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INVESTIGATING STUDENTS' LEARNING STYLES AND MEMORY IMPROVEMENT STRATEGIES FOR EFFECTIVE LEARNING OF MATHEMATICS AND SCIENCE AT TERTIARY LEVEL

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ABSTRACT

The study investigates Learning Style and Memory Improvement Strategies for effective learning of mathematics and sciences at higher institutions. The sample for the study consists of 172 students which were randomly selected from the two colleges of education in Katsina state of Nigeria. Three validated instruments used for data collection were Student Learning Style Rating Scale (SLSRS), Student Memory improvement strategy Inventory (SMISI) and Mathematics and Science Achievement Test (MSAT) with the following reliability coefficients respectively (0.75, 0.83 and 0.77). The study findings indicate that (i) LS of both mathematics and science students cannot substantially differentiate their academic performance. This finding is not statistically significant $F(4,107) = 0.524$, $F(4,55) = 1.121$ at $p > 0.05$ (ii) Though low positive relationship exists between the MIS and performance of both mathematics and science students. This relationship is not significant (iii) Performance of both mathematics and science students is not significantly influenced by their MIS ($R^2 = 0.02, 0.01$; $p > 0.05$.) (iv) Gender cannot be used to differentiate their performance ($t = 0.661, -0.079$), MIS rating ($t = 0.948, -0.110$) at $p > 0.05$ and predicts their LS ($\chi^2 = 4.688, 4.238$, $p > 0.05$) respectively. Based on the findings, we suggest that each student should endeavor to identify and use his/her LS effectively.

Keywords: Learning style, Memory Improvement Strategies, Effective Learning, and Achievement.

INTRODUCTION

There are different learning styles (LS) exhibited by students though the same method or approach is employed during classroom instructions. There is no right or wrong learning style (Fatokun, 2012) and it has nothing to do with intelligence but with the way a person's brain works to learn and store information efficiently (Norman, 2008; Kolbs, 2005). Most students learn in essentially the same environment and learning can be highly efficient and effective if the learning situation is consistent with how students learn (Peverley, 1991). Since everyone learns differently, understanding learning style can help a teacher perform better by matching the teaching pattern with students learning style for appropriate understanding (Fatokun & Eniayeju, 2014).

There are different classifications of learning style from scholars based on varied perspectives. Myers-Briggs (1962) proposed three major learning styles namely; auditory, tactile and visual. Another classification by Honey & Mumford (1982) is theorist, pragmatist, activist and reflectors. Recent classification by Kolb & Kolb (2005) is based on his experiential learning theory where he identified a complete learning cycle as including four specific ways of learning, viz: concrete experience, reflective observation, abstract conceptualization and active experimentation. Dunn & Dunn (1992) identified five key dimensions on which students' learning styles differed as; environmental, emotional support, sociological

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composition, physiological and psychological elements. These major issues are fundamental to learning and memory enhancement.

LITERATURE REVIEW

Memory is a wonderful trait of human being and it is very important to educators because of the role it plays in teaching/learning process as the yardstick for measuring content learnt (Fatokun, 2012). Memory function is a process which begins from the time of receipt of information to the time of recall and usage. Slavin, (1997) described memory according to its storage system as long term and short term. Fatokun & Eniayeju (2014) asserted that learning is evident by proper understanding, assimilation and linkage of the new ideas learnt to the existing cognitive structure which promote the retention of such integrated concepts and its recall when required. Human is prone to forgetfulness especially when effective learning has not occurred (Reeds, 1992; Eggen & Kauchak, 1997). Most conditions that affect learning also affect memory (Johnstone & Otis, 2006). Level of intelligence, motivation, emotional state, environmental factors, significance of the learning object to the learner and method of teaching and learning are some factors that affect a person's memory (Dunn & Dunn, 1992). Studies (Banikowski, 1999; Abiodun & Abiodun, 2014; Fatokun & Eniayeju, 2014) have shown numerous strategies for memory improvement since the brain serves as the center for assimilation, coordination, retention and reproduction of information which is often linked with the learning situation and this is consequently a vital determinant of achievement in science and mathematics.

Such memory improvement strategies include mnemonics, (such as acrostics, rhymes, acronyms) spatial visualization, repeating, imagery, peg method, over learning, number sets, sub-heading, concept mapping, organization. Inekwe & Zakariya (2008) posited that learning of difficult mathematical concepts can be enhanced through metacognitive strategies of learning which is based on constructivist theory as this affords the learner the consciousness of his or her own cognitive processes as learning progresses (Fatokun & Fatokun, 2012). Furthermore, a gender issue in Nigerian's science education has always remained inevitable. This is because studies conducted in mathematics and sciences have been frequently producing equivocal results about male and female students' superiority in their performance (Kolawole, 2008; Mamman & Mohammad, 2014; Olasehinde & Olatoye, 2014).

The quest to investigate the contributions of students' personal characteristics in their learning experience and academic performance has gained interest of researchers in education since 1970s in Nigeria. Adoption of different perspectives to view learning style has also presented many educators opportunities to explore its influence on students' performance. Despite this opportunity, existing studies in mathematics (Kolawole, 2008; Zinyah & Ahmadzanzali, 2013) and science (Alade & Ogbo, 2014; Fatokun & Eniayeju 2015; Ibe, 2015) in the country have little or no support from physiological model of learning style. Therefore, the present study investigates the influence of learning style and memory improvement strategies adoptions on mathematics and science students' academic performance at tertiary level, precisely at the college of education where elementary school teachers are trained to teach basic science at the foundational level.

Purpose of the study

The study is aimed at achieving the following:

1. To identify student learning style

2. To assess student performance in mathematics and chemistry
3. To determine the extent at which student adopt some memory improvement strategy
4 To compare students' achievement in mathematics and chemistry based on their favoured learning style
5. To investigate the relationship between gender and their preferred learning style.

Research Questions

The following questions were raised to guide the study;

1. Will mathematics and science students' performance in each learning style group differ?
2. Do relationships exist between performance of mathematics and science students and their memory improvement strategies rating?
3. Will performance of mathematics and science students be influenced by their MIS rating?
4. Among mathematics and science students, do
   (a) difference in MIS preference and performance exist between male and female
   (b) relationships exist between gender and learning style?

Null Hypotheses

The null hypotheses were formulated and tested at 0.05 level of significance.

1. There is no significant difference in the performance of mathematics and science students in each LS group.
2. There is no significant relationship between mathematics and science students' achievement and their MIS rating
3. There is no significant influence of MIS rating on the achievement of mathematics and science students.
4. No significant (a) difference exist between MIS preference and male and female students' performance
   (b) relationship exist between gender and LS preference

METHODOLOGY

Research Design

The research design adopted for the study was descriptive survey and partly correlational.

Population and Sampling Technique

All the science and mathematics students of the two existing Colleges of Education in Katsina State of Nigeria constituted the target population for the study. Stratified random sampling was employed to obtain 172 college students (138 males and 34 females). This gender ratio was informed by their enrollment rate in the college. From the sciences 60 students (those offering two different science subjects) and mathematics 112 students (those studying mathematics and computer science) participated in the study.

Instrumentation and Administration

Three instruments were used by the researchers to generate data. One of the instruments; Mathematics and Science Achievement Test (MSAT) consisted of 40 structured objective test items drawn from the topics already taught in the current college science and mathematics syllabus was developed by the researchers while the other two; Student Learning Style Rating Scale (SLSRS), a 24 item instrument used for rating the students according to their learning style (LS) grouping and Student Memory Improvement Strategy Inventory (SMISI), used to ascertain student's adopted memory improvement strategy (MIS) were adapted from Feldman, (2011). The three instruments were subjected to both content and construct validity by three experts in educational psychology and science education, after which they were field tested. Reliability coefficients of SLSRS, SMISI and MSAT are 0.75, 0.83, and 0.77 respectively. The instruments were administered to sampled students at the two colleges by the researchers.

Data Analysis

The compiled data was analyzed with SPSS version 16.0. The first and second hypotheses were tested using ANOVA and Pearson Product Moment Correlation (PPMC) respectively while linear regression and t-test were used for testing the third and fourth hypotheses. Chi-square test of independence was used for 4(b).

RESULTS

Table 1: Comparison of student's performance in each learning style (LS) group

LS	Mathematics						Science					
	N	Mean	S.D	F	P	η^2	N	Mean	S.D	F	P	η^2
Read	35	1.742	1.34	0.524	0.718	0.02	20	2.20	1.15	1.121	0.356	0.08
Visual	18	1.777	1.35				7	3.43	1.99			
Auditory	28	2.107	1.29				11	2.55	1.21			
Tactile	12	1.583	1.24				15	2.67	1.40			
Multiple LS	19	1.737	0.99				7	2.57	1.13			

Not significant at p> 0.05, η^2= Effect size

Table 1 shows that there is a small and medium difference in the student performance in all the learning style groups for mathematics (η^2= 0.02) and science students (η^2= 0.08) respectively. These findings are found non-significant statistically F (4,107) = 0.524, F (4,55) = 1.121 at p> 0.05 for both mathematics and science students respectively. Therefore, the null hypotheses which state that there is no significant difference in the performance of mathematics and science students in each LS group is retained and we conclude that LS favoured by students' will not substantially differentiate both mathematics and science student performance.

Table 2: Relationship between students' performance and their memory improvement strategy

	Variable	N	Mean	SD	Corr, r	P	Remark
Mathematics	MIS	112	22.125	5.457	0.127	0.182	NS
	Scores	112	1.821	1.254			
Sciences	MIS	60	20.733	6.199	0.118	0.369	NS
	Scores	60	2.567	1.345			

NS = Significant at p> 0.05(2-tailed)

Table 2 indicates that there is positive though low and non significant relationship between students performance and their MIS rating for both mathematics (r= +0.127, p> 0.05) and science (r= +0.118, p> 0.05) students. Therefore, the null hypothesis which states that there is no significant relationship between mathematics and science students' achievement and their MIS rating is retained and we conclude that significant relationship does not exist. The results show that increase in MIS increases performance of both mathematics and science students.

Table 3: Influence of memory improvement strategy (MIS) on students' performance

		Sum of Sqr	Df	Mean Sqr	F	P	R	R^2	Adj R^2
Maths	Regression	2.817	1	2.817					
	Residual	171.612	110	1.560	1.805	0.182	0.127	0.016	0.007
	Total	174.429	111						
Sciences	Regression	1.487	1	1.487					
	Residual	105.247	58	1.815	0.819	0.369	0.118	0.014	0.14
	Total	106.733	59						

Not significant at $p > 0.05$ R^2= Effect size

Table 3 shows that MIS only accounts for 2% and 1% of total variance in students' performance in mathematics (R^2= 0.02) and science (R^2= 0.01) respectively. These percentages are not significant and the results are not statistically significant $F (1,110) = 1.805$; $F (1,58) = 0.819$, $p > 0.05$, respectively. Therefore, the null hypothesis which states that there is no significant influence of MIS rating on the achievement of mathematics and science students is retained and we conclude that MIS does not significantly influence students' performance. This means that increase in MIS may contribute very little increase in students' mathematics and science performance.

Table 4(a): Comparison of male and female students' memory improvement strategy (MIS) preference and performance

	Variable	Gender	N	Mean	SD	*t*	P	*D*	Remark
Maths	MIS	Male	93	22.279	5.373	0.661	0.448	0.16	NS
		Female	19	21.368	5.946				
	Performance	Male	93	1.817	1.301	-0.079	0.314	0.02	NS
		Female	19	1.842	1.014				
Science	MIS	Male	45	21.111	6.267	0.948	0.815	0.24	NS
		Female	15	19.600	6.056				
	Performance	Male	45	2.556	1.323	-0.110	0.855	0.03	NS
		Female	15	2.600	1.454				

NS= Not Significant at $p > 0.05$, *d*= Effect size

Table 4(a) shows that there is small difference in male and female students' MIS preference for both mathematics (*d*= 0.16) and science (*d*= 0.24) students in favour of male for the two groups. It is also indicated from the table that there is a mere statistical difference in male and female performances for both mathematics (*d*= 0.02) and science (*d*= 0.03) students. These findings are found to be non-significant statistically (t= 0.661, -0.079; $p > 0.05$); (t= 0.948, -0.110; $p > 0.05$) respectively. Therefore, the null hypothesis which states that no significant differences exist between MIS preferences and male and female students' performance is retained and we conclude that mathematics and science male students exhibited subtle preference for MIS over female students but their academic performances cannot be differentiated on the basis of gender.

Table 4(b): Relationship between gender and learning style (LS) preference

	Row	Column	N	Df	χ^2	P	V	Remark
Maths	5	2	112	4	4.688	0.321	0.21	NS
Science	5	2	112	4	4.238	0.375	0.27	NS

NS= Not Significant at $p > 0.05$, V= Effect size

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Table 4(b) depicts that 21% and 27% degree of association exist between gender and LS of Mathematics and Science students respectively and these relationships are not statistically significant (χ^2= 4.688, 4.238, p> 0.05 respectively). Therefore, the null hypothesis which states that there is no relationship between students' gender and their preferred LS among both mathematics and science students is retained and we conclude that students' gender can only minimally predict their favoured LS.

DISCUSSION

All the formulated null hypotheses were retained (probably due to effect size), It was discovered that no significant difference exist in the performance of mathematics and science students in each learning groups, though the mean score of the science students was slightly higher than that of the mathematics students. This result is consistent with the assertion earlier made by Fatokun & Eniayeju, 2014a and Norman, 2008 that learners' academic performance is not greatly dependent on their learning style preference. It was also indicated that though direct correlation existed between students' achievement and their memory improvement strategy, this relationship was not significant as MIS does not have significant influence on student's performance in each of the learning groups. This report confirms partly with Inekwe & Zakariya, (2008) submission, but contradicts Reeds, (1992), Eggen & Kauchak, (1997) who asserted that memory is a major determinant of achievement. They posited that students perform poorly after learning due to forgetfulness and most forgetting occurs because information in the working memory is not transferred to the long term memory. Low exposure of students noticed to MIS may account for this contradiction. Fatokun and Eniayeju (2014) equally emphasized the influence of concept mapping, a memory improvement strategy for enhancing retention and recall. No considerable gap exists between the performance of male and female science and mathematics students but a slight difference was noticed in their MIS preference in favour of male students. This finding, with regard to student performance is related to literature by (Olasehinde & Olatoye, 2014) while it contradicts literature by (Kolawole, 2008; Mamman & Mohammad, 2014). The latter literature findings stressed that male students performed better than their female counterparts after subjecting the two groups into mathematical intervention program.

Implication of the study

The study revealed that students' favoured learning style have no substantial influence on their performance in mathematics and science, though a considerable influence was noticed in the latter group. Also, a positive but low relationship was observed between student's memory improvement strategies adopted and their performance which account for just trivial differences in the groups. It is also indicated that gender cannot substantially differentiate MIS adoptions and academic performances of both mathematics and science students but can only slightly predict both group of students' LS preference.

CONCLUSION

Though the results of the present study have implications for intervention in enhancing college students' performance in science and mathematics and it is recommended that each student should identify and utilize his/her learning style and adopt effective memory improvement strategies but it is difficult to make any firm conclusions about the findings.

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LIMITATIONS AND SUGGESTIONS FOR FURTHER STUDIES

Few limitations of this study may be acknowledged here and suggestions made for further research. First, a replication of this study for targeting more students should be conducted in order to generate a more solid relationship among constructs examined because generalization of the results is somewhat limited due to sample size. Second, as correlational statistics were utilized, no definitive statements were made about causality. Third, the instruments used in this study may not appropriately capture the participants' perceptions and expressions of their learning styles and adopted memory improvement strategies, the use of more comprehensive research instruments and trained research assistants may be required.

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