the instruction is tailored accordingly (Pashler, McDaniel, Rohrer, & Bjork, 2008). A learner's learning style has been recognized as a potential factor affecting that learner's performance (Gohar & Sadeghi, 2012). A Chinese quotation that states, "I hear and I forget. I see and I remember. I do and I understand" by Confucius (551-479 BC), provides evidence that, even in early times there was recognition of the existence of different learning preferences among people. Learning style preference is not a concept that is merely discussed by researchers and psychologists. It is the key to improving school climate and student achievement by recognizing that all people are not the same, and that all students do not learn in the same way (Dunn & Griggs, 2000). Omrod (2008) reports that, some students seem to learn better when information is presented through words (verbal learners), whereas others seem to learn better when it is presented in the form of pictures (visual learners). Others learn better through physical manipulation of learning resources (kinesthetic). Furthermore, in Othman and Amiruddin's studies, learning style approaches are found to some extent to improve students' motivation (2010).

One of the most common and widely-used categorizations of the various types of learning styles is Fleming's VARK model (an acronym for the Visual, Auditory, Read/Write and the Kinaesthetic sensory modalities) which provides the learners with a profile of their learning styles, based on the sensory modalities which are involved in taking in information. This model expanded upon earlier Neuro-linguistic programming (NLP) models which split into three groups VAK (Visual, Auditory and Kinesthetic) which are referred to as Representational Systems (Sree & Chinyi, 2017). The present study is underpinned by the visual, auditory and kinesthetic learning style (VAK) model. The original VAK concepts were first introduced by psychologists such as Fernald, Keller, Orton, Stillman and Montessori in the 1920´s (Chislett & Chapman, 2005) but recently, the interest has further gained ground in the quest for best teaching practices in education. The VAK theory is considered to be one of the classical learning theories in the educational field, it is best known as VAKT, visual (V), auditory (A), kinaesthetic (K) and tactile (T) (Mackay, 2007). Chislett and Chapman (2015) are of the view that respondents with a preferred learning style focused on Reading (the R in VARK) are included in the Visual learning style. The Intel Corporation (2007) also reported that this theory has proven to be a popular and simple way to identify different learning styles. Byrnes (2010) stated that "the VAK model can be utilized to assist in incorporating different learning techniques into classroom instruction and activities".

A study by Lisle (2007) used a VAK learning model in determining the learning style preferences of adults who experience learning difficulties. The study showed that (34%) participants preferred a visual style, which was an equal proportion to those who prefer an auditory style (34 %). Of the remaining students, (23 %) were kinaesthetic learners and (9 %) had multimodal learning style preferences. The result showed most of

the learners preferred visual and auditory learning, and that younger learners prefer kinaesthetic more than adult learners. From the above, it convincingly suggests that learning is more effective if education is delivered and oriented in a way that matches an individual's learning style. In Kenya, a study by Nzesei on a correlation study between learning styles and academic achievement among Secondary School Students in Kenya found out that, no significant difference existed in learning style preference among male and female students. Also, there is strong positive and statistically significant relationship between learning styles and academic achievement (Nzesei, 2015).

2 PROBLEM STATEMENT

Integrated science is one of the core subjects in senior high schools in Ghana. It comprises biology, chemistry, physics, agriculture and partly environmental science. It is a course designed to show the unity, and interrelationship of the distinct disciplines that make up science (Abba, 2000). Poor performance of students in Integrated Science in most Ghanaian schools leaves much to be desired. Tracing the causes of students' poor performances has been a challenge for stakeholders in the educational sector. Perhaps this low performance in science could be attributed to the fact that students learning styles have not been considered. Though extensive literature and research exist on learning styles in some countries, especially European and Asian countries, there have been only a comparatively small number of studies that have assessed learning styles preferences and academic performance of senior high school students in Ghana. A study by Esia-Donkoh on differences in learning style preference of students in Colleges of Education in Central –Western Zone of Ghana revealed that, generally, a combination of visual, auditory and kinesthetic were prefered by the students (Esiah-Donkoh, 2019). This study only focused on Colleges of Education (higher institution) students and did not extend to the Senior High School level. This study will increase the baseline study by Esia-Donkor.

3 OBJECTIVES OF THE STUDY

The objectives of the study were to determine:

1. The preferred dominant learning style of students in the Gomoa East district.
2. The relationship between preferred learning style of first and second year students.
3. The difference between preferred learning styles of male and female students.
4. The correlation between preferred learning style and academic achievement among students in the district.

4 RESEARCH QUESTIONS

1. What is the preferred dominant learning style of students in the Gomoa East district?
2. What is the relationship between preferred learning style of first and second year students?
3. What is the difference in preferred learning styles of male and female students?
4. What is the correlation between students' preferred learning styles and their academic achievement?

5 NULL HYPOTHESIS (Ho)

Ho 1. There will be no relationship between preferred learning styles of first and second year students.

Ho 2. There will be no statistical difference in the preferred learning styles of male and female students.

Ho 3. There will be no correlation between students' preferred learning styles and their academic performance in Science.

6 METHODS

6.1 Conceptual framework

The phillosophical underpinings of the study are hinged on ontology and epistemology. These two paradigms deal with the nature of reality, what can be known about it and how we go about attaining this knowledge. According to Bryman and Bell (2013) epistemological issue concerns the question of what is (or should be) regarded as acceptable knowledge in a discipline. Learning theories concern studies of human mind and behaviour. The theoretical framework of the study is based on the theories of cognitivism, behaviourism and constructivism. These theories considered in this study seek to explain the underpinning variations in student learning styles and performances. Each of these theories makes different assumptions about how people learn and remember. Each of them provides general explanations based on observations over time. They explain processes of knowledge acquisition and predict behaviour.

Learning style theory could be seen as interconnection between the learner, his environment and the learning process. The framework developed by the researchers from these relationships is conceptualized as interplay of several factors within the individual (learner) and the environment. Figure 1 presents how factors such as learning style preferences, and other environmental factors, as evidenced from literature, influence students' performance.

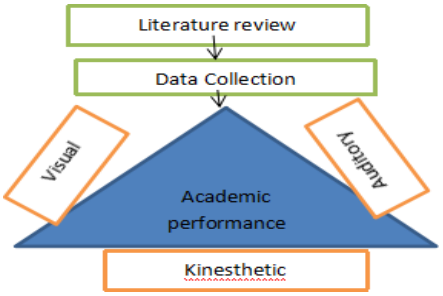


Figure 1: A conceptual framework the study.

The framework suggests that any of the visual, auditory or kinesthetic learning styles could influence students' performance. Other factors include gender and grade level. Reviewed literature has it that culture and teaching style also affect students' performance inadvertently.

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6.2 Research Design

The study was carried out using the survey design. The study was also designed along the lines of correlation research to assess the correlation between desired

variables. Gay (1996) described correlation research as that involving the collection of data to determine whether and the degree to which a relationship exists between two or more quantifiable variables. In correlational studies information is collected without manipulating the environment. Correlational studies are also conducted to demonstrate associations between variables, causality cannot be inferred (Creswell, 2008).

6.3 Population and Sample size

The target population for the study was all Senior High students in the central region of Ghana while the accessible population comprised of all the senior high school students in the Gomoa East district. The population of the students in the district stood at 2,792. Stratified sampling technique was used to select a sample size of 280 students from the two public senior high schools in the district. According to Van-Dalen (1979) a survey research should involve at least 10-15% of the accessible population. The 280 sample size selected constituted 10.02% of the accessible population and is in conformity with Van-Dalen (1979) and is in conformity with the normal sample size for making assumptions.

6.4 Instrumentation

In this study, data was collected by using an adopted VAK 's Learning Style Self-assessment questionnaire originally developed by Chislett and Chapman (2005) and results from administered Integrated Science Achievement Test (ISAT).

Description of VAK learning style self-assessment questionnaire

Dreeben (2010) suggested that the practical mode of VAK assessment, which includes asking learners about the way they receive information, is a strong reason for using it in the educational field. Questionnaire is one of the most widely used instruments for collecting data in survey research. The VAK questionnaire is practical self-assessment instruments that can help the students assess their unique learning styles (Chislett & Chapman, 2005). The model was developed to evaluate each individual's preferred learning style through different sensory channels namely Auditory, Visual, and Kinesthetic. In the present study the researchers adopted the model to model to help identify students that are Visual, Auditory and Kinesthetic learning style in the Gomoa East district of Ghana.

Below are examples of some of the items in the questionnaire:

- If I was buying a new car, I would: A) read reviews in newspapers and magazines

B) discuss what I need with my friends C) test-drive lots of different types

- When I am learning a new skill, I am most comfortable: A) watching what the teacher is doing B) talking through with the teacher exactly what I'm supposed to do C) giving it a try myself and work it out as I go

Scoring of the instrument was based on a three points Likert scale response where the number of A's B's or C's were added up. If one chooses mostly A's, one is visual, B's auditory and C's kinesthetic. In the case that one chooses equal number of A's or B's or C's, then he/she has a bimodal number learning style.

Description of integrated science achievement test (ISAT)

A 25 test items was developed to assess the performance of students in

Integrated Science. The Integrated Science Achievement Test (ISAT) was based on items culled from topics in the integrated science syllabus. The test was based on energy, diversity of living things matters and soil. The researcher made sure that, the selected topics in which the test items were culled from were all topics treated by both the first and second year students. This is because, high school education Ghana is a progressive one in which students would go through all the courses till they write the final year examinations by the West Africa Examinations Council (WAEC). Prior to the actual study, a pilot test was conducted using the instruments in a school in Gomoa Central district. This was to establish the validity and reliability of the instruments.

6.5 Validity and reliability of the instruments

To ascertain content validity of the instruments, the instruments were given to the academic supervisor at the department of Science Education, University of Education, Winneba to determine its workability. This consultation was aimed at examining the contents and the structure of the instruments, and judged their adequacy for use in the study. The resultant suggestions and recommendations were used to make appropriate amendments to the instruments. In ensuring reliability of the instruments, data obtained from the LSI and ISAT were subjected to a reliability test using SPSS software which recorded a Cronbach's alpha value of 0.80 and 0.85. This means that, data obtained using the instruments were all reliable.

6.6 Data analysis

The data gathered from the study sample were organized, coded and recorded. SPSS (Version 20) statistical software was used for the quantitative data collected from the questionaires. Prior to the analysis, normality test were run on the relevant variables. The data derived from the VAK categorized into three; visual, auditory and kinesthetic. Again, the data from the ISAT were also recorded and matched the VAK learning styles. Descriptive statistics was run to obtain frequencies of dominant learning styles, the learning styles of boys and girls as well as the form or the grade level of the students. Pearson Product Moment Correlation and Chi square tests were used to find the correlation between preferred learning style of respondents and their academic performances to show whether a relationship exists and how strong or weak it is by gender and grade level.

7 RESULTS AND DISCUSSIONS

7.1 Research question 1

What is the dominant learning style of SHS students in the district?

To answer research question 1, statistics on the dominant learning style of students is summarized in Table 1.

Table 1: Learning Styles preferences among SHS Students in the Gomoa East District

Statistics	Visual	Auditory	Kinesthetic
Mean	12.17213	10.71622	11.22619
Kurtosis	-1.30267	-0.6842	0.203724
Skewness	0.13984	-0.21379	-0.51999
Count	122	74	84

According to Tabachnik and Fidell (1996) normality of data is attained when kurtosis and skewness are between -2 and +2. The computed scores for the learning style preferences fell within the ranges for skewness and kurtosis. Hence, all the observations on learning style preferences were normally distributed signifying the absence of extreme values that have the potential of upsetting the results of the study. From the findings, the visual learning style was observed to have recorded the highest standard deviation (2.15), followed by auditory (1.10) and kinesthetic (0.899) (Table 1).

The results in Table 1 also show that visual learning style recorded the highest mean score of 12.17 ± 2.15 (SD). This was followed by kinesthetic and auditory learning styles which respectively recorded means of 11.226 ± 0.899 (SD) and 10.716 ± 1.10 (SD). The foregoing result therefore indicates that the visual learning style was the most dominant learning style amongst the study participants surveyed. This is because the visual learning style recorded the highest count of 122, and a mean score of 12.17 The second dominant learning style by virtue of registering the second highest count of 84 and a mean score (11.23) was the kinesthetic. Auditory learning was found to be the least preferred learning style among the surveyed participants with a count of 74.

The findings of the study are in agreement with a dissertation carried out in Kenya which showed that, majority of the students had strong visual than auditory and kinesthetic modalities (Nzesei, 2015). However, this finding is against the findings by Tachie-Young (2010) on learning style preference of Junior High School (JHS) students in some selected schools in the greater Accra region of Ghana. His findings rather showed that, majority of the students showed preference for the auditory leaning style (65%), followed by the kinesthetic style (25%) and then the visual learning style (10%).

From the findings, the poor performance of students in the Gomoa East district could be due to the fact that, most of them are visual learners but their teachers are mostly known to be using more of the lecture method in teaching (which satisfies the auditory learners). Therefore, the teaching method does not match majority of the students' preferred learning style hence, the low performance in Integrated Science in the area.

7.2 Research Question 2

What is the relationship between learning style of first and second year students?

The objective for this question was to determine the relationship between learning style preferences of first and second year students. Before answering the research question 2, the distribution of students' learning styles and their grade levels were determined. The adapted VAK questionnaire was administered to the students (n=280).

Out of 129 respondents from the first year, who participated in the study, 60(46.5%) respondents were used to the visual learning style, 38(29.5%) were used to audio learning style and 31(24.0%) were used to the kinesthetic style. For the second year students, though majority of them were visual 62(41.0%) from the total (n=151), it was rather followed by kinesthetic 53(35.0%) and then Auditory 36(24.0%).

To determine the relationship between learning style preferences of first year students and second year students, a Pearson product moment correlation test was conducted. Before conducting the analysis on correlation, the number of observations for the learning style preferences for the second year students (n = 151) was brought to be at par with that of the first year students (n = 129). This is because the observations for the second year students exceeded that of the first year students by twenty-two (22) observations. This move was necessary to ensure that each observation under one variable (i.e. second year students learning style preferences) could be paired with observations under the other variables (i.e. first year students learning style preferences) under investigation. Summary of the Pearson moment correlation analysis on learning style preferences of first and second year students are summarized in Table 2.

Table 2: Analysis on learning style preferences of 1st and 2nd year students

Statistics	Computed Values	Critical values
Pearson Moment Correlation, r	0.1209	0.117*
N	129	

From Table 2, the r critical value was found to be 0.117 at a 0.05 significant level. The computed r-value was observed to be 0.1209, suggesting a positive correlation between learning style preferences between first year and second year students. Furthermore, since the computed r-value (r = 0.1209) was observed to be greater than the r-critical value ($r_{critical}$ = 0.117), it meant that the relationship or correlation between the learning style preferences of first year and second year students in the schools was statistically significant and could not be due to chance. The finding is, however, at

variance with a study by Asiry (2015) on the learning styles of dental students at King Saud University. He found that the learning preference of students remained unchanged from their first to final year at College of Dentistry. This suggests that first year and second year students in Gomoa East District could have learning style preferences which may persist until they have completed school. This has implications for teaching and learning methods used as far as form is concerned. The finding therefore presupposes that a learning style that is effective for first year students may by extension be also effective for second year students to facilitate learning.

7.3 Research question 3

This question sought to determine whether there was any relationship between learning style of males and females. Table 3 presents the summary of cross tabulation of learning styles of respondents and their gender distribution.

Table 3: Crosstab of Learning Style and Gender distribution

	Learning styles			Total
	Visual	Kinesthetic	Auditory	
Male	43(30%)	30(22%)	28(20%)	137(26.4%)
Female	79(58%)	54(38%)	46(32%)	143(41.2%)
Total	122(44%)	84(30%)	74(26%)	208(100%)

Source: SPSS version 20.0 output, 2017.

From Table 3, out of 143 male respondents who participated in the study, 54(38.0%) of them were used to the kinesthetic learning style, 46(32.0%) to audio learning style while 43(30.0%) were used to the visual learning style. However, the female respondents showed more preference for the visual style 79(58.0%), followed by kinesthetic 30(22.0%) and then auditory 28(20.4%). Assessment of the academic performance (scores) of male and female students is summarized in Table 4.

Table 4: Statistics of Academic Scores of Male and Female Students in Gomoa East District

Descriptive Statistics	Males	Females
Mean	51.5524	51.0949
Standard Deviation	13.7997	14.2240
Count	143	137

From Table 4, it can be observed that male students registered a mean academic score of 51.55 ± 13.799 (SD), whilst the female students in the study recorded a mean academic score of 51.09 ± 14.224 (SD).

To determine the relationship between learning style preferences of males and females, a Pearson product moment correlation test was conducted. Before conducting the analysis, the number of observations for the learning style preferences for the male students were made to be at par with that of the female students (n = 137), as the former exceeded the latter by six (6) observations. This move was necessary to ensure that each observation under one variable could be paired with another observation under some other variable under investigation. A summary of the Pearson moment correlation analysis on learning style preferences of male and female students at a significant level of 0.05 was found to be 0.117. The computed r-value was observed to be 0.0526, suggesting a positive correlation between learning style preferences between males and females. However, since the computed r-value (0.0526) was observed to be smaller than the r-critical value (0.117), it meant that the relationship or correlation between the learning style preferences of male and female students in Gomoa East District was statistically insignificant.

To test the second hypothesis, "There is no significant difference between learning style preference of male and female students, a paired t-test was conducted. The computed t-statistic was found to be 0.0177 (p = 0.493, df = 136), a value less than the t critical value of 1.656. This therefore means that there is no significant difference between learning style preference of male and female students. We fail to reject the null hypothesis that there is no significant difference between learning style preference of male and female students.

This finding parallels a study that involved physiotherapy students in Sri Lanka which showed that there was no significant difference among male and female students on the preferred VARK mode. The finding therefore presupposes that a learning style that is effective for male students may also be effective for female students. This means that performance of male and female students in the district may not be influenced by a choice of a particular learning style but largely by other factors as well.

7.4 Research question 4

The last question sought to find out the correlation between the students' learning styles and their academic performance in science. To answer this, a Pearson Product Moment Correlation analysis was conducted. At a 95% confidence level results indicated that r critical at 0.05 was found to be 0.095. The computed r-value was observed to be 0.09948, suggesting a positive correlation between learning style and academic achievement. Furthermore, since the computed r-value was observed to be greater than the r-critical value, it meant that the relationship or correlation between the learning style and academic achievement of students in the district was statistically significant. In the light of the foregoing, the hypothesis, "There is no correlation between students learning styles and their academic performance in Science" is thus rejected.

Dobson's (2009) study revealed that there was a significant different relationship between perceived sensory modality preference and academic performance (p = 0.06 by ANOVA). This implies that a respondent's score is affected by their choice of learning style. Perhaps majority of the

students in the district have not identified and adopted appropriate learning styles, hence the low performances. The need for students to adopt proper learning styles could help them become better learners, leading to increase in performance.

In contrast, studies related to the effects of learning styles on achievement in a World Wide Web course, results showed that learning styles had no effect on students' achievement or attitude in Web-based instruction (Shih & Gamon). This finding could be due to the Web-based instruction. Learning in a Web-based instruction environment is different from learning in physical environment, perhaps that contrary view. Stakeholders in education should therefore aim at providing enabling environments, as well as auditory-visual materials to increase performance of students in SHS Integrated Science. Also, science teachers should be encouraged to make their lessons as practical as possible to help students' understanding. Besides, Senior High School authorities should organize in-service training on learning styles for teachers. This will enlighten them to be able to vary their teaching methods.

8 CONCLUSION

The findings revealed that the most preferred learning style of high school students in the district was the visual (43.6%), followed by kinesthetic (30%), and auditory (26.4%) modes. There was a positive correlation between learning style of students and their academic performance while a statistical difference was found between learning styles of first and second year students in the district. However, there was no statistical significant difference between the learning style preferences of male and female students. Findings from the study reveal that teachers must of necessity be aware of students' varying learning styles and vary their teaching strategies to cater for each learning style. Since most students in the district showed more preference for the visual learning style, it was found that the teachers' teaching styles, which were mainly suited for other styles did not match these students' style of visual learning style. This could be inferred as the cause of the poor performance of students. Science teachers should focus more on valid methods such as the use of videos, animations, charts and more importantly practical lessons.

9 RECOMMENDATIONS

The following recommendations were provided:

- National Council for Curriculum Assessment (NACA) of the Ministry of Education could consider introducing strategies related to learning styles to be used by teachers.
- Teacher education institutions must introduce pre service teachers to the concept of learning styles. The concept must be made part of curriculum studies or other educational related courses being run in the institutions.
- School authorities within the Gomoa East district may provide seminars regarding the importance of the awareness of the learning style of students.
- Schools should ensure that their facilities such as libraries, science laboratories and ICT laboratories are well equipped with audio-visual equipment and encourage their usage.
- Future scope: Researchers may consider and extent the study to the correlations between learning styles and teachings styles in future.

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