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Effects of Group Size on Students Mathematics Achievement in Small Group Settings

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Abstract
An ideal group size is hard to obtain in small group settings; hence there are groups with more members than others. The purpose of the study was to find out whether group size has any effects on students' mathematics achievement in small group settings. Two third year classes of the 2011 / 2012 academic year were selected from two schools in the Central Region of Ghana for the study. The two classes constituted the control and experimental groups respectively and consisted of 50 students in the control group and 47 in the experimental group. The experimental group was subdivided into 12 groups made up of groups of 3members, groups of 4 members and groups of 5 members using stratified and simple random sampling. The students' pre- and post-test scores served as the data for the study. The results of the study showed no significant difference in the mean scores of the three subgroups of the experimental group.
Keywords: Group size, Cooperative learning, Achievement

Introduction

Research has analyzed the effectiveness of cooperative learning with respect to academic achievement. There is excessive empirical support in favour of cooperative learning as important contributor for higher academic achievement. Vaughan (2002) examined the effects of cooperative learning on achievement and attitude towards mathematics of a group of 5^{th} grade students and found that there is a positive gain in attitude and achievement of students in the cooperative group.

Rucker (1997) also examined the impact of cooperative learning on the attitude, confidence and performance of students in undergraduate discrete mathematics course. The results indicated that cooperative learning group performed better to significant degree and there was a significant increase in attitude and confidence of cooperative students in learning of mathematics.

Although, cooperative learning increases performance, there has been a diverging view on the number of students (group size) a group must have to ensure effective learning among students by teachers who uses this instructional procedure.

It seems prudent to keep groups as small as possible to promote positive interdependence, yet as large as necessary to provide sufficient diversity of opinions and backgrounds as well as resources to get the work done. Deutsch (2003) noted that the effects of class size on student achievement have been debated among educational researchers. But most of this debate has centered on class size at the primary level. He noted that researchers have often times ignored or discounted the importance of small class for high school students. Some educational researchers and policy makers are in favour of small class size owing probably to the belief that small is effective.

Anamuah-Mensah, Mereku and Asabere-Ameyaw (2004) observed that, there is a positive correlation between class size and achievement in mathematics and science. That is, large classes seemed to perform better than smaller classes. This could be due to the fact that in rural areas in Ghana, where class size are generally small, teaching is generally very poor compared to urban areas where class sizes are generally high but have comparatively better teaching and learning resources.

Hayfron (2004) also asserted that managing large class size in schools has been one problem that seriously hinders success for both the teacher and the learner. While, small group cooperative learning is an option for teachers, it is currently the least frequently used. Cooperative learning advocates agree that groups

should be kept relatively small. Some recommend 3 to 4, saying it is better for students' achievement (Lou, Abrami & d'Apollonia, 2001; Caulfield & Persell, 2006), whereas others recommend three to five (Oakley et al.2004). Kagan (1993) pointed out that, group size of 4 to 5 is best for small group cooperative learning. He asserted that, the number of learners in a group will determine the number of lines of communication in the group. Shimazoe and Aldrich (2010) reported that the ceiling on group size should be four, given that the chance of shirking or social loafing among group members will exponentially increase with group size. However, according to McCrorie (2006) a small group is around 8 to 12 learners facilitated by a teacher. McCrorie (2006) also asserted that group size is probably less important in what the group actually does. So what characterize a small group is not so much its size but the teaching and learning context and the way in which the teacher works in facilitating the learning process. Based on these mixed findings, this paper sort to find out whether group size has any effect on students mathematics achievement in small group settings.

Research design

The study used quasi- experimental design. This involved pre-test and post-test of non-randomized, control and experimental groups (Martyn, 2008). The design can be written as follows:

Pre		Post	
O_1	X	O_3	Intervention group
…….			
O_2		O_4	Control group

X = intervention; O = observation group

The essence of the pretest was to help establish the baseline performance of the groups and possibly differentiate between the groups before the intervention. The class with the apparent weaker pretest performance became the experimental group with the control group being the other group with relatively better pretest performance. Analyses of the pretest scores did not established any statistically significant difference between the mean scores of the two groups.

Population and Sampling

The target population for the study was all SHS 3 students within Komenda Edina Eguafo Abrem Municipality (KEEAM) in the Central Region of Ghana. The sample consisted of two intact classes of third years students from two schools selected through Simple random sampling technique. The sample size consisted of 97 students. Of these, 47 were in the experimental group while 50 others were in the control group. The mathematics marks obtained by the students in their previous term examination were used to put students in the experimental group into ability strata, namely: High ability stratum, Average ability stratum and below average ability stratum. A combination of stratified random sampling and simple random sampling procedures were used to constitute small groups of mixed ability strata. In all 12 groups made up of 3 groups of 3 members, 7 groups of 4 members and 2 groups of 5 members. Gender and ethnicity among other factors were not considered in the formation of the groups, though each group had at least a female student. (See table 1)

Table 1: Composition of groups in terms of students' ability

Member Groups	Number of high ability students	Number of average ability students	Number of below average students
3	1	1	1
4	1	2	1
5	1	2	2

Method

Data for the study was collected by means of two achievement test- the pretest and the posttest. In order to ensure that validity and reliability of the instruments, both instruments were pilot tested in a school with similar characteristics as those used for the study. Analyses of the results of the pilot pretest and posttest showed that the test were internally consistent. The Cronbach's alpha for the pretest was 0.76 and that of the posttest was 0.83 and theses values were high enough to attest to the reliability of the test. In terms of validity, the tests were subjected to peer reviews and suggestions resulting from the reviews were duly implemented.

Intervention

The experimental group followed the STAD, cooperative learning strategy which consist of a regular cycle of instructional activities. The cycle of instructional activities include: lesson presentation; group study, where students worked on worksheet in their groups to master the material; Evaluation, where students took individual

quizzes. Finally, group recognition, where group scores were computed on the basis of group members improvement scores. Certificates were awarded to group(s) with high scores. The award was based on average group scores.

Also, the five critical elements of cooperative learning (Johnson, Johnson and Holubec, 1994) were observed. Groups sat in circles during group activities thereby promoting face to face communication. Individual accountability was achieved through the quizzes that were taken without help. To develop interpersonal and group skills the groups were encouraged to communicate accurately and unambiguously, accept and support each other. Time was given to groups to discuss how well they achieved their goal to ensure group processing and this was done after every quiz.

Result

Hypothesis

H_{01} : There is no significant difference between the mean scores on performance of 3member groups, 4 member groups and 5 member groups in the experimental group.

The hypothesis sought to find out if "there is any difference between the mean achievement score on performance of the subgroups of the experimental group namely: 3member groups, 4 member groups and 5 member groups. In answering this question, the mean scores of the three groups on the posttest was first compared. Also analyses of variance (ANOVA) was carried out to find out whether there is a significant difference between the three groups

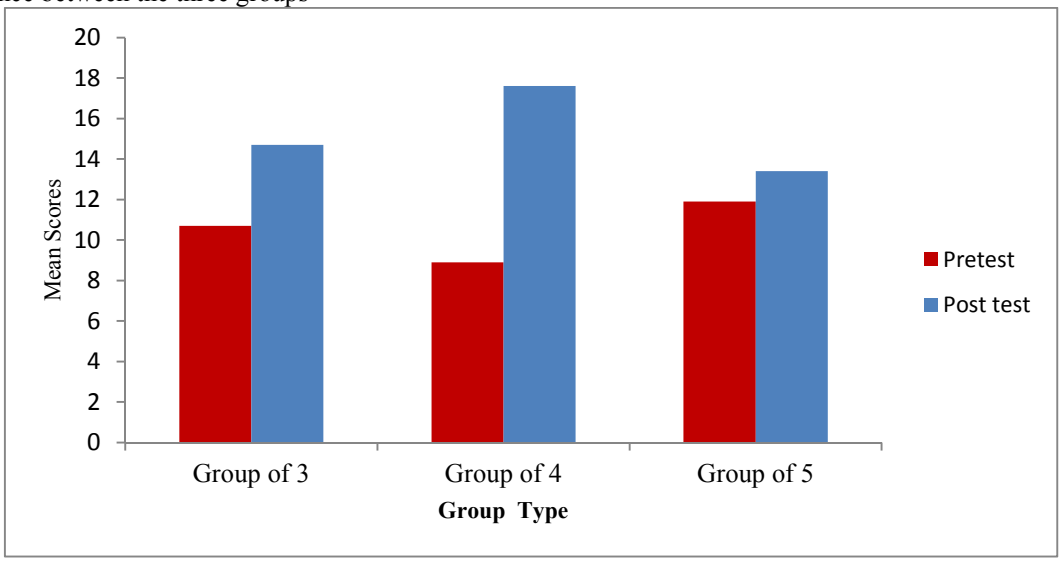

Figure 1: Pretest and Posttest mean scores of group types

From Figure 1, it can be seen that the five member groups had the highest pretest mean score while the four member groups performed poorest at the pretest level.

However, the four member group had the highest post test mean score while the five member groups obtained close to the same posttest mean score as the three member groups.

Table 2: Comparison of the Mean Scores of the Subgroups in the experimental group in the Posttest

Statistics	3member Groups	4 member Groups	5 member Groups
Sample size(n)	3	7	2
Mean	14.7	17.6	13.4
Standard deviation	1.94	1.89	2.2

The significant gain by the groups as shown in the figure 1 and table 2 suggest that small group cooperative learning improves performance of students across groups. Based on this significant gain made by the groups, a further analysis was carried out using analysis of variance to find out whether there is a significant difference between the three groups and the result is shown in table 3.

Table 3: Summary of analysis of variance of posttest scores by the experimental group

	Sum of Squares	df	Mean Square	F	p - value
Between groups	9.130	2	4.565	0.97	0.387
Within groups	207.083	44	4.706		
Total	216.213	46			

As shown in Table 3, analysis of variance of 3, 4 and 5 member groups on the posttest shows that there is no statistically significant difference among all the three groups on the achievement posttest at 5% level of significant.

Discussion

The result of the test is an indication that small group cooperative learning improves performance of students across groups. This finding agrees with Biott (1999) claims that there should be no fixed rules about group size and hence group size of 3-5 learners are satisfactory since any decision made will need to be dependent on the classroom context. The result of the study also support McCrorie(2006) assertion that group size is probably less important in what the group actually does, since there was no significant difference between the mean scores on performance of the groups.

Conclusion

The outcome of the research suggests that group size does not characterize small group learning rather, the teaching and learning context since the result shows no significant difference between the subgroups of the experimental group. The instructional process used provides opportunities for learning that are difficult to establish in large group settings. It was also useful to enable learners to take part in discussion, reflection, feedback and to consolidate learning, clarify understanding and explore ideas and concepts.

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