Achievement in Physics Using Mastery Learning and Mind Mapping Approaches: Implication on Gender and Attitude

Bello Theodora Olufunke[1] (Ph.D.)

[1]Institute of Education
Obafemi Awolowo University
Ile-Ife, Nigeria
bledore@oauife.edu.ng

Oluwatosin Omolara Blessing[2]

[2]Department of Science and Technology Education
Obafemi Awolowo University
Ile-Ife, Nigeria

Abstract: *This study ascertained the performance differential in Physics between the male and female students when taught using Mastery Learning Approach (MLA) and Mind Mapping Approach (MMA). It also established the influence of MLA and MMA in enhancing students' attitude towards Physics. These were with a view to developing positive attitude of students towards Physics and thereby improving on their performance in the subject. The study adopted the non-equivalent pre-test, post-test control group design. The sample for the study was 74 senior secondary school one (SSS1) Physics students from the three selected secondary schools in Ikere Local Government Area in Ekiti state, Nigeria. Three intact classes were used for the study. Each group of students in their intact classes was taught Gravitational Field and Electric Field. The instruments used for data collection were "Physics Achievement Test" (PAT) and "Students' Attitude to Physics Questionnaire" (SAPQ). The instruments were trial tested to establish reliability using person product moment correlation analysis. Reliability coefficients of 0.78 and 0.82 were obtained for PAT and SAPQ respectively. Data collected were analyzed using t-test and analysis of variance (ANOVA). The results showed that no significant effect of treatment in the pre-test and post-test scores of the male and female students when taught with the MLA and MMA (F = 0.079, p = 0.995). Also, the students taught with MMA developed a more positive attitude towards Physics. (F = 22.689, p = 0.00), MLA ($\bar{X}$ = 65.3214), MMA ($\bar{X}$ = 72.9333) and the conventional method ($\bar{X}$ = 61.5484). The study recommends that Physics teachers should adopt mind mapping and other participatory strategies during instruction so that learners would be guided to learn meaningfully and would be assisted to develop positive attitude towards Physics.*

Keywords: *Mastery learning, Mind mapping, Attitude, Academic Performance, Conventional, Learning, Teaching.*

1. INTRODUCTION

Physics is a core science subject that is closely related to technology. It is a branch of physical science that explains the property of matter and energy, and the relationship between them. The subject focuses on the general nature of the natural world and has played a crucial role in the service of mankind. Its principles are daily applied in our homes in our day to day activities and the discoveries made from these principles have been of great importance to human existence. The knowledge of Physics is very important in the technological world because its principles and laws are applied at various degrees in our life considering the very large number of electrical and electronic devices which utilize them one or the other.

However, despite the importance of Physics and its applications in various fields, the subject is not attractive to most students. Students generally avoid it when provided with an alternative. In many countries, there has been reduction in the number of students wishing to continue with Physics (Ho and Boo, 2007). Okebukola (1997), Ogunleye (2000) and Umeh (2002) were of the opinion that students' academic performance in sciences subjects especially Physics has not been

encouraging. Many attempts have been made to improve the learning of the subject such as provision of better teaching approach and materials (Mills, 1991), using cooperative teaching method (Bello, 2011) and concept mapping (Kibett and Kathuri , 2005). It is therefore pertinent to consider other factors such as attitude of students and gender in relation to the teaching methods in improving the learning of Physics.

Attitude is an internal state that influences the actions of an individual. Gbore (2013) defined attitude as the totality of an individual's inclination towards object, institution or idea. According to Reid (2003), attitude expresses our evaluation of something or someone which may be based on our knowledge, our feelings or our behaviour, and may influence future behaviour. Reid (2004) stated that attitudes are important to us because they cannot be neatly separated from study. Attitude could be learnt or formed and acquired from member of the family, teacher and peer group. Adesina and Akinbobola (2005) opined that attitudes could be acquired through learning and can be changed through persuasion using variety of techniques. Omotayo (2002) stated that students bring into classroom acquired attitude which could hinder or facilitate learning.

Gender consideration in the learning of Physics is very important because gender disparity has not only been observed in the daily life matters but also in academic performances. While the males are accorded the responsibility of dealing with complex and difficult tasks of life matters inside and outside the house, the girls are to hand the relatively easy and less demanding tasks. Hausmann, Tyson and Zahidi (2009) reported that there is no country in the world that has yet reached equality between women and men in different critical areas. According to Kwaileh and Zaza (2011), studying the gender differences is important because it influences the society's views about the roles of females in the society, females' self-confidence and ambitions, and the effect of stereotyping in education. Owuamanam and Babatunde (2007) noted that the girls tend to go for courses that do not require more energy and brain tasking such as home making while the boys look for jobs in management, engineering, banking and other brain tasking professions. This contention is supported by a study carried out by Ehindero (1986) on Nigerian Physics student population. In the study, it was determined that the interaction of sex-role stereotyped expectations and achievements were significant and that the lower expectations of the female students correlated with lower performance. Abosede (2010) opined that a probable reason for inequality in sex selection in some sex dominated subjects could be adduced to more cultural and social orientation from parents and the entire society.

Salami (2013) stated that what differentiates men and women are their ethical and behavioural approaches to their academic pursuits, social environment and traditional gender ideology. Alao and Abubakar (2010) opined that gender roles affect familiarity with academic content, career aspirations, attitude towards subjects, teacher's expectation and preferred approaches and these in turn affect academic performance. Considering all the above mentioned factors, it will be necessary to look at different teaching methodology to be able to identify which of the teaching approaches will enhance gender equality in achievement and create positive attitude in both sexes.

1.1. Objectives of the Study

The specific objectives of the study are to:

i. Ascertain the performance differential in Physics between the male and female students when taught using Mastery Learning Approach (MLA) and Mind Mapping Approach (MMA). determine the relationship between undergraduate students' academic achievement introductory Physics course and their academic performance in secondary school Mathematics;

ii. establish the influence of MLA and MMA in enhancing students' attitude towards Physics

1.2. Research Hypotheses

The research hypotheses that were generated to guide the study are:

i. There is no significant performance deferential in Physics between the male and female students when taught using MLA, MMA and the conventional method.

ii. There is no significant influence of MLA, MMA and conventional method on students' attitude to Physics.

2. METHODOLOGY

This study adopted the non-equivalent pre-test, post-test, control group design. The population for this study consisted of all senior secondary school Physics students in Ekiti State. The sample consisted of 74 Physics students in their intact classes in three selected secondary schools in Ikere Local Government Area of Ekiti State. Simple random sampling technique was used in the selection of the three schools. The three selected schools were randomly assigned into experimental groups A and B, and the control group C.

2.1. Instrumentation

Two research instruments were used for data collection in this study. The first instrument was a Physics Achievement Test (PAT), which consisted of twenty structured multiple choice questions. The PAT was used as a pre-test to ascertain equivalent ability of the students as well as a post-test after treatment was to determine the effect of the treatment on their academic performances. The second instrument was Students' Attitude to Physics Questionnaire (SAPQ).It was sub divided into two sections. Section A sought for information on the demographic variables of the respondents such as name, gender, class and name of school. Section B consisted of twenty attitudinal self-rating items using a 5 – point Likert Scale of 4 = Strongly Agree (SA), 3 =Agree (A), 2 = Disagree (D), 1 = Strongly Disagree (SD), and 0 = Undecided (U) designed to elicit the individual students' attitude to the learning of Physics before and after treatment.

The instruments were given to three experts in education and the students' Physics teachers to establish the face validity of the instruments. Their corrections were followed in selecting the items included in the instruments. Field testing was carried out by administering the instruments on 21 students from an intact class of a co-educational secondary school different from the selected schools used for the study. Test retest method was used to generate 2 set of scores for the students. The scores were subjected to correlation in other to determine the reliability of the instruments. Using person product moment correlation analysis, reliability coefficients of 0.78 and 0.82 were obtained for PAT and SAPQ respectively.

2.2. Procedure for Data Collection

The collection of data was carried out in two phases. The first phase required the administration of the Physics Achievement Test together with the Students' Attitude to Physics Questionnaire as pre-test to the students in the two experimental groups and the control group. This is needed to ascertain the equivalence in ability and attitude of the students. In the second phase, the treatments were introduced to the experimental groups. Students in experimental group A were taught using the Mastery Learning approach, those in experimental group B were taught using the Mind Mapping approach while the Control group C were taught using the conventional approach. The teaching in all the groups was done by the researcher. The researcher taught two selected topics from the third term scheme of work, which are; Gravitational Field and Electric Field concurrently in all the three schools using the appropriate treatment in each school for a period of four weeks of two hours per week. Then the Physics Achievement Test together with the Students' Attitude to Physics Questionnaire were administered to the three groups as post-test. .

3. RESULTS

Research Hypothesis One: There is no significant performance deferential in Physics between the male and female students when taught using MLA, MMA and the conventional method.

To test this hypothesis, the pre-test and post-test scores of the male and female students taught Physics using the MLA, MMA and the conventional method were compared and subjected to statistical analysis using two-way Analysis of Variance (ANOVA) at 0.05 level of significance. The results are presented in table 1a and table 1b.

Table1a. *Descriptive Statistic of Gender and Students' Pre-test and Post-test Scores.*

Approaches	Gender	Mean	Std. Deviation	N
pre-test MLA	male	4.5385	2.02548	13
	female	4.4000	1.63881	15
	Total	4.4643	1.79469	28
post-test MLA	male	6.3846	1.60927	13
	female	6.6667	2.31969	15
	Total	6.5357	1.99039	28
pre-test MMA	male	3.6000	1.67332	5
	female	3.5000	.97183	10
	Total	3.5333	1.18723	15
post-test MMA	male	8.2000	1.48324	5
	female	8.5000	1.58114	10
	Total	8.4000	1.50238	15
pre-test control	male	4.6667	2.41030	15
	female	4.3750	2.27669	16
	Total	4.5161	2.30754	31
post-test control	male	5.7333	2.18654	15
	female	5.6250	2.21736	16
	Total	5.6774	2.16621	31
Total	male	5.4091	2.27344	66
	female	5.4390	2.44494	82
	Total	5.4257	2.36209	148

Table 1a shows the pre-test mean scores of male (4.5385, 3.6000and 4.6667) and female (4.4000, 3.5000 and 4.3750) students in MLA, MMA and control group respectively. And the post-test means score for male (6.3846, 8.2000 and 5.7333) and female (6.6667, 8.5000 and 5.6250) students in each of the groups respectively. This is an indication that male and female students performed equally irrespective of the approaches.

Table1b. *Two-way Analysis of Variance of Gender effect on teaching approaches and performance*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	276.175[a]	11	25.107	6.277	.000
Intercept	3824.560	1	3824.560	956.126	.000
Approaches	247.431	5	49.486	12.371	.000
Gender	.003	1	.003	.001	.979
Approaches * Gender	1.714	5	.343	.086	.994
Error	544.008	136	4.000		
Total	5177.000	148			
Corrected Total	820.182	147			
a. R Squared = .337 (Adjusted R Squared = .283)					

From table 1b, teaching approaches main influence (F = 12.371, p = 0.00) is significant while gender main influence (F = 0.001, p = 0.979) is not significant, However, the interaction between the teaching approaches and gender (F = 0.086, p = 0.994) is not significant. This implies that the teaching approaches significantly contribute to the students' academic performance in Physics but gender has no significant effect on students' academic performance. Also, gender has no significant influence on the effectiveness of the teaching approaches. That is, all the teaching approaches are effective for both male and female students in Physics. Thus, the null hypothesis is accepted.

Research Hypothesis 2: There is no significant influence of MLA, MMA and conventional method on students' attitude to Physics

In testing this hypothesis, the attitudinal pre-test and post-test scores of students in the three groups were compared and subjected to statistical analysis using one way Analysis of Variance (ANOVA) at 0.05 level of significance. The results are presented in tables 2a, 2b and 2c respectively.

Table2a. *Descriptive Statistics of Students' Pre-test and Post-test Attitudinal Scores*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
pre-test MLA	28	54.9643	5.55433	1.04967	52.8105	57.1180	46.00	70.00
post-test MLA	28	65.3214	11.18549	2.11386	60.9842	69.6587	42.00	80.00
pre-test MMA	15	54.2000	5.01711	1.29541	51.4216	56.9784	46.00	66.00
post-test MMA	15	72.9333	3.12745	0.80750	71.2014	74.6653	65.00	77.00
pre-test control	31	51.6452	6.00860	1.07918	49.4412	53.8491	41.00	64.00
post-test control	31	61.5484	9.29817	1.67000	58.1378	64.9590	38.00	79.00
Total	148	59.3514	10.12498	0.83227	57.7066	60.9961	38.00	80.00

Table 2a shows the pre-test attitudinal mean score of the students in MLA, MMA and conventional groups as 54.9643, 54.2000 and 51.6452 respectively. While the post-test attitudinal means score of the students in each group are 65.3214, 72.9333 and 61.5484 respectively. This is an indication that students taught using the mind mapping approach developed a more positive approach to Physics.

Table2b. *One-way ANOVA for the Students' Attitude to Physics Questionnaire in the MLA, MMA and Conventional method*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6692.551	5	1338.510	22.689	0.000
Within Groups	8377.179	142	58.994		
Total	15069.730	147			

p< 0.05

Table 2b shows the results of the ANOVA for the SAPQ among the three groups. The table shows that there is a statistically significant difference between the means. (F = 22.689, p = 0.000). This means that the F factor is significant at p < 0.05 level and between means square is statistically significantly greater than within means square. This implies that there is a significant overall effect of treatment. In order to establish where the experimental effect was located, Scheffe's post hoc test of multiple comparisons among the group was carried out. The result is presented in table 2c below.

Table2c. *Scheffe's Pair-wise Multiple Comparisons of Students' Pre-test and Post-test Attitudinal Scores*

(I) Approaches	(J) Approaches	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
pre-test MLA	post-test MLA	-10.35714[*]	2.05277	.000	-17.2850	-3.4293
	pre-test MMA	.76429	2.45762	1.000	-7.5298	9.0584
	post-test MMA	-17.96905[*]	2.45762	.000	-26.2632	-9.6749
	pre-test control	3.31912	2.00249	.739	-3.4390	10.0773
	post-test control	-6.58410	2.00249	.062	-13.3422	.1740
post-test MLA	pre-test MLA	10.35714[*]	2.05277	.000	3.4293	17.2850
	pre-test MMA	11.12143[*]	2.45762	.002	2.8273	19.4156
	post-test MMA	-7.61190	2.45762	.095	-15.9060	.6822
	pre-test control	13.67627[*]	2.00249	.000	6.9181	20.4344
	post-test control	3.77304	2.00249	.617	-2.9851	10.5312
pre-test MMA	pre-test MLA	-.76429	2.45762	1.000	-9.0584	7.5298
	post-test MLA	-11.12143[*]	2.45762	.002	-19.4156	-2.8273
	post-test MMA	-18.73333[*]	2.80462	.000	-28.1985	-9.2681
	pre-test control	2.55484	2.41578	.952	-5.5981	10.7078

	post-test control	-7.34839	2.41578	.107	-15.5013	.8045
post-test MMA	pre-test MLA	17.96905[*]	2.45762	.000	9.6749	26.2632
	post-test MLA	7.61190	2.45762	.095	-.6822	15.9060
	pre-test MMA	18.73333[*]	2.80462	.000	9.2681	28.1985
	pre-test control	21.28817[*]	2.41578	.000	13.1352	29.4411
	post-test control	11.38495[*]	2.41578	.001	3.2320	19.5379
pre-test control	pre-test MLA	-3.31912	2.00249	.739	-10.0773	3.4390
	post-test MLA	-13.67627[*]	2.00249	.000	-20.4344	-6.9181
	pre-test MMA	-2.55484	2.41578	.952	-10.7078	5.5981
	post-test MMA	-21.28817[*]	2.41578	.000	-29.4411	-13.1352
	post-test control	-9.90323[*]	1.95092	.000	-16.4873	-3.3191
post-test control	pre-test MLA	6.58410	2.00249	.062	-.1740	13.3422
	post-test MLA	-3.77304	2.00249	.617	-10.5312	2.9851
	pre-test MMA	7.34839	2.41578	.107	-.8045	15.5013
	post-test MMA	-11.38495[*]	2.41578	.001	-19.5379	-3.2320
	pre-test control	9.90323[*]	1.95092	.000	3.3191	16.4873
*. The mean difference is significant at the 0.05 level.						

The results in table 2c shows that each approach has effect on students' attitudes to Physics with the post-test mean score of each approach higher than their pre-test mean scores. Specifically, the mean difference of the post-test and pre-test scores of MMA (18.733) was found to be significantly higher than that of MLA (10.357), and that of the control group (9.903) at p = 0.00. Furthermore, the difference in post-test mean score in attitude to Physics of students in the MMA group and MLA group (7.61) was lower than that in MMA and control group (11.38). All of these point to the difference in effect of three approaches in enhancing students' attitude to Physics with mind mapping showing the highest effect followed by the mastery learning and the conventional method. Since the mind mapping approach enhances students' attitude towards Physics better than the mastery learning approach and the conventional method, the null hypothesis is rejected

4. DISCUSSION

Hypothesis one aimed at finding out the influence of gender on the performance of students when taught using the mastery learning, mind mapping and the conventional approaches. The result showed that there was no significant difference in the performance of male and female students taught Physics using the mind mapping and the mastery learning approaches. This implies that male and female students exposed to the same treatment will not differ significantly in their performance score in Physics. This suggests that sex is not a barrier to performance when mastery learning and mind mapping are used. This is supported by the findings of Alebiosu (1998) that there is no significant interaction effect on students' gender as performance is concerned, and Adodo (2004) that both sexes are not differ in their studies when equally encouraged to use their intellectual gifts fully and that gender does not affect students learning of science and their performance. The finding also agrees with that of Alao and Abubakar (2010) that there is no significant difference between male and female students' performance in Physics. However the result is at variance with Aina and Akintunde (2013) submission that male students perform better than the female in Physics.

Hypothesis two aimed at finding the significant influence of mastery learning, mind mapping and conventional approaches on students' attitude to Physics. The result showed a significant difference in the attitude of students taught using the three approaches in favour of the students in the mind mapping group. This implies that the treatment has greatly improved the attitude of students towards Physics. The results of the findings also revealed that the teaching approach which improves students' attitude also enhances their performance. This is in correlation with the findings of Alao (1990) that a positive correlation exists between attitudes and performance. The findings also corroborate that of Gbore (2013) who reported that students' attitude has the most potent contribution to the prediction of academic achievement in Biology. It agrees with Stephen (2010) that positive attitude of Physics students significantly influences their achievement in the subject.

5. CONCLUSION

Based on the results of this study, since the two approaches tested under this study are not gender bias it can be concluded that gender does not affect effectiveness of any learning strategy in teaching Physics in as much as the appropriate learning strategies are employed, therefore, appropriate and effective learning strategy should be used to teach both sexes. On the other hand, mind mapping approach enhances students' attitude to learning Physics better than the mastery learning approach. It is therefore recommended that science teachers and students should also be encouraged to use mind mapping in teaching and note taking as it helps the learner to develop positive attitude to their studies and this will enhance their academic performance.

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