International Journal of Multidisciplinary Studies and Innovative Research
Published by Catholic University College of Ghana
ISSN: 2737-7180 (Print), ISSN: 2737-7172 (Online)
DOI: http://doi.org/10.21681/IJMSIR-0.1.213.6102-2021

RELATIONSHIP AND IMPACT OF LEARNING STYLES ON STUDENTS' ACADEMIC ACHIEVEMENT

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Abstract: The study examined learning styles on students' academic achievement. In Kintampo North Municipal. It investigated such research questions as what is the relationship and impact between learning and students' academic achievement in mathematics and ICT. Descriptive-correlational design was employed to answer the research questions investigated. One hundred forty (140) respondents (junior high students) were selected through simple random sampling techniques to be part of the study. Pearson correlation and hierarchical regression were used to analyse the results of the study. The findings revealed that the learning style modalities, visual, reading-writing, and kinesthetic were positively related to mathematics learning. However, the learning style aural was inversely related to the learning of mathematics. Besides, it was found that the sensory modalities visual and kinesthetic were also positively related to learning of ICT, aural and reading-writing were inversely related to ICT learning. The hierarchical regression model indicated that visual, reading-writing, and kinesthetic had a positive impact and mediate learning of mathematics($p - value = 0.134 > 0.05$). Additionally, the analysis of outcomes also indicated that visual and kinesthetic mediate learning of ICT and had a positive impact $(\text{Adjusted } R^2 = 0.452,\ \text{p} - \text{value} = 0.000 < 0.05 \text{ and change in } R^2\ 0.023, \text{p} - \text{value} = 0.000 < 0.05)$. The study, therefore, strongly recommends that mathematics teachers should optimise visual, reading-writing, and kinaesthetic sensory modalities in the learning of mathematics. Again, maximizing the use of visual and kinaesthetic sensory modalities would increase performance in ICT.

Keywords: Learning styles, academic achievement, performance, kinesthetic mode, mathematics, ICT

I. INTRODUCTION

One of the most critical factors indispensable to students' learning and could define their academic achievement is the students' thought and judgment. Any country's quest of producing a solid human resource base relevant to her socio-economic development by delivering quality services to the citizenry is contingent on the progress that students make in their learning right from the scratch of their various educational levels. Students' poor academic performance consequently incapacitates our various educational institutions to shoulder tasks that they are prepared to navigate (Nja & Obi, 2019). It is instructive to observe that most vital institutions such as health, education, engineering, etc., mandated to perform essential services to humanity are navigating those roles with a sense of mediocrity. The issue of poor academic performance continues to engage the attention of educationists and policymakers over the period of time. Several reasons in the past have been advanced accounting for this phenomenon. For instance (Nbina & Obomanu, 2011; Nkanu, 2009; Oriade, 2008) in their studies identified insufficient instructional materials, poorly equipped laboratories, and in most instances, learning laboratories practically out of existence for instructors' use are reasons explaining specifically poor performance of students in Chemistry. These reasons are not different from those causing performance to take nose-dive in other subjects in general, consequently moderating poor performance and low academic achievement among students.

Students differ diametrically in respect of how they process, encode, recall and apply information that they receive by way of learning. Some of them exhibit much thought in their learning endeavors while others process information they receive peripherally. Learning styles among students are factors whose promise for accounting variance in the students' academic achievement cannot be over-empathised. According to Ghaedi and Jam (2014), learning styles denote modifying one or more senses to make meaning, organize and keep learning experiences impacted to the learner. In their study, Alavi and Toozandehjani (2017) brought to light that the students' learning can be improved through their learning styles. Further along this spectrum, Barman, Aziz and Yusoff (2014) also studied learning style and academic performance and came to conclusion that

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learners' awareness of the ways they process and retain information can leap-frog their gain and progress in learning. It was revealed in a study conducted by Dalmolin et al. (2018) that there was a strong association mediating how learners process and retain information and their achievement levels in learning. Additionally, Magulod Jr. (2019) also corroborated this assertion through his study by further stating that a significant connection existed between learning styles and academic achievement.

Therefore, teachers should be constructing a learning atmosphere conducive to learning since academic achievement is a pointer to effective learning experiences. The students' style should be considered as an essential pathway to harness their innate potentials in learning. Instructively, different viewpoints on the approaches and strategies of learning exist, which have been validated by theorists. These scrutinize and discern several facets such as subconscious, subliminal, milieu, personality modality, and experiential learning. Interestingly, these approaches and strategies demonstrate that learning has cognitive, affective, and behavioural features, premised on viewing, responding, and interacting with methods and principles. Based on all these denotations and postulation advanced, it stands to reason that how students process and retain information or students' strategy that they adopt in learning works with specific milieu, learning processes, interpreting and obtaining information, practice or worthwhile skills. The students' way of processing and retaining information considers various factors such as age, sex, personality, heritage, breed, and environmental influence, specifically parental level of education and the dynamics of culture, school, and surroundings Othman and Amiruddin (2010). Several educators can vaunt better instructional strategies; nonetheless, they cannot deliver with such promising approaches to students in the reality of teaching. This stems from the fact that an average teacher is bound with formal-routine teaching styles and more organized class activities.

Consequently, learners should express to educators the instructional modes they feel good with and desire to allow educators to better appreciate them to fashion instruction tailored to their needs. Educators, too, should be much encouraged to figure out suitable teaching styles corresponding to their students' needs. Shallow knowledge and skills in learning theories with its attendant low insight of learning styles by some educators explain why students' learning has become ineffective. When students' learning styles are compatible with teachers' teaching styles, students will be more inspired to maximize learning, leading to academic performance (Miller 2001Still Gohdes 2003) in Othman and Amiruddin (2010). This research hinges on the VARK learning model which denotes visual, aural, reading, and kinesthetic learning modalities Fleming (2006) in Othman and Amiruddin (2010). They further argued that students with aural mode are inclining to get information by listening and discussion. Those identified with the style of reading has the propensity to accept and interpret printed information. Students who are susceptible to accept learning through interpreting charts, graph figures, and pictures are visually inclined. Kinesthetic mode demonstrates learning premised on such behaviour as touch, feel, see, and listen.

As surmised by Annie, Howard, and Mildred (1996), academic performance indicates measures of the results of education and the extent to which a learner, teacher, or institution has achieved their educational set standards and goals. Academic achievement is also assessed as the level of progress that student makes in their learning as reflected in the feedback of the students' formative and summative learning outcomes. Several studies have established a relationship between learning styles and academic performance. Lu (2013) posited that middle school students with high English scores like to utilize visual, auditory, verbal, logical, and independent learning styles. Inversely, a kinesthetic and interpersonal learning style is insignificant in influencing scores of English. Pashler, McDaniel, Rohrer, and Bjork (2008) surmised that students' academic achievement could be best when students' learning styles are compatible and consistent with the teachers' teaching styles. Further along, Lu and Lin (2013) added that the reason explaining students' remarkable scores in Mathematics is obviously related to procedural-organised learning style, which gives prominence to repeated practice, which is consistent to teachers' teaching styles that emphasise on practicing and step by step problem-solving. Even though several studies have been done espousing the connection between learning styles and academic achievement, in most instances, not much has been done to establish this link between the student's style of learning and achievement in Mathematics and Information Communication and Technology [ICT] in peri-urban settings. Learning styles and achievement has received much attention in recent times; notwithstanding, this current study extends the past studies by examining the relationship and impact between learning styles and students' achievement in contextually and methodologically different ways. The indispensable role that learning styles play in the students' academic achievement has fortified the conceptualization of this study to measure the relationship and impact of learning styles of junior high students in Wenchi municipal district. The investigated the research question ''what is the relationship and impact between learning styles and students' academic achievement in mathematics and ICT?''.

II. MATERIALS AND METHODS

Study Type and Design

The study used descriptive-correlational research with cross-sectional methods to collect the data to help analyze and interpret the results. According to Creswell (2007) descriptive research emphasized practices, conditions, differences or relationships that exist, opinions held processes that are going on, or trends that are evident. Correlational research is used to measure the degree of

relationship between two variables Subia, el at. (2019). The study used a quantitative type of method.

Sample and Sampling Techniques

The study used stratified random sampling to sample 140 junior high students in the Kintampo North Municipal to be part of the study after seeking their consent, and briefing them about the purpose of the study. Stratified random sampling seeks to divide the population into smaller groups known as strata composed on account of members' shared qualities or attributes (Sharma, 2017). Having put the respondents into strata, lottery method of simple random sampling was used. A sampling frame consisting of an alphabetical list of the names of each respondent was used. The sampling frame was established, indicating the names and exchanged with the numbered marble such that each one ties in with the respondent's name. The number on the marble selected was recorded to tie to the respondent's name. The activity was continued till the required sample needed for the study was accomplished.

Instruments

Adapted VARK Questionnaires (Version 8.01) and self-developed items were used to measure Visual, Aural, Reading-Writing, and Kinesthetic styles and academic achievement, respectively. The questionnaires had the necessary biographic data of the respondents and the main items measuring the construct. The questionnaire items for the learning styles and academic achievement have 5-point Likert scale ranging from Strongly Agree (SA), Agree (A), Moderately agree (MA), Disagree (D), and Strongly disagree (SA) in which the respondents were to select one. The study relied on the scores of the unstandardised summative assessment of Junior high students in ICT and Mathematics. For the ICT and Mathematics, a score below 35 was ranked ''below minimum achievement'', 35-54 ''minimum achievement'', and score 55-69 was maximum achievement, and 70 and beyond wasabove maximum achievement. All the responses were subjected to statistical analysis, having been coded by the researchers.

Variables for the Study

Independent variable- The independent variable for the study is learning styles designated as Visual (V), Aural (A), Reading-writing (R), and Kinesthetic (K). According to Desire (2019), the VARK model of learning indicates four main types of learners.

Intervening variables- The study controlled three variables that can engender influence on pupils' academic achievement. These variables were pupils' gender, age, and class size.

Dependent Variables

The pupils' summative unstandardised assessment results for Mathematics and ICT for junior high two and three students were used as outcome variables.

Data Collection Procedure

The municipal education directorate was contacted, and permission was sought to participate in the study. All the respondents were willingly asked to participate in the study, having solicited their informed consent and assured of confidentiality before administering the questionnaires. The questionnaires were self-distributed to the participants by the researchers. The questionnaire comprised two sections, namely A and B, representing demographic information and the main section measuring the construct. The students were charged to submit the items after a few hours to ensure a good response rate.

Data Analysis

The results of the data were analysed using descriptive (Mean and Standard deviation) and inferential statistics (Pearson's correlation and hierarchical regressions) with the help of the Statistical Package for Social Sciences (SPSS) version 25.0. The descriptive statistics helped to discover a level of learning styles among the students, while the inferential was used to measure the relationship and impact of learning styles and achievement.

III. RESULTS AND DISCUSSION

A reliability test was carried out on the learning styles modalities (Visual, Reading-Writing, Aural, and Kinesthetic) of each of the 28 items on a scale of 1 to 5 [1= strongly disagree, 2 = disagree, 3= no opinion, 4= agree, 5 = strongly agree]. The results indicate that Cronbach's alpha showed items of Visual, Reading-Writing, Aural and Kinesthetic to reach acceptable reliability, $\alpha = 0.753$, $\alpha = 0.823$ $\alpha = 0.703$, $\alpha = 0.81$ respectively. Most items appeared to be worthy of retention, resulting in a decrease in the alpha if deleted. The dependent variable was unstandardized students' end-of-term examination raw scores in Mathematics and [ICT].
Table 1 and 2 show the correlation matrix and descriptive statistics for all variables indicating a relation between the criterion variable mathematics and ICT scores and independent variable learning styles (visual, Reading-writing, Aural, and Kinesthetic). The correlation matrix in Table 1 shows that as the predictor's visual, Reading-writing, and kinesthetic modalities increase, mathematics performance correspondingly goes high. Again, there is an inverse relationship between the moderator variable aural and the dependent variable, indicating an increase in moderator variables would result in the decrease in the performance of mathematics. The correlation matrix in Table 2 shows that there is a positive relationship between the predictor visual and kinesthetic and the performance in ICT.

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Reading-writing and aural are inversely related to the criterion variable, performance in ICT. The descriptive statistics (Mean and standard deviation) confirmed that the students agreed that their respective learning styles were present in them and were heterogeneous in their opinions. Hierarchical regression analyses were employed to analyse the data by entering control variables, age, gender, and class size. The results of hierarchical regression are shown in table 3. All continuous predicted variables were mean-cantered to address the occurrence of multicollinearity. Table 1 indicates all correlation coefficients among variables are less than 0.6 ($r < 0.6$), showing less correlation among variables. Variance inflation factors (VIF) for all variables were tested to detect the absence of multicollinearity. The results in table 3 and 4 show that all variables (VIF) are below a threshold value of 10, indicating that multicollinearity is not a concern among variables.

Table 1: Correlation Matrix and descriptive statistics between the learning styles and performance in mathematics

	Mean	Standard deviation	Maximum	Minimum	Correlation coefficient
Mathematics	42.11	14.53	80.00	15.00	1
Age	14.21	1.09	16.00	12.00	.039
Gender	.450	.499	1.00	.00	.067
Class size	40.94	7.759	51.00	35.00	-.033
Visual	3.870	0.930	4.86	2.00	0.247**
Reading-writing	4.091	.604	4.86	2.00	.107
Aural	4.17	0.671	4.86	2.00	-.057
kinesthetic	4.07	0.717	4.86	2.00	0.150

Table 2: Correlation Matrix and descriptive between the learning styles and performance in ICT

	Mean	Standard deviation	Maximum	Minimum	Correlation coefficient
ICT	38.01	18.59	85.00	11.00	1
Age	14.21	1.09	16.00	12.00	.411**
Gender	.450	.499	1.00	.00	.049
Class size	40.94	7.759	51.00	35.00	-.0139
Visual	3.870	0.930	4.86	2.00	0.220**
Reading-writing	4.091	.604	4.86	2.00	-.040
Aural	4.174	0.671	4.86	2.00	-.018
kinesthetic	4.070	0.717	4.86	2.00	0.028

Regression Model 1[Control Variables]

Model 1(table 3), including only control variables, is statistically insignificant (p>0.05), indicating that age ($\beta = 0.480$, p-value= 0.687>0.05), gender ($\beta = 2.396, p - value = 0.353$>0.05), positively influence performance in mathematics but insignificant. However, class size ($\beta = -0.081, p - value = 0.638$>0.05) negatively influence performance in mathematics insignificantly. The adjusted ($R^2 = 0.071\ p - value$>0.05) indicating 7.1% of variation in performance in mathematics is explained by control variables.

Regression Model 2[Including Learning Styles]

Model 2(table 3), including independent variables, learning styles (visual, Reading-writing, Aural, and Kinesthetic), and control variables (age, gender, and class size) in respect of mathematics. Visual ($\beta = 3.328$, p-value=0.024< 0.05), indicating visual learning styles positively influence learning of mathematics. Reading-writing ($\beta = 1.482, p - value = 0.563$>0.05) is insignificant, aural ($\beta = -1.049, p - value = 0.662$>0.05) influence performance in mathematics negatively but insignificant and kinesthetic ($\beta = 1.972, p - value = 0.413$>0.05) is statistically insignificant. The ($Adjusted\ R^2 = 0.008,\ p - value = 0.766$>0.05 $and\ change\ in\ R^2 = 0.071, p - value = 0.134$>0.05) indicating when learning styles were introduced, 7.1% of variation in mathematics performance was explained, enhancing the power of the model. It, therefore, stands to reason in the light of the above findings that visual, Reading-Writing and Kinesthetic learning styles have an impact on learning of mathematics, and if those learning styles are improved by 1 unit, it shall moderate to improve performance by 3.328, 1.482, and 1.049 respectively.

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Table 3: Regression Model (Dependent Variable –Unstandardized scores of mathematics)

Variables	Model 1				Model 2				Test for Multicollinearity	
Control variables	β	Stan. error	t	Sig	β	Stan. error	t	Sig	Tolerance	VIF
Constant	37.53	19.98	1.88	0.063	28.668	22.15	1.294	0.198		
Age	0.480	1.19	0.404	0.687	-.227	1.258	-.183	.855	.807	1.239
Gender	2.396	2.573	.931	.353	.522	2.706	.193	.847	.807	1.239
Class size	-.081	.172	-.472	.638	-.150	1.96	-.767	.444	.636	1.571
Indep. Variable										
Visual					3.328	1.461	2.277	0.024	0.797	1.255
Reading-Writing					1.482	2.629	.563	.574	.584	1.713
Aural					-1.049	2.395	.0438	.662	.571	1.752
Kinesthetic					1.972	2.402	.821	.413	.496	2.015
R-Value		.091				.282				
R- Square		.008				.079				
Change in R-Square		___				.071(7.1%)				
F-Statistics		.382				1.625				
Sig		.766				.134				

Table 4: Regression Model (Dependent Variable –Unstandardized scores of ICT)

Variables	Model 1				Model 2				Test for Multicollinearity	
Control variables	β	Stan. error	t	Sig	β	Stan. error	t	Sig	Tolerance	VIF
Constant	-58.08	23.243	-2.499	.014	-51.82	26.348	-1.967	.051		
Age	6.974	1.382	5.047	.000	6.80	1.472	4.618	.000	.807	1.239
Gender	4.00	2.99	1.33	.184	2.573	3.219	.800	.425	.807	1.239
Class size	-.118	.200	-.590	.556	-.065	.233	-.278	.782	.636	1.571
Indep. Variable										
Visual					2.11	1.738	1.387	.168	.797	1.255
Reading-Writing					-2.826	3.128	-.904	.368	.584	1.712
Aural					-2.099	2.849	-.737	.462	.571	1.752

Kinesthetic		1.394	2.857	.488	.626	.496	2.016
R-Value	.425		.452				
R- Square	.181		.204				
Change in R-Square	___		.023(2.3%)				
F-Statistics	9.987		4.845				
Sig	0.000		0.000				

Regression Model 3[Including Learning Styles]

Model 3 (table 4) includes independent variables, learning styles, and control variables for visual, Reading-writing, Aural, and Kinesthetic. Visual ($\beta = 2.411$, p-value=0.168>0.05), indicating visual learning styles positively influence learning of ICT but insignificant. Reading-writing ($\beta = -2.826, p - value = 0.368$>0.05) negatively impact on learning of ICT but is insignificant, aural ($\beta = -2.099, p - value = 0.462$>0.05) influence performance in ICT but insignificant and kinesthetic ($\beta = 1.394, p - value = 0.626$>0.05) is statistically insignificant. The ($Adjusted\ R^2 = 0.452,\ p - value = 0.000$<0.05 $and\ change\ in\ R^2 = 0.023, p - value = 0.000$<0.05) indicating when learning styles were introduced, 2.3% of variation ICT performance was explained, enhancing the model's power. These findings indicate that visual and kinesthetic learning styles positively impact the learning of ICT, and if those styles are improved by 1 unit, performance in ICT shall correspondingly increase by 2.411 and 1.394, respectively. The model is also indicating $p - value = 0.000$<0.05 depicts that the independent variables mediated the variance observed in the criterion variables. Conversely, Reading-wring and Aural learning styles are inversely related to the learning of ICT; an increase in those learning styles results in decrease in the performance of [ICT]

IV. CONCLUSION

The study's findings showed that the learning styles modalities visual, reading-writing, and kinesthetic reinforce the learning of mathematics positively; however, aural styles mediated inversely to the learning of the subject. Thus, this finding suggests that when teachers take steps to nurture and incorporate these sensory modes in their teaching, it shall moderate to optimise mathematics learning. Lu and Lin (2013) argued that the procedural-organised learning style, which gives prominence to repeated practice, is consistent to teachers' teaching styles that emphasise practicing and step-by-step problem-solving in mathematics moderate the remarkable performance in the subject. As postulated, Lu and Lin relied on visual and kinesthetic modalities that stress fashioning learning to recruit a sense of seeing and a hands-on teaching approach. Further along, visual and kinesthetic were also found to relate positively to learning of ICT. The learning of ICT can be maximised when a student is given an opportunity to see the process involve in undertaking a task and finally practice them, which falls within the purview of visual and kinesthetic mode. The learning styles visual, reading-writing, and kinesthetic, on the one hand, were found to positively impact mathematics, indicating that when they are nurtured in students, it shall leap-frog performance. Additionally, visual and kinesthetic were also found to have a positive effect on the learning of ICT. The study eventually recommends that the learning styles modalities (visual, reading-writing, and kinesthetic) on the one hand and (visual and kinesthetic) on the other, when nurtured among the students, shall construct and maximising performance in mathematics and ICT respectively among the students.

V. ACKNOWLEDGEMENTS

The authors acknowledge the support of the Junior high school teachers, especially the head teachers who participated in the study, by giving out the unstandardised assessment scores to make this study a reality.

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