

Effects of Cooperative Learning on Mathematical Achievement of French Students: A Case Study of Bagabaga College of Education, Tamale

Yakubu Sumani¹, James Natia Adam²

¹ Bagabaga College of Education, Tamale, Ghana

² Zonzongili Development Associates, Tamale, Ghana

Abstract

The main purpose of the study was to explore the effect of cooperative learning on the mathematical achievement of teacher trainees in Bagabaga College of Education in Tamale. The sample size was 80. The data collection instruments were observation checklist, tests, questionnaires and unstructured interviews. The results of the study show a statistically significant difference in the pre-test score between male (mean = 34.77; std. deviation = 14.73) and female (means = 37.50; std. deviation = 11.61) teacher trainees. There was no statistically significant difference in the post-test score between male (mean = 61.79; std. deviation = 12.24) and female (mean = 59.72; std. deviation = 10.24) teacher trainees after the intervention. The major effect of cooperative learning was improvement in leadership role of teacher trainees. Therefore, colleges should take keen interest in applying cooperative learning to improve students' academic performance.

Keywords: Action research, cooperative learning, teacher trainees, pre-intervention and post-intervention

1. Introduction

Among the varied teaching strategies advocated for teaching in the tertiary level, cooperative learning is what Effandi and Zanaton (2006) settled on as being very effective in achieving results. Galvan et al. (2006) suggest that social interdependence theory views cooperation as resulting from positive links of individuals to accomplish a common goal. Vermette (1998) defines a cooperative classroom team as a relatively permanent, heterogeneously mixed, small group of students who have been assembled to complete an activity, produce a series of projects or products, and/or who have been asked to individually master a body of knowledge. According to Glosser (2009) Cooperative learning is situated within the social constructivist paradigm where students work on projects or problems in teams with both personal and team accountability for conceptual understanding. Sharan (1980) states that cooperative learning is a generic term that is used to describe an instructional arrangement for teaching academic and collaborative skills to small heterogeneous groups of students. By heterogeneous, Sharan (1980) means mixed ability, tribe, interest and exposure.

On the other hand, Effandi and Zanaton (2006) have it that a cooperative group is one that has been structured to work together in such a way that all are involved in process with well spelt out activity for

the whole group to be successful. Blosser (1992) conjectured that group work was not synonymous with cooperative learning. Yackel, Cobb and Wood (1991) use small groups interactions to describe an experiment on cooperative learning, where all the instructional process was replaced by small group problem solving strategies for an entire school year. Pang and Barba (1995) and Vaughan (2002) view cooperative learning as not simply a matter of grouping students heterogeneously, but stress that understanding that some groups of students, especially, students of colour, are more inclined to function better in group settings than individually.

Describing cooperative learning, Zafran (2002) argues that students should work with one another in small groups, which is in a non-competitive fashion to accomplish a goal. Zafran cites learning a concept in maths, practicing the application of a formula or procedure, or solving a complicated mathematics problem over a number of days as examples of goals. Zafran (2002) contends that cooperative learning emphasizes students working together in a non-competitive manner to achieve a goal they had set. This paper is structured in four sections. The first section presents the background to the study, statement of the problem and literature review. The second section presents the methodology of the study. The last but one presents the results and discussion. The conclusion and recommendations constitute the final section of the paper.

1.2 Statement of the Problem

Mathematics is part of the curriculum at all levels of Pre-University Education in Ghana with the aim to develop the required manpower for the country's development. Yet, students do not perform well in Mathematics in either the West African Senior School Certificate Examination or the Diploma in Basic Education for professional teachers. In the international scene, Ghana placed 44th out of 44 countries in 2003 and 47th out of 50 countries in 2007 in Trends in Mathematics (Martin et al., 2008; Mullis et al., 2004). Also, in 2005, the Institute of Education, University of Cape Coast which is mandated to conduct examination for professional teachers showed that out of 8,966 Diploma in Basic Education students who wrote the first semester in Algebra and Number country wide, 52 percent of the students obtained grades between 'D+' to 'E'. In Bagabaga College of Education, 135 out of 265 candidates representing 51 percent who wrote the exams obtained grade 'E'. Fifty-eight percent of the students of Bagabaga College of Education who got grade 'E' were French students. In the second semester of the 2006 first year students, out of 197 candidates presented by the Bagabaga College of Education, 37 percent obtained grade 'E'. Again, majority of the students (42%) who obtained grade 'E' were French students.

On major reason for the poor performance of students in mathematics at the College level is the use of the lecture based methods for teaching mathematics which is not a reading subject. The lecture based instruction dominates classroom activity especially with the teacher delivering well over 85% of the talk in the classroom. In such an environment, students become passive recipients of knowledge and resort to rote learning. The general aim of the teacher is to cover the syllabus without recourse to whether the students understand or not. Students who rely on their teachers to decide what, when and how to learn

get disappointed with the lecture method. The disadvantage of the lecture method is that students are forced to memorize what they are taught without understanding the process and procedure involved.

Due to the limitations of the lecture method, the need for cooperative study groups in mathematics has been advocated by scholars because it de-emphasize the passive acquisition of knowledge. Studies (Kagan, 1994; Johnson & Johnson 1994; Slavin 1983; Zafran, 2002) have all shown that an effective way of improving learners' performance in Mathematics is by putting them in well-structured cooperative study groups. Cooperative learning in Secondary Mathematics have proven many benefits to the students in achievement test (Slavin, 1995; Zafran, 2002). According to Johnson & Johnson (1999) cooperative learning is a powerful tool for learning and is based on the axiom that two heads are better than one. Yet, little research exists on the effects of cooperative learning on teacher trainees' academic performance in Mathematics.

1.3 Purpose of the Study

The main purpose of the study was to explore the effects of using cooperative learning on the mathematical achievement of Diploma in Basic Education French students in Bagabaga College of Education in Tamale.

1.4 Research questions

The following research questions need empirical investigation

1. Does cooperative learning influence students' confidence, abilities and participation in Mathematics lessons?
2. What are the impacts of cooperative learning for French students?

1.5 Cooperative learning as a teaching method

Kagan (1989) states the use of Jigsaw method, Teams-Games-Tournament, Student Team-Achievement Divisions, among others as types of cooperative learning. In Aronson's Jigsaw method, students are placed in small heterogeneous groups (Sharan, 1980; Slavin, 1990). The task given to students is then divided into pieces based on their ability level. Groups then split up and meet with individuals from other groups who are also given the same portion of the task. The students then work together to become experts on the material. After students had become experts on their portion of the task, they return to their original groups and taught the material to their jigsaw group members. By the end of the task, students are expected to know all the pieces of the lesson and are assessed individually (Kagan, 1989; Slavin, 1990). In Slavin's (1990) review of cooperative learning research, he concluded that the results involving the Jigsaw method were not very clear on its effect on race relations, achievement, liking of school and mutual concern. Sharan (1980), however, found significant achievement gains for

minority groups. One consistent result found when using the Jigsaw method was an increase in self-esteem (Sharan, 1980; Slavin, 1990).

Another cooperative learning is the Team-Games-Tournament, which consists of 4 to 5 heterogeneous team members. Team members prepare each other to do well in the tournament to be conducted the next day over the material taught by the teacher. Tournament tables are grouped by ability level so that the competition is made fair. Students compete as a representative of their team on the material presented by the teacher and on the study sheet. By having tournament tables organized by ability level, all students are given a chance to succeed (Sharan, 1980). Guak (1999) in a study using TGT models found that students outperformed those in individualistic goal structure in mathematics problem solving. Slavin (1980) has also shown that TGT has positive effects on achievement, race and mutual concern.

In the Student-Teams-Achievement-Divisions (STAD) created by Slavin, it is conducted in a similar manner to TGT Sharan (1980). Students are to explain their answers to each other and ask questions to team mates rather than the teacher (Slavin, 1980; Sharan, 1980; Whicker et al., 1997). In order for the group to succeed, all members must learn the material and receive points (Whicker et al., 1997). There is high reward of interdependence in STAD (Slavin, 1980). Students taught using STAD expressed a mutual concern for peers; had more positive race relationship; showed increase in learning; a more on-task behavior; and students had more positive attitudes and were more likely to help each other than in a traditional classroom (Sharan, 1980; Slavin, 1980).

2 Methodology

2.1 Research design

Babbie and Mouton (2001) state that a research design is a set of guidelines and instructions that are followed in conducting research. Considering the nature of the problem at stake, the action research design was used. According to Parsons and Brown (2002), an action research is a form of investigation designed for use by teachers to attempt to solve problems and improve professional practices in their own classroom. It involves systematic observations and data collection which can be used for decision-making and the development of more effective classroom strategies.

2.2 Sampling and Sampling Techniques

The population of the study was 556 male and female teacher trainees of Bagabaga College of Education. Bagabaga College of Education was chosen for the study because of convenience and the fact

that it is the only College of Education in Northern Ghana that runs French programme. A purpose sampling technique was used to select first year French teacher trainees on the basis of their grades in the West African Senior Secondary Certificate Examination and class performance. The sample size was 80. The French teacher trainees were used as the experimental group, while the General Art teacher trainees were treated as the control group. A few of them who had special problems and wanted to work with some specific teacher trainees were considered. The groups together with the researchers agreed on three fixed days a week at specific times for groups to carry out the tasks to be carried out and a particular day after every two weeks for the whole group to meet with the researchers to discuss given tasks.

As recommended by Johnson et al. (1990), each group had a leader, a recorder, a time keeper and an organizer. Leadership positions rotated every time learners met. Each person was given the guidelines for the role to play. This made each learner equal and so each wanted to exercise his or her role well. The intervention lasted for three weeks and the researchers monitored the groups occasionally to ascertain individual and group participation.

2.3 Research instruments

The four main research instruments used in the study were observation, tests, questionnaires and unstructured interview. Observation was used to get first hand information on how the teacher trainees behaved before, during and after mathematics lessons as well as night studies. All the 80 French teacher trainees were given a pre-test at the beginning of the study. The pre-test, which consisted of 5 items, was teacher made, but took the structure of Diploma in Basic Education Mathematics Examination paper of the Institute of Education, University of Cape Coast. A pre-intervention questionnaire was administered to solicit background information of the 80 participants. After 6 weeks of the treatment period, a post-intervention questionnaire followed immediately to find out their impressions on the grouping, socialization, gender sensitivity, individual and group contribution and competition. The items in the post-intervention questionnaire were similar to that of the pre-intervention questionnaire. The questionnaire contained 14 closed-ended and opened-ended items given to the 80 French teacher trainees who were exposed to cooperative learning methods.

2.4 Intervention

Within cooperative learning groups, students worked on Lines, Angles, Polygons and Circles, 2-D and 3-D shapes, Pythagoras theorem, Geometrical constructions, Simple trigonometrical ratios, Movement geometry, and Vectors and Co-ordinate geometry. They topics were based on the course outline for Diploma in Basic Education. Occasionally, groups worked on tasks which were scored and ranked by the researchers to show which group emerged winner. This was done fortnightly on Saturday mornings

before breakfast. These were to tell students that even though they were in groups, the result needed was improvement in individual performance.

2.5 Data analysis

This research was a comparison of performance of a group which did not experience cooperative leaning with one which experienced cooperative learning. It also compared the performance of male and female teacher trainees before and after intervention to know if there was improvement in students' academic performance. The test conducted for the students were marked and scored. Also, analysis of the results obtained by the students in the end of semester examination of the Institute of Education, University of Cape Coast was done. The use of frequency distribution tables and statistical measures as mean and standard deviation were used to present the findings of the study.

3 Results and Discussion

3.1 Pre- Intervention Results and Data Analysis

Table 1 shows the gender distribution of the respondents. The results show that 35 french students representing 44% were males as against 45 french students representing 56% females. The distribution suggests that more females are offering language related courses than males at the Senior High School level.

Table 1: Gender distribution of respondents

Gender	Frequency	Percent
Male	35	43.75
Female	45	56.25

3.2 Last Senior High Schools attended by French students

Table 2 presents the last Senior High Schools attended by French students. The findings indicate that majority of the respondents attended endowed schools. Endowed schools are schools with adequate infrastructure and experienced graduate teachers. Such schools include Tamale Senior High School, Ghana Senior High School, Nandom Senior High School, Navrongo Senior High School and Wa Senior High school. The results show that 44% of the respondents attended less endowed schools which are Wulensi Senior High School, Bimbilla Senior High School, Tuna Senior High/Technical School. The findings of the study suggest that students from the less endowed schools do not attend night studies and do not do group studies compared to those from the endowed SHS who study in groups and are under direct teacher supervision during preps/night studies.

Table 1 Type of Senior High School attended by French Students

Nature of School	Number of Students	Percentage
Endowed	45	56.3
Less endowed	35	43.7

3.3 Grades obtained by French students in Senior High School

Table 3 shows the grades that the trainees used for entry into the Bagabaga College of Education. The results of the study show that none of the students obtained grades A and B2 in the West African Senior School Certificate Examination. The findings indicate that 7 trainees representing 9% and 26% of the students obtained grades B3 and C4, respectively. The results also indicate that 33% of the students entered the College with grades C5 and C6.

Table 2: Entry grades of DBE French students in the 2008/2009 academic year

Grade	Number of Students	Percentage
B3	7	8.8
C4	21	26.2
C5	26	32.5
C6	26	32.5

3.4 Methods of studying mathematics

Table 4 shows the methods of studying mathematics. The results of the study show that an overwhelmingly majority (85%) of the respondents studied mathematics individually. This suggests that the students did not deal with any form of group study and hence did not engage in cooperative learning. The findings of the study indicate that fewer students engaged in group work. The composition of the groups ranged from two to more than five members.

Table 3: 2008/2009 French trainees’ study pattern

Mode of Study	Number in Group	Number in Group	Percentage
Individual	-	68	85.0
Group Work	3	4	5.0
	4	4	5.0
	5	2	2.5
	>5	2	2.5

3.5 Students’ performance in mathematics before intervention

Table 5 shows the result of students’ performance in mathematics. The findings are that no student from the French Class scored above 70%. The mean score of female trainees for the pre-test was 34.8, while that of the male was 37.5. This shows that the males did better than the females in the pre-test. The standard deviation for the female respondents for the pre-test was 11.61 compared to 14.73 male respondents. The standard deviations show that the marks of the female trainees in the pre-test were considerably closer to their mean than that of their male counterparts. Their combined mean was 35.9 with standard deviation of 13.35.

Table 6 show results of the DBE French students for the first semester (February, 2009) of the 2008/2009 academic year. The results show that 28% and 29% of the respondents obtained grade D and E, respectively. This findings is not so different from the scores obtained during the pre-test conducted by the researchers.

Table 5: Scores of Pre- intervention test conducted by the researchers

Marks	Male	Female	Total	Percentage
< 20	5	5	10	12.5
21-30	8	13	21	26.2
31-40	7	14	21	26.2
41-50	7	8	15	18.8
51-60	2	4	6	12.5

61-70	2	1	3	03.8
-------	---	---	---	------

Mean (SD) 37.5(14.73) 34.8(11.61) 35.9 (13.35)

Table 6: Scores of French students first semester (February, 2009) test conducted by Institute of Education, Univeristy of Cape Coast

Grade	Male	Female	Total	Percentage
A	0	0	0	0.0
B+	0	0	0	0.0
B	1	0	1	1.3
C+	2	5	7	8.8
C	3	5	8	10.0
D+	9	10	19	23.7
D	13	9	22	27.5
E	7	16	23	28.7

3.6 Post-intervention

Table 7 shows the marks of the first year DBE French teacher trainees of Bagabaga College of Education in the 2008/2009 academic year. The Post-intervention test was conducted to ascertain the efficacy of the intervention process. After analyzing the data, it was observed that the mean mark for females was 59.72 compared to 61.79 for male teacher trainees. There is no statistically significant difference in the mean scores of male and female trainees in the post-intervention test. The female French teacher trainees had a standard deviation of 10.24 while the male French teacher trainees’ standard deviation was 12.87. This means that the marks of the males were more spread out from the mean while the female marks were clustered around the mean. The combined mean of the French trainees was 60.63 with the combined standard deviation of 11.48 implying that there is significant improvement in the scores of the students due to the project intervention.

Table 8 shows the post-intervention scores of the French students in exams conducted by the Institute of Education, University of Cape Coast. The findings indicate that 33% of the respondents scored 61-70 percent in the test conducted by the researchers after implementing the intervention while 6% scored 81-100 percent. This trend is similar to the second semester results of French Students in the Institute of Education, University of Cape Coast’s end of second semester examination.

Table 7: Post- intervention scores of French students in test conducted by the researchers

Marks	Male	Female	Total	Percentage
< 41	0	0	0	0.0
41-50	8	9	17	21.3
51-60	9	15	24	30.0

61-70	10	16	26	32.5
71-80	5	3	8	10.0
81-90	2	2	4	5.0
91-100	1	0	1	1.2

Table 8: Post-intervention scores of French students in second semester (July, 2009) test conducted by Institute of Education, Univeristy of Cape Coast

Grade	Male	Female	Total	Percentage
A	2	0	2	2.5
B+	7	5	12	15.0
B	10	7	17	21.2
C+	8	12	20	25.0
C	5	10	15	18.8
D+	4	2	6	7.5
D	2	2	4	5.0
E	2	2	4	5.0

3.7 Impact of cooperative learning on French students

Table 9 presents the impact of cooperative learning on 2008/2009 First year DBE French Students of Bagabaga College of Education. The findings indicate that cooperative learning has several impacts to the beneficiaries. The results show that majority of the respondents state that cooperative learning is very high in the areas of sensitivity to gender needs and improvement in leadership role of student (79). Also, cooperative learning leads to improved socialization (73), which is very vital for the personal development of the student in and out of school because it helps the trainee to avoid cultural shock and also integrate well with their peers after leaving school.

Table 9: Impact of Cooperative Learning on 2008/2009 French Students

Impact	Very High	High	Mod erat	Low	Very Low

			e		
Improved socialisation	72	4	2	2	-
Sensitive to gender needs	80	-	-	-	-
Enhanced leadership role	79	-	-	-	1
Speeds monitoring	78	-	-	-	2
Improved group work	69	7	2	2	-
Improved confidence	35	35	5	5	-
Improved academic performance	33	37	5	5	-

4. Conclusions

Students who originally did not learn in groups, resorted to cooperative learning because it does not pose any threat to their learning skills. Students in cooperative learning were not only satisfied in the socialization and learning process but developed more interest in mathematics, increased their level of confidence, improved their mathematical performance and reduced their fear and anxiety when in mathematics lessons or mathematics examinations. In fact, before the end of second semester, students had transferred the concept of cooperative learning in mathematics to other courses such as Social Studies, English and French. Therefore, implementing cooperative learning influence students confidence in their mathematical abilities and their involvement in the Mathematics classroom. Indeed, the type of grouping, group tasks, leadership roles, effective monitoring to check participation levels of groups and individuals did enable students to reap the benefits of cooperative learning. The study therefore recommends that tutors in other course areas should take keen interest in cooperative learning since it has been found to be effective in Mathematics at the College of Education.

References

- [1] E.R. Babble, and J. Mouton, The practice of social research. Cape Town, SA: Oxford University Press, (2001).
- [2] P.E. Glosser, The effects on students' cognitive achievement when using cooperative learning method in Earth Science classroom, (2008)
- [3] Z. Effandi, and I. Zanaton, "Promoting Cooperative Learning in Science and Mathematics Education: A Malaysian Perspective". Eurasia Journal of Mathematics, Science and Technology, Vol. 3, No. 1, 2006, pp. 35-39.
- [4] C.V. Galvan, R. Renee, and M.M. Bobbette, Cooperative learning, Mathematical Problem Solving and Latinos, 2006.
- [5] G. Glosser, "Cooperative learning techniques". Mathematics Education Research Journal, Vol. 6, No. 1, 2009, pp.
- [6] D.W. Johnson, and R.T. Johnson, "Social skills for successful group work". Educational leadership, Vol. 47, No. 4, 1990, pp. 29-33.
- [7] D.W. Johnson, R.T. Johnson, and E.J. Holubec, Cooperative learning in the classroom. Alexandria VA: Association for Supervision and Curriculum Development.
- [8] S. Kagan, "The structured approach to cooperative learning" *Educational Leadership*, Vol. 47, No. 4, 1989, pp.
- [9] S. Kagan, Cooperative learning. San Clemente CA: Kagan Publishing, 1994.
- [10] V.O. Pang, and R.H. Barba, The power of culture: Building culturally affirming instruction. In C.A. Grant (Ed). Educating for diversity, 1995, pp 341-358.
- [11] S. Sharan, "Cooperative learning in small groups: Recent methods and effects on achievement, attitudes and ethnic relations". Review of Educational Research, Vol. 50, No. 2, 1980, pp. 241-271.

[12] R. Slavin, Team Assisted Individualization: Combing Cooperative Learning and Individualized Instruction in Mathematics. In R.E. Slavin, S. Sharan, S. Kagan, (Ed), 1985.

[13] W. Vaughan, “Effects of cooperative learning on achievement and attitude among students of color”. The Journal of Educational Research, Vol. 96 No.6, 2002, pp. 359-366.

[14] P.J. Vermette, Making cooperative learning work, student teams in K-12 Classrooms. New Jersey: Prentice-Hall Inc, 1998.

[15] K.M. Whicker, L. Bol, and J.A. Nunnery, “Cooperative learning in the secondary mathematics classroom”. Journal of Educational Research, Vol. 91, 1997.

[16] E. Yackel, P. Cobb, and F. Wood, “School science and mathematics”. Journal for Research in Mathematics Education, Vol. 22, No. 5, 1991, pp. 390-408.

[17] L. Zafran, Cooperative learning in the Secondary mathematics lassroom: Discussion, Theory and Contemporary Research, 2002,

About the researchers

Yakubu Sumani a Senior Tutor and Head of Mathematics Department at Bagabaga College of Education. He has over 20 years teaching, supervision and research experience at the tertiary education level. He holds MEd in Mathematics and B.Ed in Mathematics.

James Natia Adam is a development sociologist. He holds MPhil in Peace and Development Studies, MPhil in Agricultural Extension and Rural Development, and BA. in Integrated Development Studies. He is currently a private development consultant.