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EFFECTS OF GROUP SIZE ON STUDENTS MATHEMATICS ACHIEVEMENT IN SMALL GROUP SETTINGS

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ABSTRACT: *This experimental study investigated the effects of group size on students' mathematics achievement in small group settings. Two third year classes studying General Art were selected from two schools in the Central Region of Ghana for the study. The rational for the selection of these classes is that traditionally these have been classes whose students do not show interest in the study of mathematically based subjects and that they might not be very much different in mathematics performance. 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 3 members, 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 showed that after approximately 12 weeks, students' who were instructed using small group cooperative learning achieved a significantly higher scores on the achievement posttest then those taught by the conventional method of instruction. However, the study also revealed that there was no statistically significant difference in the mean scores of the three subgroups of the experimental group. The study therefore support that, group size is less important in what the group actually does.*

KEYWORDS: Group size, Cooperative learning, Achievement

INTRODUCTION

Research on cooperative learning over the past decades has documented academic and social benefits that students derive when they work together (Gillies & Boyle, 2010). However, an ideal group size for small group cooperative learning is unknown. Although, there is no ideal size for cooperative learning, the right size of a group depends on the objectives for the lesson, student's ages, experiences working in teams and the available curriculum materials and equipment (Holubec, Johnson & Johnson, 1994).

There has been a diverging views 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. 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 group of 3 to 4 members, saying it is better for students' achievement (Lou, Abrami & d'Apollonia, 2001; Caulfield & Persell, 2006), while others recommend three to five (Oakley et al.2004). Kagan (1993) pointed out that, group sizes of 4 to 5 are 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 colloquial among group members will exponentially increase with group size. However, according to McCrorie (2006) a small group is defined as group of 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 characterizes 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 sought to find out whether group size has any effect on students mathematics achievement in small group settings.

Purpose of the study

The primary objective of the study was to determine whether small group cooperative learning has influence on the performance of students in the study of mathematics. The specific objective was to find out the effect of group size on student performance.

Hypothesis of the study

The following hypothesis was formulated for testing at 5% level of significance

H_{01}: There is no statistically significant difference between the mean scores of experimental group and control group with regards to achievement in posttest.

H_{02} : There is no significant difference between the mean scores on performance of 3 member groups, 4 member groups and 5 member groups in the experimental group.

REVIEW OF RELATED LITERATURE

Theoretical Perspective of Cooperative learning

\While there is general consensus among researchers about the positive effects of cooperative learning on students' achievement, there remains controversy about why and how they affect achievement and most importantly, under what conditions they have these effects. Slavin (2009) identified motivation, social cohesion, cognitive-development and cognitive- elaboration as the four major theoretical perspectives held by different researches on the achievement effects of cooperative learning.

The motivationalist perspective presumes that task motivation has the greatest impact on the learning process and that the other process such as planning and helping are driven by individuals' motivated self-interest. Motivationalist focus is especially on the reward or goal structure under which students operate. Social cohesion perspective on the other hand suggests that, the effects of cooperative learning are largely dependent on the cohesiveness of the group. In this perspective,

students help each other to learn because they care about the group and its members and come to derive the benefits of self-identify from group members (Johnson & Johnson, 1989).
The cognitive perspectives focus on the interaction among groups of students, holding that these interactions themselves lead to better learning and thus better achievement. The cognitive developmentalist attributes these effects to processes outlined by Jean Piaget and Lev Vygotsky.

Cooperative Learning and Group size
Cooperative learning begins with the formation of groups into teams of students. These teams may be heterogeneous or homogeneous in nature. However, group compositions on cooperative learning are mixed regarded as to whether to form heterogeneous or homogeneous groups in cooperative learning (Peterson & Schreiber, 2006).

Lou, Abrami and d'Apollonia (2001) suggested that group composition through mixed criteria instead of ability only is better at promoting students' achievements. Caulfield and Persell (2006) assert that groups should be kept relatively small and recommended group size of three to four.
Vermette (1998) argues that a group larger than four is a problematic because members tend to play a reduced role and it is difficult to account for everyone's opinion during discussion. He further suggest that an ideal group size should be in the range of three to four as each group can have a balance of interest, personalities, strengths and talents for sparking creativity. According to Biott (1999) there should be no fixed rules about group size. He suggests that 3 – 5 learners are satisfactory since any decision made will need to be dependent on the classroom context. In contrast Kagan (1989) is very clear about group size, since it will have a marked impact on the opportunity for and the nature of learner interaction. He points out that the number of learners in a group will determine the number of lines of communication and hence states that group size of 4-5 are ideal.

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 described 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 classes of

third years students from two schools selected through a 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, Average ability and below average ability. A combination of stratified random sampling and simple random sampling procedures was used to constitute small groups of mixed ability strata. In all 12 sub groups were formed. That is (A, B, C) made up of 3 members each, (E, F, G, H, I, J and K) made up of 4 members and finally (L, M) made up of 5 members each. 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 tests; pretest and posttest. The achievement test was made up of 20 multiple choice questions, each with four options and only one correct answer. Some of the topics which were included in the test items for the posttest are: indices, Percentages, sequence and series while the pretest items were from numbers and numerals. 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 Student Teams – Achievement Divisions (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 and to accept and support each other. Time was given to groups to discuss how well they achieved their goals to ensure group processing and this was done after every quiz.

RESULT

Research hypothesis

Research question one sought to find out if there is any difference in achievement test scores between students instructed using cooperative learning strategy and those instructed using the conventional method of instruction.

Table 2: Independent sample t-test of the posttest MAT scores of the experimental and control groups

Group	N	Mean	SD	t-value	df	*p*-value
Experimental	47	14.32	2.17	2.812	95	0.077
Control	50	13.09	2.47			

Table 2 shows that there was statistically significant difference between the mean scores of the experimental group (M = 14.32, SD = 2.17) and that of the control group (M = 13.09, SD = 2.47); t (46) = 2.812, $p = 0.007$. The magnitude of the difference in the means was very large (eta squared = 0.077). Since $p < 0.05$, a decision that there is a significant difference between the experimental group and the control group with respect to the posttest achievement score is upheld. An eta square value of 0.077 was obtained from the analysis suggesting that 7.7% of the variance in the scores of the experimental and the control group were explained by the instructional strategy.

The finding of a significant difference between the two groups in favour of those exposed to the use of the cooperative learning strategy suggests that students' performance might have been improved through the use of the small group cooperative learning which might have helped them in concept formation and as a result enhanced understanding of the relevant concepts. Findings from this study uphold the assertion that cooperative learning increases student achievement.
The result of the study therefore confirms the findings of the study conducted by some researchers. Tarim and Akdeniz (2008) reported that cooperative learning method results in higher achievement than the traditional method of instruction. Johnson, Johnson, and Stanne (2000) found in their meta – analyses of cooperative learning methods that cooperative learning increased student achievement. Also Dotson (2001) showed that the Kagan cooperative learning method had positive results on academic achievement.

Hypothesis 2

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: 3 member 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

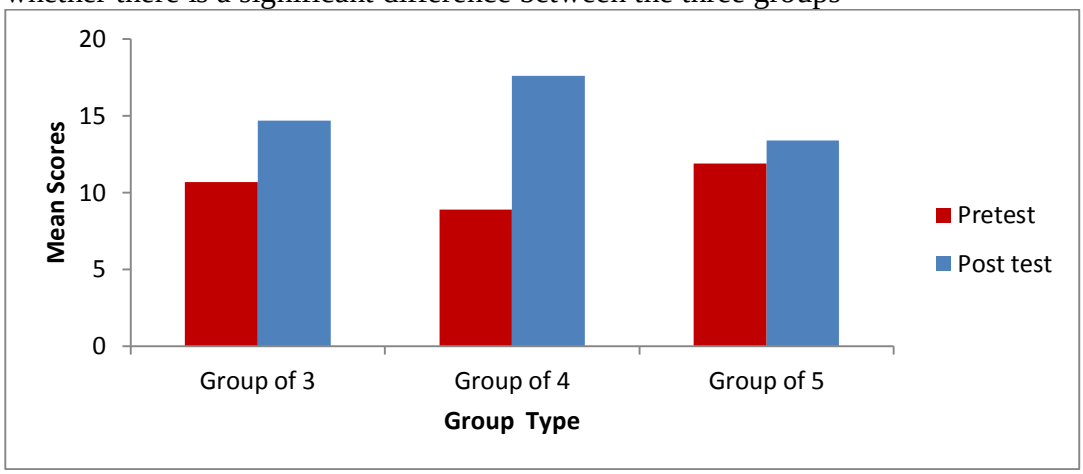

Figure 1: Pretest and Posttest mean scores of group types

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 posttest mean score while the five member groups obtained close to the same posttest mean score as the three member 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 4.

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 study is an indication that small group cooperative learning improves performance of students across groups. This finding agrees with Biott (1999) claim that there should be no fixed rules about group size 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 also enable learners to take part in discussion, reflection, feedback and to consolidate learning, clarify understanding and explore ideas and concepts.

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