EFFECT OF SELF-REGULATORY LEARNING STRATEGY ON STUDENTS' ACHIEVEMENT IN BASIC SCIENCE AND TECHNOLOGY IN MINNA, NIGER STATE

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Abstract
This study is one of the attempts to seek ways of improving students' learning so as to reflect in their academic achievement, especially in the sciences, through the use of self-regulatory learning. The study involved manipulation of three independent variables of treatment, gender and school type (mixed sex and same sex) to see the effect on the dependent variable-students' learning as reflected in their achievement in Basic Science and Technology. Five research questions were asked and answered while five hypotheses were tested using analysis of covariance. A quasi-experimental design was employed using six intact non-equivalent class groups. The population for the study was 2500 junior secondary class two (JSII) students within Minna education zone while the sample was 167 JSII students drawn from the population. An instructional package on how to use self-regulatory as a learning strategy was designed and used while achievement test on JSII Basic Science and Technology served as the instrument. It was found that the treatment involving use of self-regulatory strategy had significant effect on students' achievement. School type also had significant influence on students' achievement. However, gender was found not to have a significant influence on the achievement of those that employed self-regulatory learning strategy. It was then concluded that equipping students with skills for using self-regulatory strategy facilitates their learning and so improved academic achievement in school.
Keywords: self-regulatory, learning strategy, achievement, basic science and technology, students.

INTRODUCTION

The main objectives of teaching and learning of Basic Science and Technology in Nigeria schools as stipulated by NERDC (2012) is to develop learners interest in science and technology; acquire basic knowledge and skills in science and technology; apply scientific and technological knowledge and skills to meet contemporary societal needs; take advantage of the numerous career opportunities provided by science and technology; become prepared for further studies in science and technology; avoid drug abuse and related vices; and to be safety and security conscious. In order to achieve the objectives of Basic Science Technology, the thematic approach to content organization was adopted by NERDC for the holistic presentation of scientific and technological concepts, knowledge and skills to learners for better self-regulation achievement.

Self-regulation is described as the individuals' ability to direct their actions towards goals and ideals which can come from personal desires or the expectations of others, and helps individuals adjust to the demands of society and the environment. Zimmerman (2013) believes self-regulation is of great importance for the existence of mankind because it is directly linked to being socially accepted and depending on the group, as humans tend to get most of what we need from other humans.

Behncke (2012) divides self-regulatory processes into different stages, namely, self-control, goal-setting and goal attainment, self-evaluation, self-importance, self-efficiency, self-regulatory failure, and so on. Knowing and understanding these processes can improve self-regulation and motivation. Zimmerman (2013) explains why we are able to self-regulate some actions, and not others. Unlike metacognitive approach to self-regulation which emphasizes the level of knowledge and deductive thinking when selecting a cognitive strategy, Zimmerman applies a social cognitive perspective and advises including the individuals' self-beliefs and emotional responses, such as fear or doubt in the process.

Achievement according to Adeyemi (2012) is the scholastic standing of a student at a given moment. It has to do with the successful accomplishment of goal(s). The purpose of testing an achievement is to help the teacher and the students evaluate and estimate the degree of success attained in learning

a given concept. It is also useful in testing the retention of information and skill. It is equally appropriate in determining the efficiency of instruction. One of the issues at stake in education today is students' achievement measure in relation to teaching and the overall success of learning outcome, Use of self-regulatory teaching method in teaching simple machine by basic science and technology teachers may make Basic science and technology lesson objective stimulating and interesting to the students.

Gender refers to the characteristics, whether biological or socially influenced, by which people define male and female (Myers, 2012). Gender may also be explained as the socially constructed roles, behaviours, activities and attributes that a given society considers appropriate for men and women. Disparities according to Okoro (2016) usually exist in the levels of performance between males and females.

The observed poor achievement of many students in the sciences and reported discrepancies between academic achievement of male and female students as well as the variations in students' academic achievement according to school type necessitated this study to see if there would be a different result with students who employed self-regulatory strategy.

Statement of the Problem

There is high rate of poor achievement of students in basic science and technology in Junior Secondary School Certificate Examination (JSSCE) over the years (NECO Chief Examiner's Report, 2015). This could be as of the teachers use ineffective methods and strategies in science teaching which among other factors have contributed to the student's poor achievement in basic science and technology at the junior secondary school. This poor achievement of students at JSSCE level has necessitated the need for teaching and learning improvement of basic science and technology in junior secondary school by the Federal Government. The available literature on methods of teaching and learning in science education suggests the need to employ new and innovative teaching and learning strategy such as self-regulatory learning strategy. Based on the fact that basic science and technology in Nigerian 6 3 3 4 system of education, it evolved from sciences which was reviewed to provide a holistic presentation of science and technology with the theme ''you and technology''. There is need to explore more into the best methods of teaching specific topics in basic science and technology in other to enhance students' achievement. Therefore, the problem of this study is posed as a question; what is the effect of self-regulatory learning strategy on student's achievement in basic science and technology in Minna, Niger State.

Purpose of the Study

1. To determine the differences in the mean achievement scores of Basic Science and Technology students exposed to self-regulatory strategy and those not exposed
2. Determine the effectof gender on the mean achievement scores of students in Basic Science and Technology exposed to self-regulatory strategy and those not exposed.
3. Determine the effect of school type on students' mean achievement scores in Basic Science and Technology exposed to self-regulatory strategy and those not exposed
4. To determine the interaction effect of treatment and gender on the students' posttest mean achievement scores in Basic Science and Technology
5. To determine the interaction effect of treatment on school type on the students' posttest mean achievement scores in Basic Science and Technology?

Research Questions

1. What is the differences in the mean achievement scores of Basic Science and Technology students exposed to self-regulatory strategy and those not exposed?
2. What is the effect of gender on the mean achievement scores of students in Basic Science and Technology exposed to self-regulatory strategy and those not exposed?
3. What is the effect of school type on students' mean achievement scores in Basic Science and Technology exposed to self-regulatory strategy and those not exposed?
4. What is the interaction effect of treatment and gender on the students' posttest mean achievement scores in Basic Science and Technology?
5. What is the interaction effect of treatment and school type on the students' posttest mean achievement scores in Basic Science and Technology?

Hypotheses

The following hypotheses were tested at .05 level of significance: -

1   There is no significant difference between the mean achievement scores of students in the treatment and control groups in Basic Science and Technology.

2   There is no significant difference in the mean achievement scores of male and female students in Basic Science and Technology.

3   There is no significant difference in the mean achievement scores of students in Basic Science and Technology due to school type.

4   There is no significant interaction effect of treatment and gender on students' achievement scores.

5   There is no significant interaction effect of treatment and school type on students' achievement scores.

METHODOLOGY

This study wasa quasi-experimental research design involving pretest-posttest. The study was carried out in Minna educational zone, Niger State. The population of the study comprised 2500 junior secondary school (J.S.S II) students in the area of study.   The sample consisted of 167 junior secondary class two (JSII) students drawn from six schools. This means that a class of JSSII was drawn from each of the two schools from the respective cluster of schools.The researcher first constructed a sixty item questions comprising three questions on each of the objectives per topic and gave same to some Basic Science and Technology teachers to do face and content validation. They were requested to reframe the questions, if necessary, to suite the level of the students. After this, the researcher gave the questions to some experts in science education to check if they properly fit into the four stated behavioural objectives. In doing this, some items were reframed.

Reliability test was obtained by analyzing the responses obtained from the trial testing among JSS II students from Junior Secondary School, Sulejawhich is outside the research area. A stability index of 0.73 was obtained through a test-retest method. This method was used to estimate the stability of the items since the same instrument was used for both the pretest and the posttest. An index of internal consistency of 0.82 was obtained using Kudder-Richardson formula 20 (K-R 20). The K-R 20 was applied since the items were dichotomously scored. The result of the posttest was analyzed by the use of analysis of covariance (ANCOVA) in testing the hypotheses, since the subjects involved non-equivalent groups. The Mean scores and standard deviations were used in answering the research questions.A posthoc analysis using Scheffe test was done to determine the direction of differences among school types.

RESULTS

Research Question 1: What is the differences in the mean achievement scores of Basic Science and Technology students exposed to self-regulatory strategy and those not exposed?

To answer the question, the pretest and posttest mean scores and standard deviations of all the subjects are presented in the table below:

Table1: Mean Scores on the Basic Science and Technology Achievement Test.

Group	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Treatment	75	10.23	2.21	32.32	5.82	22.09
Control	92	11.75	3.37	29.19	4.75	17.44

In the above table, it can be seen that the mean posttest score for the treatment group was 32.32 and that of the pretest was 10.23 thus, giving a mean gain of 22.09. The control group, on the other hand, had a mean posttest score of 29.19 and that of pretest was 11.75 thus having a mean gain of 11.44. From these, it can be seen that the treatment group had ahigher mean gain having got a higher mean posttest score despite a higher mean pretest score by the control group. The treatment group had a pretest standard deviation of 2.21 and 5.82 for the posttest, whereas the control group

had standard deviations of 3.37 and 4.75 for the pretest and posttest respectively. This shows that there was greater variation among the treatment group after exposure to treatment.

Research Question II: What is the effect of gender on the mean achievement scores of students in Basic Science and Technology exposed to self-regulatory strategy?

In order to answer this question, the mean scores of both males and females in the study were as presented in the table below

Table 2: Mean Scores of Males and Females

Group	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Males	35	8.23	3.12	30.43	6.36	22.20
Females	40	13.75	4.13	30.73	4.65	16.98

From the above table, it can be seen that the mean posttest score for the male subjects was 30.43 and this was not quite different from that of the females, which was 30.73. However, the mean gain for males, which was 22.20, was higher than that of females, which was 16.98 despite a higher mean pretest score by the females.It was observed that the females were more stable having standard deviations of 4.13 and 4.65 for the pretest and posttest respectively as against the males with wide variation of 6.36 standard deviation in the posttest despite the clustered nature in the pretest with a small standard deviation of 3.12.

Research Question III: What is the effect of school type on students' mean achievement scores in Basic Science and Technology exposed to self-regulatory strategy and those not exposed?

To answer this question the pretest and posttest mean scores and standard deviations of the subjects from the different school types(mixed, all males and all females) are as presented in the table below.

Table 3: Mean Scores according to School Type

School Type	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
All Males	52	2.00	1.96	32.10	5.81	30.10
All Females	64	3.98	3.75	30.84	3.91	26.86
Mixed Sex	51	2.29	2.45	28.75	6.30	26.45

From the above table, it can be seen that the mean pretest scores of students from the same sex or single-sex schools were 2.00 and 3.98 for males and females respectively with the corresponding mean posttest scores of 32.10 and 30.84. These were higher than that of students from mixed sex schools, which stood at 28.75. Similarly, the mean gain in same sex schools, which were 30.10 and 26.86 for males and females respectively were higher than that of mixed sex schools which was 26.45. Itwas also observed that those in all female schools were stable having standard deviations of 3.75 and 3.91 in the pretest and posttest respectively unlike those in all male schools with 1.96for pretest and 5.81 for posttestand those in mixed-sex schools with 2.45 and 6.30 for pretest and posttest respectively.

Research Question IV: What is the interaction effect of treatment and gender on their mean posttest achievement scores in Basic Science and Technology?

In order to answer the above question, the result of the posttest achievement scores according to gender and treatment were as presented

Table 4: Mean Posttest Scores according to Gender

Gender	Group	N	Mean	SD
Male	Treatment	35	31.92	6.94
	Control	40	28.97	5.44
Female	Treatment	38	32.71	4.53
	Control	54	29.33	4.24

From the above table, it can be seen that the male treatment group had a higher mean posttest score of 31.92 than their counterparts in the control group with a mean posttest score of 28.97. Again, the variation within each of the groups was different with standard deviations of 6.94 and 5.44 for treatment and control respectively. In the same vein, the female treatment group had a higher mean posttest score of 32.71 than their counterpart in the control group with a mean posttest score of 29.33. The variation within the two groups was similar with a standard deviation of 4.53 and 4.24 for treatment and control respectively. It can also be seen that the female treatment group had a higher mean score of 32.71 than their male counterparts with a mean score of 31.92. It was observed that the females were more stable having standard deviations of 4.53 and 4.24 by the treatment and control groups respectively as against the males with 6.94 and 5.44 respectively.

Research Question V: What is the interaction effect of treatment and school type on the mean posttest achievement scores in Basic Science and Technology?

In order to answer the above question, the mean scores of students from the different school settings – same sex (all males and all females) and mixed sex were as presented in the table below.

Table 5: Mean Posttest Scores according to School Type

School Type	Group	N	Mean	SD
All Males	Treatment	24	33.04	7.18
	Control	28	31.29	4.28
All Females	Treatment	26	32.77	4.60
	Control	38	29.53	3.59
Mixed sex	Treatment	25	31.16	6.27
	Control	26	26.42	5.49

A look at the above table shows that the treatment group in the same sex or single-sex schools had higher mean posttest scores of 33.04 and 32.77 for all males and all females respectively than their counterparts in mixed sex schools with a mean posttest score of 31.16. The variations within each of the groups equally differed with standard deviations of 7.18, 3.60 and 6.27 for all males, all females and mixed sex respectively. It can also be seen that the mean scores of the treatment groups in each type of school were higher than those of the control groups with 33.04 versus 31.29; 32.77 versus 29.53 and 31.16 versus 26.42 for all males, all females and mixed sex schools respectively. It was also observed that students in all female schools were more stable with standard deviations of 4.60 and 3.59 for the treatment and control groups respectively. This was quite different from those in all male schools with a wide variation of 7.18 in the treatment group and 4.28 in the control group as well as those in mixed-sex schools with 6.27 and 5.49 in the treatment and control groups respectively.

Testing the Hypotheses

The following hypotheses guided the study

1: There is no significant difference between the mean achievement scores of students in the treatment and control groups in Basic Science and Technology.

2**:** There is no significant difference in the mean achievement scores of male and female students.

3: There is no significant difference in the mean achievement scores of students in Basic Science and Technology due to school type.

4**:** There is no significant interaction effect of treatment and gender on students' posttest achievement scores.

5**:** There is no significant interaction effect of treatment and school type on students' posttest achievement scores.

The observed differences in the mean scores were then tested to see if they were chance occurrence or otherwise and the results are as presented in the table below. The figures in the table were used for all the hypotheses whereby the relevant information is extracted for any given hypothesis.

Table 6: ANCOVA on Posttest Achievement by Treatment, Gender and School Type

Source	Type III Sum of Squares	Degree of Freedom	Mean Square	F Ratio	Level of Significance
Corrected Model	1763.121[a]	8	220.390	10.891	.000
Intercept	63421.770	1	63421.770	3134.201	.000
Pretest	682.430	1	682.430	33.725	.000
Exptal	808.373	1	808.373	39.949	.000
Gender	141.691	1	141.691	7.002	.009
Schtype	497.492	2	248.746	12.293	.000
Exptal * Gender	46.634	1	46.634	2.305	.131
Exptal * Schtype	151.765	2	75.882	3.750	.026
Error	3197.191	158	20.235		
Total	161259.000	167			
Corrected Total	4960.311	166			

Hypothesis 1: There is no significant difference between the posttest mean achievement scores of students in the treatment and control groups in Basic Science and Technology.
From the above table 6, it can be seen that the test of significance of the differences in the mean scores of control and treatment groups showed that the F-ratio obtained was 39.949, which was significant at .000 level of significance. This meant that there was a significant difference in the mean scores of the treatment and control groups and so the null hypothesis was rejected. In considering the nature of the difference, the figures in the table showed that the group that used self-regulatory strategy (treatment) performed better than the groups that did not use it.

Hypothesis 2: There is no significant difference in the posttest mean achievement scores of male and female students.
When the difference between the mean scores of males and females were subjected to a test of significance, as shown in table 6, the F-ratio obtained was 7.002, which is significant at .009 level of significance. This meant that there was a significant difference between the mean scores of males and females. Hence, the null hypothesis was rejected. From table 12 it can be seen that the males performed better than the females.

Hypothesis 3: There is no significant difference in the posttest mean achievement scores of students in Basic Science and Technology due to school type.
The difference in the mean scores of students from same sex and mixed sex were subjected to test of significance, as shown in table 6, and the obtained F-ratio of 12.293 was high and significant at .000 level of significance. Hence, the null hypothesis was rejected. Table 12 shows that those in single or same sex school performed better than those in mixed sex school.

Hypothesis 4: There is no significant interaction effect of treatment and gender on students' posttest achievement scores.
When the difference in the mean scores of males and females from the control and treatment groups respectively, was subjected to a test of significance, the calculated F ratio of 2.305, as shown in table 6, was significant at .131 level of significance. But it was not significant at .05 level of significance. Hence, the null hypothesis was upheld.

Hypothesis 5: There is no significant interaction effect of treatment and school type on students' posttest achievement scores.
When the difference in mean scores of students from different school types was subjected to test of significance, the calculated F ratio of 3.750, as shown in table 11, was significant at .026 level of significance and so it was significant at .05 level of significance. Hence, the null hypothesis was rejected. This is a case of ordinal interaction.
The direction of the difference among the different school types were tested using Scheffe test and the result is as presented in the table below.

Table 7: Scheffe Test for Multiple Comparisons

School Type (I)	School Type (J)	Mean Difference (I-J)	Std Error	Sig	95% Conf. Int	
					Lower Bound	Upper Bound
All Male	All Female	1.252	.996	.455	-1.207	3.712
	Mixed Sch.	3.351*	1.051	.007	.755	5.947
All Female	All Male	-1.252	.996	.455	-3.712	1.207
	Mixed Sch	2.099	1.001	.114	-.374	4.572
Mixed School	All Male	-3.351*	1.051	.007	-5.947	-.755
	All Female	-2.099	1.001	.114	-4.572	.374

The mean difference is significant at the .05 level

From the above table, it was found that there was significant difference between the mean scores of those in all males school and mixed sex school in favour of male school but that those in all females schools did not obtain mean scores that differ significantly from those in mixed sex schools.

Discussion

The study sought to find out whether the employment of self-regulatory strategy would affect students' learning as indicated by their academic achievement in Basic Science and Technology. The findings indicated that those who were guided on how to apply self-regulatory strategy in their learning performed better than those who were not. This showed that the use of self-regulatory strategy improved students' achievement in learning. This means that when students employ self-regulatory strategy in learning, it helps them for better understanding and recall of the concepts. The improvement of the treatment group could have resulted from the fact that when a student thinks about what he is learning, setting out goals and asking himself questions from time to time, such student would likely be more focused in what is being learnt. Again, the intermittent self-evaluation of one's progress, as obtains in self-regulatory learning, helps one to consider other learning strategies that could better lead to achievement of the goals.

The finding agreed with those of researchers like Anderson (2014) who reported how training on application of metacognition improved students' acquisition of a second language; Eze (2017) who found that training in organizational and comprehension monitoring strategy improved students' achievement in English and Basic Science and Technology, as well as Imel (2012), Wong and Chang (2015) who had reported that the use of self-regulatory strategy contributes greatly in improving learning. However it must be noted that most of these studies looked at other aspects of self-regulatory strategy but this work was limited to the self-regulatory strategyand a similar result was obtained. This shows that the use of self-regulatory learning strategy like any other self-regulatory strategy is important in improving students' learning.

It was observed that those in control group had a higher mean pretest score than those in the treatment group but with the exposure to treatment, the result was reversed. This shows that the use of self-regulatory learning strategyhas improved the learning of those in the treatment group, enabling them to have better understanding so as to have out-performed those in the control who did not use the strategy. The study sought to find the influence of students' gender on their learning as reflected in their achievement. The finding showed that there was significant difference between the achievement of males and females, which meant that the gender of a student did necessarily affect one's learning.

This finding agrees with reports from researchers like Eze (2017) who reported that students' gender was a significant factor in their achievement in Basic Science and Technology where males performed better. Other researchers like Taiwo and Aina (2016), Okoli(2015) and Marshal (1984) also reported significant differences in the performance of boys and girls. However, it differs from the findings of others like Okoli (2015), Awodeyi (2013) and Obiyo (2016), who had reported that gender has no significant influence on students' academic performance.

It was observed that female students in all the groups showed more cohesion having less variation of scores. This could mean that female students compete more than the male ones.

The study equally sought to find whether the gender of the student would have any influence on their use of self-regulatory strategy. It was found that the performance of male and female students who employed self-regulatory strategy did not differ significantly. This meant that one's gender did not influence the ability to make use of self-regulatory strategy to improve learning. In other words, the fact that one is a boy or girl does not confer on him/her any superiority in processing learning materials or problem solving neither does it interfere with one's learning. Whatever differences that might have occurred could have resulted from natural individual differences and not necessarily from gender differences.

This finding agrees with those of Jenkins in Okoli (2015), Awodeyi (2013) and Obiyo (2016), who had reported that gender has no significant influence on students' academic performance. However, they differ from many other reports as presented by Maduabum *et al.* (2011), Okoro (2013), and Obioma (2012), where there were reports of clear differences in the academic performances of boys and girls. Most of these studies found boys to have achieved more than girls in the sciences but this was not found to be so among those that employed self-regulatory learning strategyin Basic Science and Technology, where no difference as a result of the treatment was found. The disparity in the findings could have resulted from the fact that the use of self-regulatory strategy improved the ability of both sexes and made them understand the topics clearer and so retained more.

The study sought to find the influence of school type on students' learning as reflected in their academic achievement and it was found that those from same sex or single sex schools performed better than those from mixed sex or coeducational schools. This meant that the type of school one attended had some influence in one's learning. It could be that students in same sex or single sex schools had less distracting events than their counterparts in mixed schools which made them to concentrate more on their studies.

The finding from this study agreed with those from studies by NASBE (2015), Riodan (2016) and Dean (2018), which reported that students in same sex schools perform academically better than those in mixed sex schools. However, it differs from the report of Smith (2016) that there was no significant difference between the performance of students from each school type; and that of Willis and Kenway (2014), who said that there was no casual relationship between single-sex school attendance and superior academic achievement.

It was equally found that even with the use of self-regulatory strategy, those students from same sex or single sex schools, who employed the strategy performed better than their counterparts from mixed sex or coeducational schools. This meant that the type of school one attended could influence one's ability to employ a given strategy. It could be that students in same sex or single sex schools had less distracting events than their counterparts in mixed schools which made them to master any given strategy easily.

The findings in this study agreed with those of NASSPE (2015), Soyibo and Adeniyi (2012) who have reported that students in same sex school perform academically better than those in mixed sex schools. NABSE for instance has stated that single sex schools give students more opportunity to demonstrate more commitment to academics, have fewer sexually stereotyped behaviours and course taking than coeducational schools. However, it disagrees with the finding of Igwue (2012), who reported that there was no significant difference in achievement of students from different school types in Basic Science and Technology.

Again, the observation that students in all males schools performed significantly different from those in mixed sex school unlike those in all females school countered the report by the National Foundation for Educational Research in England, which stated that both boys and girls performed significantly better in single-sex schools than in coeducational schools.

Conclusion

The results of this study showed that the use of self-regulatory strategy had significant effect on students' learning as shown by their achievement. It can therefore be concluded that guiding students to master and use self-regulatory strategy is a veritable means of improving students' academic performance. Thus, it should be encouraged in our schools to help minimize the high rate of poor performance of our students in both the internal and external examinations.

Recommendations

Based on the findings from this study, the researcher wishes to make the following recommendations: -

1. That students should be encouraged to apply self-regulatory strategy in their learning as from the secondary level of education

2. That the curriculum of the course, psychology of learning, be revised to include some self-regulatory strategy;
3. That guidance services in schools be intensified and that counsellors should discourage the sex biases in course selection
4. That seminars be organized for practising teachers to enlighten them on the availability and use of learning strategies like self-regulatory learning strategy.

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