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Learning Strategies, Age, Gender and School-location as Predictors of Students' Achievement in Chemistry in Rivers State, Nigeria

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Abstract

This study investigated the effect of cooperative and individualized learning strategies age, gender and school-location on Students' achievement in chemistry. 370 Senior Secondary, SS II students from six public secondary schools participated in this study. The study adopted the 3x2x2x2 factorial pretest posttest quasi-experimental and control design. The topic of instruction was thermochemistry on which a 35-item multiple choice chemistry achievement test, CAT instrument was developed with a cronbach alpha reliability value of 0.78 and used for data collection. Mean, ANOVA, t-test and regression were the statistical tools for data analyses. Learning strategies was found to have significant effect on students' achievement in chemistry. The treatment strategies were found to be better strategies for higher achievement in chemistry as confirmed by the Scheffe's multiple comparison ad-hoc analysis in the following trend of *cooperative* > *Individualized* > *conventional learning strategies*. They are therefore; recommend for adoption and implementation to school heads and science teachers in particular at the beginning on trial basis and subsequent incorporation into the system. Age, gender and school-location were individually at very close average mean margins and combined, found to have significant effect on students' achievement in chemistry. Relatively, the trend of effect was as follows; *learning strategies*>*school-location*>*gender*>*age.* However, age relatively did not significant effect.
Keywords: Learning strategies, Age, Gender, School-location, and Chemistry Achievement.

1.0. Introduction

Stakeholders in the educational sector have a consensus view that the instructional strategies in secondary schools have so much to do with the undesirable state of students' achievement in science education in Nigeria (Ezeliora, 2004; Okebukola, 2003). Efforts have been intensified on improving the methods of instruction through the adoption and customization of some learner-centred instructional methods such as cooperative, participatory, interactive strategies which are well researched and advocated for by researchers and education stakeholders (Ajiboye and Ajitoni, 2008; Omosehin, 2003). Cooperative and individualized learning strategies are two very popular examples of student-centred learning strategies and they are founded on the philosophical background of knowledge been a product of the social circumstances which is the central message in the *constructivist theory* (Bruffee, 1995).

Students' achievement in science education has been found to depend on several other factors such as students' age, gender, school-location, socioeconomic status, among others. The age and gender of students have being subject of controversy in the domain of educational research findings. Some findings report that males do better in competitive learning milieu while female do better in cooperative learning settings leading to single-sex schooling advocacies due to perceived male domination and potential harassment and by extension affirming gender differences effect on students' achievement in science (Ogunkola & Garner-O'Neale, 2013), statistically significant effect of gender on chemistry achievement was reported in WASSCE with male students domination by (Ezeudu & Obi, 2013). However, statistically non-significant effects of age and gender on science achievement in different studies was reported by (Abubakar and Oguguo, 2011; Ejimaji and Emekeme, 2011; Ogunkola and Olatoye, 2010).

School-location is a less contested domain in terms of effects on students' achievement in science education. however, there are reports on both sides of the argument as significant effect of school-location on students' achievement in science education as reported in mathematics achievement (Eraichuemen, 2003), non-significant effect was also reported by (Ezeudu & Obi, 2013). School location is an important factor in a study area like Rivers State where there is a characteristic terrain issue that has also being politicized in the allocation of the commonwealth or resources even in education over time. Therefore, it is a common phenomenon for citizens to agitate for political offices by multi-cultural stakeholders of the State along the riverine/upland divides. Most if not all studies on school location as a variable in educational researches have always been on urban, semi-urban and rural. There is no clear cut distinction in the case of Rivers State just as none also exist for the

riverine/upland variable adopted in this study except that resource allocation has always being done along such very strong arbitrary political assumption. However, studies have shown significant effects of school location based on the urban/rural divides on students achievement in chemistry (Adesoji and Olatunbosun, 2008) and in mathematics was reported by (Eraichuemen, 2003). Researchers had found that poor achievement can be attributed to specific infrastructural facilities such as buildings, standard science facilities, noisy school neighborhoods or environments, furnished classrooms, etc (Hines, 1996; Cash, 1993).

This study was undertaken to explore the effects of student-centred learning methods and some students' factors, students' age and gender on students' controversial effects on students' achievement in chemistry in Rivers State, Nigeria along the line of the inherent dichotomous riverine-upland school location disparity.

2.0. Research Questions

This study wishes to address the following research questions:

RQ1**:** Is there significant effect of learning strategies on the students' achievement in chemistry?
RQ2: Is there significant of age, gender and school location effect on the students' achievement in chemistry?
RQ3: What is the combined effect of learning strategies, age, gender and school location on students' achievement in chemistry?
RQ3: What are the relative effects of learning strategies, age, gender and school location on students' achievement in chemistry?

3.0. Research Design

This study adopted the pre-test, post-test, control group quasi-experimental design using a 2x2x2 factorial representation. All variables are dichotomous and these include the treatment strategies at two levels *i.e. individualized strategy and conventional strategy (the control),* gender at two levels *i.e. male and female* and location at two levels *i.e. riverine and upland.* The design is found to be effective in carrying out studies of this type as it controls and minimizes the effect of intact classes: regression, experimental mortality, unstable instrumentation and testing.

Symbolically, the design is illustrated as follows:

$P_1\ X_2\ Q_1 = E_1, P_2\ X_2\ Q_2 = E_2, P_3\ X_3\ Q_3 = E_3$

Where*: X_1, X_2 and X_3 = treatments and Control;*
P_1 P_2 and P_3 = Pre-test for the treatments and control groups;
Q_1, Q_2 and Q_3= Post-test for the treatments and control groups;
E_1 E_2 and E_3 = Treatments and control groups.

4.0. Population

The population of this study consists of all Senior Secondary School two (SSII) students in the Rivers East Senatorial District which is made up of seven LGAs of Rivers State.

5.0. Sampling Procedure and Sample

Multi-stage sampling method was adopted for this study. Firstly, *purposive* sampling was used for the selection of two LGAs, Okrika and Port Harcourt out of eight in the senatorial zone based on the following criteria:

- schools selected for the study must be evenly located in two Local Government Areas, LGAs that reflect the characteristic *riverine/upland* dichotomous status of the zone;
- schools selected must be co-educational; must be government or public owned schools;
- schools selected must have graduate and qualified teachers especially in the sciences
- school selected must have presented candidates for SSCE (WAEC/NECO) examination for the past 5 years in chemistry.

Secondly, *simple random* sampling was used to assign treatments to schools. All students (intact classes) in the arms of the SSII classes selected for the study were used. The total sample size was 370 students following the above sampling procedure.

6.0. Instrumentation

One instrument for data collection *chemistry achievement test, CAT* was designed by the researcher; three instructional materials, *cooperative learning manual, CLM* was designed for the cooperative treatment by according to the procedure used by Arends (1991), a *branching programmed MANUAL, BPW* was designed for individualized treatment according to the procedure used by Adesoji (1991) and a *conventional lesson note*, *CLN* for the control group. Both treatments and control instructional materials were designed to cover the topic *thermochemistry*. The data collection instrument was made up of two parts, A and B. Part A was designed to collect learners' demographic data. Part B is a 35 multiple-choice objective items. Test construction was according to Bloom's six cognitive domains, modified by Educational Testing Services Unit and adopted by (Onocha and Okpala, 1995). Content validity and test-retest was carried out to ascertain psychometric properties and a test was found to be moderately stable with reliability coefficient, r = 0.78 using Cronbach alpha statistic. Item analysis was carried out with scores obtained from the pilot testing according to item difficulty level, item discrimination power and effectiveness of distracters. (Asuru, 2006)

Research Procedure: a discussion session was held with the teachers of the classes that participated in the exercise during which questions and answers exchanges. The conditions of the different treatments were basically discussed and potentially grey areas clarified for smooth treatment sessions (Arends, 1991). Intervention period for all groups was 4 weeks each made up of 4 double periods of 80 minutes each which sums up to 320 minutes. Instructional guides or texts were adjusted to fit into this time provision. Each group was administered with a pre-test and after the end of the 4-week exercise and the same test was administered as a post-test.

7.0. Results

The variables used in this study are as shown in table 2

Table 1: Between-Subject Factors

Variables		Value label	N (%)
Learning strategies	Coop.	1	133(35.9)
	Indi.	2	120(32.4)
	Conv.	3	117(31.6)
Age	≤16 yrs	1	212(57.3)
	≥17 yrs	2	158(42.7)
Gender	Male	1	208(56.2)
	Female	2	162(43.8)
School Location	Riverine	1	136(36.8)
	Upland	2	234(63.2)
N (%)			370(100.0)

Table 1 above shows sample distributions according to the variables. The table also shows about equal number of participants in all three groups.

RQ1**:** Is there significant effect of learning strategies on the students' achievement in chemistry?

Table 2a: Effects of Learning Strategies (ANOVA)

	Sum of Sq.	Df	Mean Square	F	Sig.
Between Groups	15309.24	2	7654.62	39.26	0.00*
Within Groups	71547.15	367	194.95		
Total	86856.38	369			

*significant effect @ $p < 0.05$

Table 2a shows that, there is significant effect on students' achievement in chemistry as a result of the instructional strategies used. ($F = 39.26$; $p = 0.00$)

Table 2b: Scheffe's Post-hoc Multiple Comparisons

(I) Treatments	(J) Treatments	(I-J) Mean Diff	S E	Sig.
Cooperative	Individualized	10.28*	1.76	0.00
	Conventional	15.27*	1.77	0.00
Individualized	Cooperation	-10.28*	1.76	0.00
	Conventional	4.99*	1.81	0.02
Conventional	Cooperation	-15.27*	1.77	0.00
	Individualized	-4.99*	1.81	0.02

Table 2b shows the degree of the effects of all the treatments on the students' achievement in chemistry based on the mean effects differences. Comparing with the control, cooperative learning treatment have double as much effect followed by the individualized treatment. This trend is illustrated as follows: cooperative > individualized having a mean difference of 10, individualized > conventional having a mean difference of 5 and cooperative >> conventional at a mean difference of 15.

RQ2: Is there individual significant effect of age, gender and school location on students' chemistry achievement?

Table 3: Effects of Age, Gender and School Location on Students' Achievement

Variables		N	Mean	SD	df	t	Sig.
Age	16yrs 17yrs	212 158	42.07 47.58	13.26 17.31	368	-3.47	0.00*
Gender	Male Female	208 162	45.88 42.56	16.43 13.65	368	2.08	0.04*
Location	Riverine Upland	136 234	49.37 41.55	20.63 10.17	368	4.87	0.00*

*significant effect @ $p < 0.05$

Table 3 shows that all three moderator variables individually have statistically significant effects, age ($t = -3.47$; $p = 0.00 < 0.05$), gender ($t = 2.08$; $p = 0.00 < 0.05$) and school location ($t = 4.87$; $p = 0.00 < 0.05$) on students' achievement. The result also shows that older students, male and riverine students recorded higher achievement even though the average means values do not vary widely.

RQ3**:** What is the combined effect of Learning Strategies, age, gender and school location on students' achievement in chemistry?

Table 4: Combined Effect of all variables on students' achievement in chemistry

Model	Df	Sum of sq	Mean sq.	F	R	R^2	Adj.R^2	SE
Regression Residual Total	4 365 369	19464.22 67392.17 86856.38	4866.05 184.64	26.36	0.47[a]	0.22	0.22	13.59

[a]Predictors: (constant), learning strategies, age, gender and school location

Table 3 shows the combined effect of learning strategies, age, gender and school location on students' achievement which interestingly, accounted for 22 % ($R^2 = 0.22$) of the total variance in students' achievement and this value was found to be significant ($F= 68.92$; $p = 0.00 < 0.05$). The R^2 value which is less than a quarter of 100 % coefficient of determination shows a weak effect of the combination of the variables that accounted for the total variance in students' achievement in chemistry.

RQ4**:** What are the relative effects of learning strategies, age, gender and school location on students' achievement in chemistry?

Table 4: Relative Effects of the variables on students' achievement in chemistry

MODEL	B	β	t	Sig.
Constant	73.03		15.61	0.00
Learning Strategies	-7.32	-0.39	-7.88	0.00*
Age	0.36	0.01	0.24	0.81
Gender	-2.91	-0.09	-2.03	0.04*
School Location	-6.51	-0.21	-4.41	0.00*

*significant effect @ $p < 0.05$

Table 4 shows the relative effects of learning strategy, age, gender and school location on students' achievement in chemistry. The table also shows that, learning strategies has the highest or strongest effect ($\beta = -0.39$; $t = -7.88$; $p = 0.00 < 0.05$) followed by school location ($\beta = -0.21$; $t = -4.41$; $p = 0.00 < 0.05$) and gender ($\beta = -0.09$; $t = -2.03$; $p = 0.04 < 0.05$) and lastly age ($\beta = 0.01$; $t = 0.24$; $p = 0.84$). However, only the relative effect of age was found to be non-significant.

8.0. Discussion

Firstly, this study shows that learning strategies or instructional delivery methods in chemistry are very important factors that determine students' achievement. This finding may not be unconnected with the numerous benefits, student-based learning strategies such as cooperative learning strategies have over the conventional learning strategies in which learners enjoy the co-driver or co-teacher position during a regular classroom activity. This finding corroborates those of students' achievement in mathematics (Zakaria, Chin & Daud (2010), integrated science (Ajaja & Eravwoke, 2010) and in physics (Akinbobola, 2009) who reported that cooperative learning promotes more positive attitudes toward the instructional experience than other strategies and that students are trained on how to interact positively, resolve disputes through compromise or mediation and also encourage the best performance of each other.

Secondly, this study shows that age, gender and school location individually have significant effect on students' achievement in chemistry with the older, male and riverine students recoding higher achievements, all with very close average mean margins. This very close average mean margin between variables may not be unconnected with almost similar learning conditions and attitudes to learning across these individual variables. These findings were found to corroborate in part with other findings with narrow margin in gender effect with male domination in chemistry in Nigeria (Ezeudu & Obi, 2013) and the Carribeans (Ogunkola and Garner-O'Neale, 2013). This finding does not corroborate the non-significance effect finding of age and gender on students' achievement in chemistry (Nbina & Wagbara, 2012; Ejimaji & Emekene, 2011).

Thirdly, the combined effect of all variables accounted for only 22 % of the total variance in the achievement of the students and this value was significant. However, the relative effect of the variables on students' achievement was found to be significant as well but the following fashion: *learning strategies>school location>gender>age*. Age was the only variable with non-significant relative effect on students' achievement. This finding corroborates those of (Adesoji & Babatunde, 2005; Wachanga & Mwangi, 2004) who reported non-significant relative effect of gender on students' chemistry achievement and (Meremikwu & Enukoha, 2010) in mathematics achievement.

9.0. Conclusion and Recommendation

This study has shown that learning strategies other than the conventional or traditional teacher-centred methods are no longer fashionable in terms of achieving the purpose of organized classroom. This paradigm shift has come to stay but it requires the administrative will of school heads and teachers alike to accept and implement it in other to tap into its numerous benefits on the side of the learners and that of the teachers as well as the overall objective of the classroom system. Cooperative learning has been consistent in several research findings on its superiority to other students-based strategies; I wish to strongly recommend for adoption and implementation on trial basis and subsequent full scale implementation through an enabling policy framework with provision of minimum resources.

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