International Journal of Scientific Research and Management (IJSRM)
||Volume||06||Issue||06||Pages||EL-2018-428-435||2018||
Website: www.ijsrm.in ISSN (e): 2321-3418
Index Copernicus value (2015): 57.47, (2016):93.67, DOI: 10.18535/ijsrm/v6i6.el09

Influence of Attitude, Cooperative and Inquiry Instructional Strategies on the Academic Performance of Students in Basic Science and Mathematics in Katsina, Nigeria

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Abstract
Investigating the effects of cooperative learning as an instructional strategy for teaching basic science and mathematics to junior secondary school students in Katsina state was the focus of this study. Equally, it also looked at how gender affect students' performance and attitude in basic science and mathematics when cooperative learning was used as an instructional strategy. Quasi-experimental design was used in the study with 240 students as sample selected purposively. Cooperative Learning Guide (CLG), Basic Science and Mathematics Performance Test (BSMPT) and Students' Attitude to Science and Mathematics Questionnaire (SASMQ) were used as instruments for data collection. Reliability indices of 0.78 for BSMPT and 0.79 for SASMQ were obtained using split haft method and Cronbach alpha respectively. Analysis of the data was done using, t-test and Pearson Product Moment Correlation Co-efficient. Findings of the study revealed that students taught using cooperative learning strategy performed higher than those taught using inquiry learning strategy; there was an insignificant difference in performance between the male and female students in the cooperative learning group. The students in cooperative learning group show a more positive attitude towards basic science and mathematics than those in inquiry classroom learning. On the bases of these findings, it was recommended that cooperative learning strategy be adopted by all secondary school Basic Science and Mathematics teachers as an effective learning strategy in order to improve students' performance and positive attitude towards science and mathematic

Key words: Cooperative Learning, Inquiry Method, Basic Science, Mathematics

Introduction

Instructional strategy is generally regarded as the vehicle through which content is passed to the learners. There exist several methods of instruction which have permeated the educational system over the years. These methods include concept mapping, demonstration method, dramatization method, inquiry method, project and field trip, cooperative among others. Classroom experience shows that in most cases, two or more teaching methods are combined by teachers in classroom practice for efficiency. The teaching strategy employed by any teacher has been shown to reflect on students' understanding of the subject. According to Harman & Nguyen, (2010) teaching technique employed by any teacher in order to enhance learning is of highest significance. Thus, he further resolved that, there is the need to introduce, adopt, and adapt the newest instructional techniques that are capable of sustaining and improving the interest of the learners and possibly yield meaningful learning.

According to Amosun (2002), a number of research works have been carried out on the efficacy of Cooperative learning in Nigeria. Such studies include those of (Adeyemi, 2002; Omosehin, 2003; Obinna-Akakura, Onah, Opara, 2015) who investigated the effects of a training programme in cooperative learning of pre-service teachers' classroom practice and pupils' learning outcomes in Sciences. It was the conclusion

of all these studies that cooperative learning strategies seem to be more useful than other instructional strategies.

Cooperative learning engages groups of students carrying out an activity in order to achieve a common goal (Obinna-Akakura, Onah & Opara, 2015)). It is usually done with groups of 2-4 students, who are working together in order to hel one another learn academic content (Slavin, 2011), the smaller the group, the better the outcome. Groups produced higher performance outcomes than students working individually, but this effect was not due to the cooperation as the case may be, but the cooperation increased the likelihood of engagement in the types of talk that support learning. When working with a partner, forms of elaborated talk are more prevalent than when working individually (Krol et al., 2004).

Cooperative strategy of learning equally gives learners the opportunity to analyze and evaluate themselves as they work together to achieve a particular goal (Chukwuyenum, Nwankwo and Toochi, 2014). This can be done in a non-threatening environment. The interactions with other students can help deepen the level of understanding for all students and also communication of ideas helps to develop reasoning skills and better understanding of processes and procedures in science and mathematics (Hossain & Tarmizi, 2012).

Study has shown that cooperative learning strategy just like any other strategy has an influence (positive or negative) on students' involvement in science (Ferreira, 2001). Students appear to enjoy working cooperatively and are willing to cooperate with others in the group (Krol et al., 2004). Science and mathematics teachers also find satisfaction with the incorporation of cooperative learning groups. The use of small groups requires fundamental changes not only in the organization of the classroom but also in ways of learning (Kramarski & Mevarech, 2003; Johnson &Johnson, 2009; Tran & Lewis, 2012). There are many different research-based models of cooperative learning. One popular model is the Johnson and Johnson model. This model defines five essential elements: (a) promotive interaction, (b) individual accountability, (c) positive group interdependence, (d) social skills instruction, and (e) debriefing (Krol, Janssen, Veenman, & Van der Linden, 2004; Slavin, 2011). Learning situations are not cooperative if students are arranged into groups without positive interdependence (Johnson & Johnson, 2009).The great advantage here is that, there is no single model to be followed precisely to have a positive influence in the classroom. In fact, teachers will adapt research-based models for use in their classroom.

Through the mechanism of assimilation, teachers should reorganize the information that they receive about cooperative learning to fit their existing scheme of teaching (Siegel, 2005). The inclusion of cooperative learning need not be viewed as an added burden, but as a welcomed change of instruction in the classroom.

With even the best of practices, there may be disruptions. Behavior is one such event. Implementing any cooperative small-group setting does not automatically ensure cooperative work and a positive effect on all students. Studies indicated that greater success may be achieved when cooperative learning is implemented with heterogeneous groups of students. One study Krol, Janssen, Veenman, & van der Linden, (2004) paired a low-ability student with a medium-ability student, and a medium-ability student with a high-ability student. This pairing was based on the assumption that the ability levels of the students should be different in order to generate help-seeking and helping behaviors, but not too different in order to still make it possible for the students to work in their "zone of proximal development." Analysis of the data revealed that approximately 75% of the dialogue that occurred within the groups was cognitive in nature. There was more high-level interaction between the groups consisting of a medium-ability learner and a high-ability learner than there was in the groups consisting of a medium-ability learner and a low-ability learner.

Relative to students taught using other methods, individual assignments, and competitive grading-cooperatively taught students tend to exhibit higher academic achievement, greater persistence through graduation, better high-level reasoning and critical thinking skills, deeper understanding of learned material, greater time on task and less disruptive behavior in class, lower levels of anxiety and stress, greater intrinsic motivation to learn and achieve, greater ability to view situations from others' perspectives, more positive and supportive relationships with peers, more positive attitudes toward subject areas, and higher self-esteem. Beyond that, cooperation enhances learning in several ways. Weak students working individually are likely to give up when they get stuck; working cooperatively, they keep going. Strong students faced with the task of explaining and clarifying material to weaker students often find gaps in their own understanding and fill them in. Students working alone may tend to delay completing assignments or skip them altogether, but when they know that others are counting on them, they are motivated to do the work in a timely manner.

Inquiry teaching approach on the other hand is more focused on using and learning content as a means to develop information-processing and problem solving skills. The system is more of students centered with the teacher as facilitator of the learning process (Julius, 2014). Students are also involved in the construction of knowledge through active involvement while using inquiry as an instructional strategy. In this instructional strategy, learning starts by posing questions, problem or scenarios rather than simply presenting established facts or portraying a smooth path to knowledge. It therefore means it could an active means of acquiring scientific and mathematics knowledge of properly handled.

Attitude on the other hand may be defined as a pre disposition to respond in a favourable or unfavourablemanner with respect to a given object (Oskamp and Schultz 2005). Attitude towards science and mathematics denotes interests or feelings towards studying science and mathematics. It is the learners' disposition towards like or dislikes in a particular field. While attitude in science means scientific approach assumed by an individual for solving problems, assessing ideas and making decisions. Student beliefs and attitudes have the potential to either facilitate or inhibit learning (Yara, 2009). Many factors could contribute to student's attitude towards studying basic science and mathematics. Several studies including Berg (2005) and Adesoji,(2008) reported that students' positive attitudes to basic science correlate highly with their performance, that, in general, the attitude of Nigeria students towards the basic sciences tend to decrease in the order, Biology, Chemistry, Physics and Mathematics. They also found that using integrated science environment activities improved high school student attitude and awareness about the environment.

It is against the above background that this study investigated the influence of Cooperative and Inquiry instructional strategies and attitude on performance in basic science and mathematics among junior secondary school students in Katsina state with the view to finding out their efficacy or otherwise in the teaching and learning of basic science and mathematics.

Statement of the Problem

This study looked at the influence of cooperative strategy and inquiry method on attitude junior secondary school students' performance in basic science and mathematics in Katsina state. The problems of learning basic science and mathematics may not be unconnected with the way and manner students are taught concepts therein. In recent years however, evidences are bound showing that cooperative learning strategy tends to give students better ways of understanding scientific and mathematical concepts (Omosehin, 2003). It is believed by many that when students work in group rather than individually they tend to understand each other better than when a teacher teaches them alone. A number of research works have been carried out on efficacy of cooperative learning in Nigeria. Such studies include those of Adeyemi (2002), Omesehin (2003) and Bashir, (2005). It was the conclusion of all these studies that cooperative learning strategies seem to be more useful in social science than other instructional strategies, there is therefore the need to try it in basic sciences and mathematics to see whether it could similar results or otherwise.

The growing concern in all parts of Nigeria over a decline in the quality of students who enroll in science related areas in schools as well as their performance is increasing. Although these problems may not be rooted in the instructional strategies only but the way the students are taught may greatly affect their performance. Therefore, a study towards this direction is necessary in order to contribute in searching for answers to these numerous problems and concerns. It's against this background that this study looked at the influence of cooperative strategy and inquiry method on attitude junior secondary school students' performance in basic science and mathematics in Katsina state.

Objectives of the Study

1. To determine students' performance in basic science and mathematics using cooperative learning strategy and inquiry method of teaching among junior secondary school students in Katsina State.
2. To determine if there is any relationship between students' attitude and their performance in basic science and mathematics
3. To find out if there is any difference between the performance of male and female junior secondary school students in basic science and mathematics using cooperative learning strategy

Null Hypotheses

H_{01} There is no significant difference in the performance of students taught basic science and mathematics using cooperative learning strategy and inquiry teaching method.
H_{02} There is no significant relationship between students' attitude and their performance in basic science and mathematics
H_{03} There is no significant difference in the performance of male and female students taught basic science and mathematics using cooperative learning strategy.

Significance of the Study

Findings of this study will be useful by assisting most especially science and mathematics curriculum planners in proposing appropriate changes which will promote better study habits in science and mathematics. This will provide sound foundation in science and mathematics related fields via in cooperating cooperative learning strategy as one of the instructional strategy to be use in the teaching and learning of science and mathematics.

The study will also be of great advantage to all basic science and mathematics teachers as viable tool that will improve the performance of students in basic science and mathematics. Findings of this study revealed that students taught using cooperative strategy performed significantly higher than those taught using inquiry method. This implies that cooperative strategy is a viable strategy for science and mathematics teachers to adopt. The study is also beneficial to counselors since results revealed the superiority of cooperative strategy in terms of enhancing performance in basic science and mathematics, counselors can be in a better position to counsel and advice science and mathematics students to adopt group working while learning science and mathematics.

Professional bodies like Science Teachers Association of Nigeria (STAN), Mathematics Association of Nigeria (MAN), Curriculum Organization of Nigeria (CON) etc will also drive a good benefit from this work as that will motivate them in organizing workshops on this teaching strategy to their members who are the science and mathematics teachers and will in turn impart it to their students there by raising their performance. Finally, it contributes as an addition to the existing literature on cooperative learning, students' performance and their attitude to basic science and mathematics.

Research Methodology

Quasi- experimental research design was used for this study with the aim of finding whether students taught basic science and mathematics using cooperative learning strategy could perform better and improve their attitudes than those taught using inquiry method of teaching.

The structure of the design is represented below:

EG,	Y_{00}	X	Y_{01}	R_0
CG,	Y_{11}		Y_{02}	R_1

Where:

EG	=	Experimental group (cooperative learning strategy)
CG	=	Control group (inquiry teaching method)
Y_{00} and Y_{11}	=	Pre-test for experimental and control groups respectively for equivalence
Y_{01} and Y_{02}	=	Post-test for experimental and control group respectively for performance
R_0 and R_1	=	Attitude test for experimental and control groups respectively.
X	=	Treatment given (cooperative learning strategy).

The experimental and control groups were taught basic science and mathematics under similar conditions i.e. the same number of lesson periods, and at similar hour of the day i.e. during the morning periods. The researchers did the teaching by themselves in both the experimental and control groups. While experimental group was taught using cooperative method, control group was taught using inquiry method. Two instrument were used for data collection namely Basic Science and Mathematics Performance Test (BSMPT) and Students' Attitude to Science and Mathematics Questionnaire (SASMQ). The BSMPT was made up of (40) items from basic science and mathematics concepts derived from junior secondary three (JSS III) syllabus which was validated by experts and experience teachers of these subjects. The SASMQ was self-designed twenty items meant to assess attitude of JSS III students, it was validated by experts from educational psychology. Cooperative Learning Guide adapted by the researcher from Siegel (2005) served as guide for the cooperative learning. Both instruments were validated by experts and reliabilities of 0.79 for (BSMPT) and 0.78 (SASMQ) were established through split half method and Cronbach alpha respectively.

The population of the study were all JSS III students in Katsina state. Six school were randomly selected and proportionate sampling was used to select 240 sample students for the study.

Hypotheses Testing and Results

Table 1: Pre-Test Performance of Experimental and Control Groups for Equivalence

Group	N	Mean	Std. Deviation	t-cal.	t-critical	Remark
Cont. Pre-test.	120	7.31	4.843	0.265	1.97	Not Significant
Experimental Pre- Test.	120	7.19	4.337			

Result obtained from the table above indicates that, there is no significant difference between the performance of the control and experimental groups during pre-testing. Hence, it could be concluded that, there is no difference in their performance. This shows that the two groups (control and experimental) are homogenous before the commencement of the treatment.

Table 2 for Ho1: Post Test Means of Control and Experimental Groups

Group	N	Mean	Std. Deviation	t-cal.	t-Critical	Remark
Control Post Test.	120	11.11	5.223	2.623	1.984	Significant
Experimental Post Test.	120	19.21	4.321			

$\alpha = 0.05$ (two-tailed)

Result from table 2 showed the calculated t-value of 2.623 which is greater than the critical value of 1.98 at 0.05 level of confidence. Hence the first null hypothesis is rejected which means that, there is a significant difference in performance between those students that were exposed to co-operative learning strategy and those that were taught using inquiry method in favor of the experimental group.

Table 3 for Ho2: Relationship Between Students Attitudes and their Performance in basic science and mathematics

	Exp. Grp. Post Test.	Exp. Grp. Att. Test
Exp. Grp. Pearson Correlation	1	0.865
Sig. (2-tailed)	-	0.37
N	118	118

From Table 3 above, it can be seen that the calculated R value is 0.865. This implies that there is a very high correlation between attitude and performance of students in basic science and mathematics. Hence, the hypothesis that says, there is no significant relationship between students' attitude and their performance in basic science and mathematics was not accepted. This means that there is a relationship between performance and attitude.

Table 4 for Ho3: Means of male and female students in basic science and mathematics

Group		N	Mean	Std. Deviation	t-cal	t-critical	Remark
	Male Post Test	136	11.74	4.654	1.082	3.280	Not Significant
	Female Post Test	104	14.92	5.611			

$\alpha = 0.05$ (two-tailed)

Results on table 4 showed the t-critical value of 3.280 which is greater than the t-calculated value of 1.082 at 0.05 level of significance. Hence, there is no significant difference in the performance of male and female students taught basic science and mathematics using cooperative learning strategy was not rejected.

Discussion of Results

Findings from this study have shown the effectiveness of cooperative learning strategy in the teaching and learning of basic science and mathematics at junior secondary schools of Katsina state. The study also revealed that cooperative learning strategy is related to students' performance and attitude to basic science and mathematics. Also found in this study is the fact that students taught using the cooperative learning strategy performed better in basic science and mathematics performance test than those taught using inquiry teaching method. This could be as a result of students' participation in learning activities. Students in cooperative learning class carried out specific roles in solving problems which are presented in the classroom to the benefit of all in the group. When students are faced with problems that they must solve, they are forced to reason and think critically in order to solve the problems. The finding is in agreement with the findings of Ferreira, (2001), Zakaria et al., (2010), and (Obinna-Akakura, Onah, & Opara, 2015) who also found out that students taught using cooperative learning strategy tend to perform better. It is argued that when properly and carefully used cooperative learning activities engage the students in the learning process and tend to enhance the critical thinking and reasoning skills of learners (Etukudo 2006). Erinosho (2005) hinged his study on the principle that cooperative learning enhances active engagement of students and critical thinking. Adesokan, (2002) based his study on the principle that cooperative learning enhances students' memory and creativity, while Kolawole (2007) anchored his study on the principle that constructive activity and collaborated learning are enhanced in cooperative learning classrooms. The present study believes that cooperative learning strategy provides the students the impetus to understand better certain basic science and mathematics concepts from their colleagues with ease.

Findings of this study is also in agreement with some research works conducted on the effectiveness of cooperative learning in Nigeria. Such as that of Adeyemi (2002), Omosehin (2003) and Ibrahim (2003) who studied the effects of a training program in cooperative learning of pre-service teachers' classroom practice and pupils' learning outcomes in Sciences. Furthermore, Luu, (2010) take a look at the Learning Together effects on the reading competence owith a sample of 77 Vietnamese tertiary students over a 7-week-period. Results revealed that the small cooperative learning group outperformed their conterparts. It was found out that cooperative learning strategy seems to be more effective in yielding positive results performance wise than other instructional strategies.

Equally important, this study highlighted there is a significant relationship between performance and attitude, though performance seems to be a factor that is dependent on attitude. Students in the cooperative learning classroom were found to show better attitude towards the learning basic science and mathematics. This seems to agree with the general notion that individuals can change their attitude and disposition through interaction with others in one way or the other. Findings of this study is in agreement with Sahin (2010) who adopted a pretest and posttest style to investigate the effects of Jigsaw III on achievement, and retention, with sample of 71 Turkish sixth-grade students in a week course. The results portrayed that students in the jigsaw group outperformed better than those in the traditional lecture-based learning group. The attitudes exhibited by students in the cooperative learning class may also be by the fact that interaction among students in cooperative learning groups is intense and prolonged in classes where cooperative learning approach is used for teaching, students tend to gradually take responsibility for each other's learning. Tunga

(2014) argued that better attitude exhibited by students in the cooperative learning classroom may have been achieved because Feedback, reinforcement, and support from students' peers in the group.

Gender was found not to be a barrier to meaningful learning when cooperative learning strategy is employed. This could be the reason for finding no significant difference in the performance between the male and female students on the use of cooperative learning strategy. This implies, if one group changes in a similar amount as another group, there will be no significant difference between them. This finding is in agreement with that of Viann (2002) who studied gender differences and their effects on cooperative learning in chemistry classroom setting.

Conclusion

On the basis of this study, one can conclude that cooperative learning strategy is more effective than inquiry teaching method in teaching and learning basic science and mathematics in Katsina state. It is also safe to say cooperative learning strategy was found to be more effective teaching strategy in improving student's attitudes towards basic science and mathematics.

Recommendations

The following are recommended for improvement

1) Cooperative learning strategy be use at various secondary schools as a tool for effective learning and improvement of student's performance in basic science and mathematics.
2) Basic science and mathematics teachers need to undergo further training to update their skills in the usage of cooperative learning strategy in schools.
3) Government, stakeholders and NGOs should provide adequate infrastructure and an enabling environment for cooperative leaning strategy to be utilize at all secondary school levels.
4) Cooperative learning strategy should be adopted as a strategy of teaching basic science and mathematics for both male and female secondary school students as it has the capability of improving better students' attitudes towards learning.

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