 Stud. Home Comm. Sci., 1(1): 57-64 (2007)

Motivation Effects on Test Scores of Senior Secondary School Science Students

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KEYWORDS Experimental**;** control**;** school**;** single-sex; coeducation

ABSTRACT Motivation used in this study is hinged on the concept of need; that is the desire to score higher marks in examinations. The purpose of the study therefore, is to find out how motivation influences students scores in Science. The design of the study is 2x2x3x2 factorial, pre-test, post-test, control group design. A total of 600 students in Senior Secondary year three (SSIII), from two boys, two girls and two mixed public secondary schools in Ika South Local Government Area in Delta State were randomly divided into two groups, motivated (experimental) and unmotivated (control). Special information was read to the experimental group before a post – test on their need to do their very best, for themselves, their teachers and parents. The control group received no special instruction before the post – test. The Analysis of Covariance of the collected data at 0.05 level of significance shows that the motivated science students performed significantly better than the unmotivated sciences students. It was also found that the motivated science students in single sex schools performed significantly better than their mates in mixed schools. Motivation and school types were found to interact to influence student's achievement in science. The major conclusions drawn include (i) that motivation can greatly influence students' test scores in science, (ii) that motivation effects on science students' test scores is not gender-dependent, and (iii) that motivated students in single-sex institutions will achieve better than those in coeducational institutions.

INTRODUCTION

Government, teachers, parents and the general public are greatly worried about students' poor performance on comparison of achievement. Most state ministries of education have taken additional steps in the recent times on school comparison to measure progress in solving the national crisis. The educational arm of the government and educators recently have shown concern about the effects of students' high or low motivational states on how well they score on tests. Motivational processes help people cope with failure and keep their behaviour directed toward achieving important goal (Geary and Hamson, 2007). Early interest and positive attitude towards science learning are related to career aspirations in science.

One commonly expressed apprehension among students in test taking is that some students worry unduly about tests and suffer debilitating anxiety (Hill, 1980). Another concern is that too much testing causes students to care little about how well they do, especially on tests that have no bearing on their grades. Science teachers need to understand the role of such factors as motivation, interest, attitudes, and engagement on achievement in science. The science teachers also need to know how to apply motivational devices in their classroom interactions to sustain student's interest in classroom activities.

Good and Brophy (1980) noted that some psychologists argue that differential achievement among individuals of similar potential occurs because some individuals want to achieve more than others. Achievement becomes a dominant part of their lives and they organize their time and talent in order to pursue achievement goals. Atkinson (1964) postulated that the tendency to approach an achievement goal is a product of three factors: the need for achievement or the motive for success; the probability of success; and the incentive value of success. However, it is clear that the fear of failure can also be aroused in an achievement-related situation. According to Atkinson's theory, achievement motivation for any person is the strength of the tendency to approach the task, plus the strength of the tendency to avoid the task.

Atkinson's theory of achievement motivation involves task choice following success or failure. "I want to achieve" and "I don't want to achieve"

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are both personality factors, and the incentive values of a goal are completely dependent on the subject's perception of probable success. Weiner (1972) summarized that:

1. Motivation is enhanced following failure among individuals high in resultant achievement motivation.
2. Motivation is inhibited following failure among individuals low in resultant achievement motivation.
3. Motivation is decreased following success among individuals high in resultant achievement motivation.
4. Motivation is enhanced following success among individuals low in resultant achievement motivation. *(P.224 of 2nd Ed. Educational Psychology: A Realistic Approach).*

Research findings of Fraser, Walberg, Welch, and Hattle (discussed by Singh, Granville, and Dike, 2002) showed that motivational variables and instructional time have the largest effect on eight-grade achievement. Continuing, Singh, Granville, and Dike noted that the body of accumulated research in the last two decades indicates that motivation in one of the salient predictors of achievement in mathematics and science. Such research works which link achievement in science with motivation include the findings of: Weiner (1966), Uguroghu and Wellberg (1979), Wellberg (1986), Brown and Wellberg (1998), Nolen (2003), Geary and Hamson (2007). Psychological studies have provided insights on the effect of motivation on student's achievement in science and mathematics. Geary and Hamson (2007) for instance found that explaining the importance of mathematics to students as a motivational variable, increased the participation in advanced mathematics classes in high school.

Most research findings on the effect of sex as a moderating factor on motivation in influencing students achievement in science, indicated no effect. Damjanovie (1997) found a non-significant difference between the boys and girls exposed to a similar motivational variables on mathematics achievement. They reported that a comparison of boys and girls on problem solving strategies from grade one to three showed no differences in number of correct solutions found by girls and boys over three years period.

The literature on effect of school type as a moderating variable on motivation influencing students achievement indicates mixed results. Some research findings favour single-sex educational programmes while others support co-educational institutions. For example, Tincopa (2001) while contributing to the debate on the effect of school types on students' achievement, stated that the question of whether single-sex or coeducational schools are more advantageous is essentially an empty one. She noted that both schools offer have their respective advantages and downfall. Tincopa however, noted that all girls schools may still be able to fully impact empowering intellectual and personal education if keen attention is given to possible risks.

Quite a good number of research findings support single-sex educational programmes. The Washington Times, commenting on the single-sex schools, reported that poor minority students have been shown to perform better academically in same-sex educational programmes. Also Jeanne Allen, President for the Center for Educational Reform stated that: "this shows that one size fits all schools doesn't work… single-sex education is one of the best options". Senator Hutchison and Principal George Smiterman (2002) found that both boys and girls benefit from single-sex educational programme. In the research article by Cornelius Riordam " Girls and Boys in School: Together or separated?" he stated, "Notwithstanding other gains or losses that may result, single-sex schools provide an atmosphere that empowers African and Hispanic American students".

Still on school types and students achievement, research findings and comments on findings tend to indicate that more studies show preference for single-sex schools in terms of students' achievement than mixed schools. Most research findings on this subject matter particularly in America, indicates that the positive effects of single-sex schools are greatest among Black and Hispanic females from low economic levels. According to the book; separated by sex: A critical look at single-sex education for girls, single-sex schools are a way to reach disadvantaged girls and to break the circle of poverty prevalent in American society.

In this study, the term motivation refers to students' propensity to engage in full, serious, and sustained effort on academic tests. It is students' efforts to succeed or to excel on academic tasks. The purpose of this study is to determine the effects of experimentally manipulated motivational conditions on science students' scores in Biology, Chemistry and Physics.

Statement of the Problem

This study grew out of the conflicting opinions of experts and practicing educators about motivational effects on learning and test scores. The statement of the problem therefore is: will the experimental manipulation of motivational conditions influence science students' scores in Biology, Chemistry and Physics achievement test? Specifically, will sex and school type have differential effects on student's mean text scores among the students in the experimental group?

Research Questions

To guide this study, the following research questions were raised.

1. Is there any difference in achievement scores between a group of students who are motivated and those who are not?
2. Is there any difference in the test scores between the boys and girls?
3. Is there any difference in the test scores among students in the various school types?
4. Is there any interaction effect among motivation, gender, and school type on achievement?

Research Hypotheses

The following hypotheses were tested at 0.05 level of significance:

H01 There is no significant difference in the achievement test scores between students who are experimentally motivated and those who are not.

H02 There is no significant difference in the achievement test scores among students in the various school types.

H03 There is no significant difference in the achievement test scores between the boys and the girls.

H04 There is no significant interaction effect among motivation, school type, and gender on achievement.

METHODOLOGY

Design of the Study: The study employed a 2x2x3x2 factorial, pretest, post test control group design. The design consists of two groups (motivated and non-motivated groups), gender (boys and girls), school types (boys, girls, and mixed) and repeated testing (pretest and post test). The main independent variables are motivation, school type and gender while the dependent variable is achievement.

Population and Sample of the Study

The test population consisted of 1700 SS III students in six schools made of two boys, two girls and two mixed public secondary schools in Ika South Local Government Area of Delta State. From the 1700 SS III students, 600 students were randomly selected.

The selection of the 600 subjects was done by random selection of one intact class from each of the senior secondary schools. Three schools formed the experimental group while the remaining three schools served as the control group.

Instrument: The instruments used for the study include one simple questionnaire asking for comments from students and teachers on the relevance of the motivation used for the study. Another is the Delta Test of Basic skills in Science (DTBSS). The test, which is made up of 100 multiple choice, questions, covered concepts in Biology, Chemistry, and Physics in the national curriculum on science. The instrument was selected for the study because of its ability to accurately measure student's knowledge in science.

Although the adopted instrument has been validated before, the instrument was revalidated to show a very satisfactory reliability. The coefficient for the test was 0.80 using the Kuder-Richardson 21 formula. Thorndike and Hagen (1977) and Borich (2004) indicated that reliability has to do with accuracy and precision of a measurement procedure. A high reliability value of 0.70 or higher shows that the test is reliably (accurately) measuring the characteristics it was designed to measure. With this information, it was concluded that DTBSS was an excellent basic skills, battery that will measure global skills in biology, chemistry and physics.

Procedure: One class of SSIII from each school was randomly chosen to participate in the programme. Schools were selected for the experimental and control conditions by simple balloting i.e. withdrawal – replacement technique. Three schools emerged as the experimental group while three schools formed the control group. Each of the groups has one boys, one girls, and

one mixed school as part of the sample.

The researchers met with all participating teachers in each school to explain the instructions from the DTBSS test manual. Then the experimental teachers were retrained for the following further instructions:

"This research is being conducted to determine the effects of telling the students that the tests they are going to take is very important. It is extremely important that you read the brief script we have for you today EXACTLY as it is written to your students".

The following script was provided:

It is really important that you do as WELL as you can on this test. The test scores you receive will let others see just how well we are doing in the teaching of Biology, Chemistry, and Physics this year. Your scores will be compared with those of students in other classes here at this school, as well as to those in other schools in Delta State. The best ten students will be offered scholarships. This is why it is extremely important to do the VERY BEST that you can. Do it for your self, your parents, and your teachers.

After this information, the students are to be instructed to read the test instruction themselves. This special test information is to be provided only to the experimental group a week before the post test. Teachers in the experimental and control groups were given content materials in the DTBSS to revise with their students within six weeks. The control group teachers received no special information treatment package as the experi-mental group did but were informed of the test and date.

Five days after the training of the teachers used for the programme, a pre-test was administered to both the experimental and control groups. Six weeks after the administration of the pre-test, the experimental group was subjected to the special information treatment. A week later a post-test was administered to them and the control group. The pre-test items were rearranged before administration as a post-test. The time taken to administer the post-test was that long to enable teachers used for the programme revise all the contents covered in the DTBSS with their students.

RESULTS

The motivated students scored more marks on post-achievement test than the unmotivated students are shown in table 1. A significant difference was found between the motivated and unmotivated students on achievement as shown in table 2 ($F=358.014$, $p< 0.05$). Hypothesis 1 was not supported and so was accordingly rejected.

The motivated students in the various school types as shown in table 3 scored more marks in the achievement test than the unmotivated students in the corresponding school types. Among the motivated school types, the single boys scored the highest mark, followed by the single girls and lastly the mixed. A significant difference was found among the school types on achievement, as shown in table 2 ($F=8.744$, $p < 0.05$). Hypothesis 2 was therefore rejected. The

Table 1: Comparison of pre and post test results of the experimental and control groups on achievement.

Group	*N*	*Unadjusted Mean*	*SD*
Pre-Test			
Motivated Group	300	52.1567	8.0934
Unmotivated Group	300	52.1467	7.9882
Total	600	52.1517	8.0343
Post-Test			
Motivated Group	300	58.1367	8.7929
Unmotivated Group	300	54.6167	7.9494
Total	600	56.3767	8.5580

Table 2: Summary of analysis of co-variance of achievement (post with pre) test scores on motivation, gender, school type and interaction.

Source	*Type III Sum of Squares*	*Df*	*Mean Squares*	*F*	*Sign F*
Model	1947837.390	13	149833.645	29021.338	.000
Pre	22737.670	1	2273.670	4404.068	.000
Gender	16.586	1	16.586	3.213	.0074
School type	92.359	2	46.179	8.944	.000
Treat	1848.384	1	1848.384	358.014	.000
Gender * School type	3.848	2	1.924	.373	.689
Gender * Treat	1.053	1	1.053	.204	.652
School type * Treat	35.249	2	17.625	3.414	.034
Gender * School type * Treat	14.313	2	7.156	1.386	.251
Error	3030.610	587	5.163		
Total	1950868.00	600			

Table 3: Comparison of pre and post-tests results of motivated and unmotivated students in different school types on achievement.

Group	*N*	*Unadjusted Mean*	*SD*
Pre-Test			
Mixed school Motivated	100	45.4800	6.7845
Girls school Motivated	100	53.2700	6.0199
Boys school Motivated	100	57.7200	6.1662
Mixed school Unmotivated	100	46.1400	6.9355
Girls school Unmotivated	100	53.1400	6.1019
Boys school Unmotivated	100	57.1600	6.6753
Post-Test			
Mixed school Motivated	100	50.7200	6.7884
Girls school Motivated	100	59.7700	6.8972
Boys school Motivated	100	63.9200	6.9146
Mixed school Unmotivated	100	48.4400	6.7034
Girls school Unmotivated	100	55.5400	5.7987
Boys school Unmotivated	100	59.8700	6.7099

post-Hoc analysis to compare the school types as shown in table 4, indicates that the differences among the school types at 0.05 level of significance are significant.

Table 5 shows that the motivated boys and girls scores about the same marks in the post test. The boys slightly scored higher marks than the girls. Hypothesis 3 was favoured as shown in table 2 ($F=3.213$, $p > 0.05$). Ho:2 was therefore retained.

A significant interaction effect was found between school type and motivation on achievement as shown in table 2 ($F=3.414$, $p < 0.05$). The nature of interaction which is ordinal as shown in figure I indicates that the motivated students' and students in single-sex schools scored more marks than their corresponding counterparts. There was however no significant

Table 4: Scheffe post-hoc test to compare the school types.

(I) Level	*(J) Level*	*Mean Difference (I – J)*	*Std. Effor*	*Sig.*	*95% Confidence Interval*	
					Lower Bound	*Upper Bound*
Mixed	Girls	-8.0750*	.6875	.000	-9.7620	-6.3880
	Boys	-12.3150*	.6875	.000	-14.0020	-10.6280
Girls	Mixed	-8.0750*	.6875	.000	-6.3880	-9.7620
	Boys	-4.2400*	.6875	.000	-5.9270	-2.5530
Boys	Mixed	-12.3150*	.6875	.000	-10.6280	-14.0020
	Girls	-4.2400*	.6875	.000	-2.5530	-5.9270

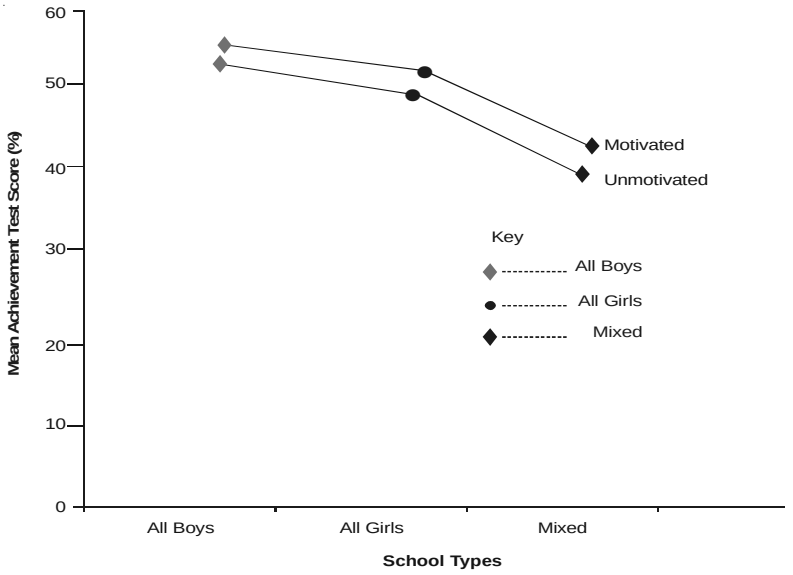

Fig. 1. Interaction between school type and motivation on achievement

Table 5: Comparison of pre and post-test results of the motivated and unmotivated boys and girls on achievement.

Group	*N*	*Unadjusted Mean*	*Adjusted Mean*	*SD*
Pre-Test				
Motivated Boys	150	52.2200		8.4852
Motivated Girls	150	52.0933		7.7098
Unmotivated Boys	150	51.6267		7.4226
Unmotivated Girls	150	52.6667		8.5095
Post-Test				
Motivated Boys	150	59.9733		9.1190
Motivated Girls	150	58.2000		8.4845
Unmotivated Boys	150	53.9067		7.3378
Unmotivated Girls	150	55.3267		8.4825

interaction effect between gender and school type, gender and motivation, and among gender, school type and motivation on achievement.

DISCUSSION

The study was undertaken to determine the effects of motivation on test scores of Senior Secondary School science students. The significant difference between motivated and unmotivated students on achievement in science, tend to suggest that motivation has strong influence on achievement. This finding is consistent with the findings of other researchers. Studies by Singh, Granville and Dike (2002), Rolen (2003) and Geary and Hamson (2007) indicate that motivation has very strong influence on students achievement in science. The motivational effect found which is relatively large, shows that the special information raised the experimental student's score above their normal.

Significant differences were not found between motivated boys and girls on science achievement. However, the boys slightly scored more marks than the girls. The non-significant difference found between the boys and girls is similar to the finding by Kahle and Damjanovie (1997). The slight difference between the boys and girls may have been caused by attitudes of students towards test taking, motivational, cultural and ability differences in student's population and variation in standards in schools. Murray's study (as discussed by Good and Brophy, 1980), and Brown and Wallberg (1998) agrees with this explanation. The non-significant difference found between the boys and girls shows that motivational effect is not sex biased.

A significant motivational effect was found among the various school types. There is however, no consensus in research findings on the particular direction of performance among the various school types. Tincopa (2001) for example stated that whether single-sex or coeducational schools are more advantageous is essentially an empty one- because both schools have their advantages and downfall. However, the post-hoc analysis to determine the direction of significance among the various school types indicate that students in the single boys school scored higher marks in achievement tests than single girls and mixed schools students. Generally the single-sex schools performed better than coeducational schools. The higher test scores found among the students in the single boys school may have resulted from the conducive learning environment and opportunity for self-esteem created by the single-sex educational programme. This finding is consistent with the findings of Senator Hutchison and Smithoman (2002). They both found that boys and girls benefit from single-sex educational programme.

On interaction, although no significant interaction effect was found between gender and school type, gender and motivation, and among gender, school type and motivation, there was however, a significant interaction effect between school type and motivation on achievement. It therefore follows that science teachers in what-ever school type should motivate their students while teaching to improve on their performance in science. The implication of the noticed interaction effect is that a combination of school type and motivation significantly affect students achievement in science. The type of interaction is described as ordinal interaction; the single-sex schools students and the motivated students scored more marks than the students in coeducational institutions and the unmotivated students.

CONCLUSION

The result indicates that motivation can greatly influence text scores. Students motivated by way of provision of special information performed significantly better than those who did not receive such special information. Although the result showed no significant difference between the motivated boys and girls, the magnitude varied a little with the boys on top. It therefore follows that the effect of motivation on science students test scores is not gender-dependent.

The results tend to suggest that science students in single-sex educational progrmmes will achieve better when one form of motivation or the other is given. The ordinal interaction found in this study favour higher post-test scores among single-sex schools and motivated students.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made:

Firstly, science teachers should always introduce motivational variables in their teaching to enhance their students' achievement in tests and participation in class.

Secondly, more public schools should be re-organized to have more single-sex educational institutions than coeducational ones.

Thirdly, the use of motivational variables to enhance science learning and participation should be emphasized for all students irrespective of their sex.

ACKNOWLEDGEMENT

We wish to particularly thank the Director of Examinations and standards in Delta State Ministry of Education for the provision of the test instrument used for the study. We wish to also thank the school heads, staff and students of the following institutions: St Charles' College, Abavo; Abavo Girls' Grammar School, Abavo; Baptist Girls' High School, Agbor; Gbenoba Grammar School, Agbor; and Ime-obi Mixed Secondary School, Agbor, for their co-operation throughout the period the study lasted. Finally our thanks goes to Ejire, our research assistant, for the very special role she played in getting information from the internet.

NOTES

1. SS III – This means Senior Secondary Class Three.
2. DTBSS – This means Delta Test of Basic Skills in Science
3. Public Secondary School – These are the secondary schools owned by the government.
4. Post-hoc Analysis – This is the analysis done after a significant difference has been established. It is done to determine the direction of significance.
5. Gender – This is term used to describe the sex of individuals. The gender of individuals is either male or female.
6. Single-sex institution. An institution where you have only boys or girls is described or single-sex.
7. Coeducational institution. This is an educational institution where both boys and girls are trained together.
8. Calculated F-value. This is the F value obtained as a result of the analysis of collected data.
9. Critical or table F-value. This is the F-value obtained from the statistical table used to compare the calculated F-value before a conclusion can be reached.

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