Effects of Cooperative Learning on Achievement and Attitude Among Students of Color

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ABSTRACT **The author examined the effects of cooperative learning on the achievement in and attitudes toward mathematics of a group of 5th-grade students of color in a culture different from the United States (i.e., Bermuda). Students participated in 12 weeks of R. Slavin's (1978) Student Teams Achievement Division method of cooperative learning in mathematics during the fall semester. Students completed 2 measures: the computation and application sections of the California Achievement Test (1985) Form E (Level 14) and Penelope Peterson's Attitude Toward Mathematics Scale for Grades 4–6 Students at 4 different intervals. The measures were completed as pretests at the beginning of the semester (before students were exposed to cooperative learning) and as posttests at the end of Weeks 5, 9, and 13. Data were analyzed with a 1-factor (4 levels) repeated measures analysis of variance design to ascertain whether there were significant differences among the pre- and posttest scores. Results suggest that there were positive gains in attitudes and achievement.**

Key words: academic achievement, cooperative learning, students living outside the United States, students of color

Cooperative learning has been widely researched and used in classrooms around the world since the 1970s. Research has proven that this methodology can be very effective in encouraging student interaction and developing positive attitudes toward school. Research also indicates that cooperative learning can produce positive effects on student achievement (Cohen, 1986; Davidson, 1989; Devries & Slavin, 1978; Johnson & Johnson, 1989; Okebukola, 1985; Reid, 1992; Slavin, 1990).

Cooperative learning is the instructional use of small heterogeneous groups of students who work together to maximize their own and each other's learning. Although there are various forms of cooperative learning, Deutsch (1962) and Johnson and Johnson (1989) recommended that in the truest form, there is positive interdependence among students' goal attainments. In other words, students perceive that they can reach their goals if and only if the other students in the group reach theirs. Cooperative-learning skills incorporate five basic elements: positive interdependence, promotive interaction (preferably face to face), individual and group accountability, collaborative skills, and group processing (Johnson, Johnson, & Holubec, 1987).

Positive interdependence is successfully structured when group members understand that they are linked together for a common cause. One cannot succeed without the others. Each student must commit to the success of the other group members as well as his or her own. This commitment is at the heart of cooperative learning. Johnson and Johnson (1989) argued that without positive interdependence there is no true cooperative learning. Promotive interaction (face to face) means that group members need to be cooperative and collaborative in carrying out assigned tasks. They need to encourage and support each other's efforts. Group accountability is the idea that the entire group must be held accountable for achieving its goals, and each group member must be held accountable for making his or her own contributions to the group. Incorporating collaborative skills requires teaching various social, leadership, decision making, and communication skills. If students are going to perform effectively in the process, they must learn these skills so they will be empowered to manage both teamwork and assigned tasks successfully. Finally, group processing occurs when group members are allowed to discuss how well they are doing and what group decisions are helpful. They can then decide on the various changes that are necessary.

Although there is a wide range of existing literature on cooperative learning as an effective approach to the teaching and learning process, some teachers do not understand that the underlying assumptions and beliefs about cooperative learning may differ from group to group on the basis of race or ethnic background. Cooperative learning is not simply a matter of grouping students heterogeneously but also of understanding that some groups of students, especially students of color, are more inclined to function better in group settings than individually (Pang & Barba, 1995). Therefore, the constant use of this approach in the class-

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room would be consistent with the learning preferences of many students of color. Research indicates that students of color often have values, behaviors, cognitive styles, and language patterns that differ from those of their schools' dominant cultures (Delpit, 1995; Fordham, 1996; Gay, 2000). Banks (2001) argued that schools' instructional programs should be structured to reflect the learning styles of students. Fordham (1996) also argued that the instructional strategies and learning styles favored in the schools are inconsistent with the cognitive styles, cultural orientations, and cultural characteristics of some students of color. Therefore, an instructional strategy such as cooperative learning could be beneficial to these students.

Using cooperative-learning groups was found to be a more effective teaching strategy for students of color than for White students in terms of achievement (Slavin & Oickle, 1981). It is theorized by leading scholars in the field of multicultural education that students of color in the United States perform at a higher level in cooperative groups than in individual learning activities because they prefer group learning (Banks, 2001; Nieto, 2000). Researchers (Cohen, 1986; Slavin, 1990; Slavin & Oickle, 1981) also found that students of color showed greater academic gains in cooperative-learning settings than in traditional classrooms, and that cooperative-learning strategies improved student performances in mathematics, language arts, science, and social studies (Devries & Slavin, 1978; Okebukola, 1985; Slavin, 1985). Likewise, Reid (1992), in a study examining the effects of cooperative learning on mathematics achievement of a group of seventh-grade minority students, found that students involved in cooperative-learning strategies performed significantly better than did students who were not exposed to cooperative learning. In a study comparing the effects of cooperative learning to individualistic learning in a racially integrated classroom, Johnson and Johnson (1983) found that cooperative-learning experiences resulted in higher academic achievement for minority students. Finally, Slavin (1985) examined the effects of Team-Assisted Individualization (TAI), Ability Group Active Teaching (AGAT), and the Missouri Mathematics Program (MMP) on mathematics achievement of third- through sixth-grade students, using experimental and controlled groups. He found that TAI, which is a cooperative-learning strategy, had the most significant impact on mathematics achievement.

Although research on cooperative learning and mathematics achievement for minority students seems to indicate positive results in the United States, there is limited evidence of comparable studies of students of color outside this country. Existing studies (Okebukola, 1986; Rich, Amir, & Slavin, 1986; Van Oudenhoven, Van Berkum, & Swen-Koopmans, 1987) have shown positive achievement gains in areas other than mathematics. A small number of studies in cooperative learning and science achievement in Nigeria have been documented (Okebukola, 1986). There is limited evidence of studies of cooperative learning and mathematics achievement of students of color in Caribbean countries.

The focus of this study is *other students of color,* referring to people living outside the United States who would be classified in this country as students of color or minority students. Here, students of color can be African American, Asian, Hispanic, or Native American. I chose to conduct this study in Bermuda because the student population would not fall into any of those categories.

In Bermuda, the curriculum used at the elementary level parallels that of the curriculum used at that level in the United States. There are similarities in the teaching and learning and assessment processes. The textbooks and resource materials are all published in the United States. The yearly assessment measure at this level is the California Achievement Test (CAT), and the teachers are trained at the undergraduate and graduate levels in the United States.

The cooperative-learning method used was Slavin's (1978) Student Teams Achievement Division (STAD). With this method, students of mixed-ability levels, gender, and ethnicity are assigned to four-member learning teams. The lesson is taught and the students work in teams to try to master the material. Finally, quizzes are given on the materials taught and team members work individually. Base scores are computed for each student on the basis of prior academic achievement. Students are awarded points for exceeding their earlier performance. They are also awarded certificates and other honors for their success.

Method

Participants

Before the study began, I obtained permission from the Department of Education of Bermuda and the principal of the building. Twenty-one students of color (10 boys and 11 girls) in a self-contained, fifth-grade classroom in one of Bermuda's elementary schools participated in the study. There were 18 Black students, 1 student of Indian descent, and 2 students from the Azores. In Bermudian culture, students from the Azores are not classified as White, so I included them in the study.

Before participating in the study, students spent 1 hr each day for 1 week learning about the importance of cooperative learning, the various skills they would have to achieve (social, leadership, and basic group skills), and the expectations that would be placed on them throughout the semester. Students were given an explanation of how Slavin's STAD worked, and they were informed of the format that their mathematics lessons would be taking. Special emphasis was placed on determining the group size, assigning students to groups, working as a cooperative group, establishing the classroom's physical environment, tabulating base scores and accumulating group points, and taking group and individual quizzes. This information was conveyed through discussion and practice activities using cooperative-learning techniques. Parents were also informed of the cooperative-learning activities that would be taking place. It was

necessary for parents and students to have a clear understanding of the procedures, given the nature of the methodology. Because cooperative learning involves students working together for a common cause, some parents may feel that their children are not being challenged or making progress when working with students of mixed abilities. Some students may have prejudices dissuading them from working with certain teammates. Aggressive students may want to take over the group. Bright students may feel and act superior to other group members. Relevant background information was therefore paramount for students and parents to help them feel more comfortable during the process.

Research Design

The research design used in this study was the single-group pretest/posttest. I was forced to use this approach because of the structure of the school system. Because of the size of the buildings, most elementary schools in Bermuda house one grade level per building. In some cases there may be two. In this case, there was only one Grade 5 classroom located in the building for which permission was granted to carry out the study. To include a control group, permission to use another building was necessary, and that was not feasible at the time. Therefore, it was necessary to conduct the study using an intact, single-group pretest/posttest design. The dependent variables (achievement and attitudes) were measured using the CAT and Peterson's (1978) Attitude Toward Mathematics Scale for Grades 4–6 Students. The treatment (cooperative learning) was administered over a 12-week period, and differences were measured by comparing pretest and posttest scores using a one-factor analysis of variance (ANOVA) repeated measures design, with which I could compare more than one posttest with the pretest for significant differences.

Instruments and Procedures

Because this study involved the measurement of achievement and attitudes, it was necessary to use two instruments. The CAT Form E Level 14 was used to measure the achievement levels. The CAT is a norm-referenced, standardized test designed for K–12 students to measure achievement in basic skills commonly found in school district curricula. It provides useful information about the relative ranking of students against a norm group as well as specific information about the instructional needs of students. I selected the CAT as a measure because it was the test selected by the Department of Education in Bermuda as an annual measure of academic achievement at this grade level. Therefore, the mathematics course work content in the cooperative-learning classroom was very much aligned to the CAT. Two sections of the test were used to measure students' achievement levels: mathematics computation, consisting of 50 items of basic computation skills, and mathematics concepts and applications, consisting of 55 items measuring skills involving number sentences, problem solving, measurement, and geometry.

Peterson's (1978) Attitude Toward Mathematics Scale for Grades 4–6 Students was used to measure student attitudes. This instrument, which was designed in 1978, is a 15-item, Likert-type, 5-point, agree–disagree scale designed to measure students' interest in mathematics. Point values are assigned to each response and are summed to reach a score for each student. Higher scores indicate more positive attitudes. Test–retest reliability yielded alpha coefficients ranging from .87 to .92.

After 1 week of receiving background information on Slavin's STAD method of cooperative learning, students completed the pretest, which consisted of the computation and application sections of the CAT and also the Attitudes Test. They were then grouped heterogeneously into four groups of 4 and one group of 5. Base scores were then assigned to students on the basis of their abilities and past performance. The classroom teacher, a doctoral candidate at a midwestern university who was very experienced in the use of cooperative learning as an instructional strategy, taught the required mathematics curriculum using Slavin's STAD. During the week, concepts were taught following the grade-level course of study, and students worked in teams to master the concepts. Groups were changed every 2 weeks to give students an opportunity to work with others. On Fridays, students were given individual quizzes to demonstrate whether they had mastered the concepts taught during the week. Team members were not allowed to assist each other during quizzes. Every student was responsible for knowing the material. Scores were tabulated using individual students' acquired scores along with their base scores to come up with points for each group. Winning teams were rewarded in class and were also recognized by the entire school community during school assemblies. At the end of Weeks 5, 9, and 13, students completed the same test that was done for the pretest as Posttests 1, 2, and 3. In short, students repeated the same test at four different intervals.

Data Analysis

Data from the CAT were scored by computer to determine individual students' raw scores for the computation and application components of the test. Items from the Attitudes Test were hand scored using the scoring guide designed by the author to determine raw scores for each student. Because there was only one group involved in the study, it was necessary to analyze the data using a one-factor ANOVA repeated measures design. This design allowed for comparisons of more than one posttest with the pretest for significant differences in case factors other than cooperative learning influenced the results. Borg and Gall (1989) suggested that single-group studies should have various measurements because the use of frequent measurements provides a clearer, more reliable description of how the participant's behavior varies naturally and how it varies in

response to the treatment. Furthermore, a statistically significant test of single-group data becomes more powerful if many measurements of the dependent variable are available.

Raw scores for computation, application, and attitudes were then analyzed separately using a one-factor ANOVA repeated measures design across four levels to determine whether there were statistically significant differences. A probability level ($p < .05$) was set for all tests of statistical significance.

Results

ANOVA statistical procedures were applied to the data across four levels, yielding significant differences in the means for the variables measured.

Achievement in computation yielded a ratio of $F(3, 60) = 7.509$, $p < .0002$. Application yielded a significant level of $F(3, 60) = 26.06$, $p < .0001$, and attitudes yielded $F(3, 60) = 5.325$, $p < .0026$. Means, standard deviations, and sample sizes for the achievement and attitudes measures for the pretest and Posttests 1, 2, and 3 are reported in Table 1.

After statistically significant differences were found for all the variables, Scheffé post hoc pairwise comparisons were applied to the data. The results indicate positive gains in student achievement after cooperative learning was implemented (see Table 2). For achievement in computation, statistically significant differences were found between the pretest and Posttest 2, $F(3, 60) = 3.113$, $p < .05$; pretest and Posttest 3, $F(3, 60) = 4.457$, $p < .05$; Posttests 1 and 2, $F(3, 60) = 3.003$, $p < .05$; and Posttests 1 and 3, $F(3, 60) = 4.235$, $p < .05$. No statistically significant differences were found between the pretest and Posttest 1, $F(3, 60) = .001$, $p > .05$, or Posttests 2 and 3, $F(3, 60) = .12$, $p > .05$.

Significant differences for application were found between the pretest and Posttest 1, $F(3, 60) = 8.648$, $p < .05$; pretest and Posttest 2, $F(3, 60) = 13.914$, $p < .05$; pretest and Posttest 3, $F(3, 60) = 23.839$, $p < .05$; and Posttests 1 and 3, $F(3, 60) = 3.891$, $p < .05$. No significant differences were found between Posttests 1 and 2, $F(3, 60) = .673$, $p > .05$ or 2 and 3, $F(3, 60) = 1.328$, $p > .05$.

Furthermore, there were statistically significant differences found at different intervals in students' attitudes toward mathematics. Significant differences were found between the pretest and Posttest 1, $F(3, 60) = 2.979$, $p < .05$; pretest and Posttest 2, $F(3, 60) = 3.45$, $p < .05$; and pretest and Posttest 3, $F(3, 60) = 4.088$, $p < .05$. However, no significant differences were found between Posttests 1 and 2, $F(3, 60) = .017$, $p > .05$; 1 and 3, $F(3, 60) = .099$, $p > .05$, or 2 and 3, $F(3, 60) = .027$, $p > .05$.

Table 1.—Descriptive Statistics for Pretest/Posttest Scores for CAT Computation, Application, and Attitude Measures

	CAT computation		CAT application		Attitude	
Test	*M*	*SD*	*M*	*SD*	*M*	*SD*
Pretest	31.7	8.1	27.4	8.2	52.4	14.4
Posttest 1	31.8	9.7	34.5	6.9	62.4	12.8
Posttest 2	37.0	4.6	36.5	6.4	63.2	9.1
Posttest 3	38.1	5.1	39.3	6.4	64.1	7.6

Note. CAT = California Achievement Test. $N = 21$.

Discussion

In this study, I examined the effects of cooperative learning on the achievement levels and attitudes toward mathematics of a group of fifth-grade other students of color. Students were taught using Slavin's STAD method of cooperative learning for a period of 12 weeks. Results indicate that cooperative learning had positive effects on the achievement and attitude levels in mathematics for these other students of color.

Achievement

Pretest/posttest means indicate positive gains for both achievement measures. In all cases except one, statistically

Table 2.—ANOVA Repeated Measures Post Hoc Multiple Comparisons of Pretests and Posttests for CAT Computation, Application, and Attitudes Toward Mathematics

	CAT computation		CAT application		Attitude	
Comparison	*M* diff.	Scheffé *F*	*M* diff.	Scheffé *F*	*M* diff.	Scheffé *F*
Pretest versus Posttest 1	–.095	.001	–7.095	8.468*	–10	2.979*
Pretest versus Posttest 2	–5.333	3.113*	–9.095	13.914*	–10.762	3.45*
Pretest versus Posttest 3	–6.381	4.457*	–11.905	23.839*	–11.714	4.088*
Posttest 1versus Posttest 2	–5.238	3.003*	–2	.673	–.762	.017
Posttest 1versus Posttest 3	–6.286	4.325*	–4.81	3.891*	– 1.714	.088
Posttest 2 versus Posttest 3	–1.048	.12	–2.81	1.328	–.952	.027

Note. $N = 21$; ANOVA = analysis of variance; CAT = California Achievement Test; diff. = difference.
*$p < .05$.

significant differences were found between the pretest and all the posttests. The one case is indicated in CAT computation in which the pretest and Posttest 1 were found to be nonsignificant, $F(3, 60) = .001$, $p > .05$. The other results clearly indicate that cooperative learning had a positive effect on students' achievement levels. They also reveal a continuing acknowledgment and support for cooperative learning as a learning-style preference for other students of color.

Attitudes

Results strongly suggest that cooperative learning had positive effects on the attitudes of other students of color toward mathematics. This is clearly supported through the differences in pretest/posttest mean scores found in Table 2 and the significant differences found between the pretest and all of the posttests.

These findings clearly support the work of researchers (Johnson & Johnson, 1983; Reid, 1992; Slavin, 1990; Slavin & Oickle, 1981) who found that cooperative learning had a positive impact on attitudes and academic achievement levels of students of color. Empirical research seems to substantiate the idea that students of color improved significantly and derived substantial social and academic benefits when involved in cooperative learning. Research (Gallien, 1988; Johnson & Johnson, 1983; Kinney, 1989; Slavin & Oickle, 1981) also suggests that students of color outperformed their White counterparts in academic achievement when involved in cooperative learning. These findings seem to coincide with the predictions of advocates for multicultural education, who espoused that students of color benefit from cooperative learning more than they do from traditional instruction, which is more competitive and individualistic in nature (Banks, 2001; Cohen, 1986; Nieto, 2000; Pang & Barba, 1995). Students in this study, although from a different culture and perhaps more privileged than some students of color in the United States, provided results that would support the results of existing research. From these and other empirical findings, it could be suggested that cooperative learning should be part of the daily instructional methods used in all schools, especially in situations involving students of color. This decision could affect whether students of color perform to the best of their ability. It is the responsibility of teachers to be aware of the various learning preferences that students bring to the classroom and to try to take full advantage of them during the daily teaching and learning process.

Conclusion

Given the rising population of people of color in America and the impact that this growth is having on schools, the need to explore better teaching and learning approaches is becoming increasingly urgent. Grant and Secada (1990) and Ladson-Billings (1994) argued that when teaching those who are culturally different, one should consider matching teaching and learning preferences to make students more responsive. Documented throughout the literature, cooperative learning and diverse learning styles are intertwined as effective strategies for teaching students of color.

This study has revealed some evidence to support the idea of cooperative learning as a learning preference for students of color. Significant differences were found between the pretest and posttests in all cases except one. This suggests that positive achievement and attitude in mathematics did occur. Because this study was conducted with students of color outside the United States, the results should interest all educators, especially those who advocate this method of instruction as a learning preference for students of color. The results support the idea that cooperative learning is truly a universal concept.

Limitations of the Study

Borg and Gall (1989) suggested that a one-group pretest/posttest design can be appropriate when one is attempting to change a behavior pattern or internal process that is stable and unlikely to change unless significant effort is made. It also can be justified when it is absolutely certain that extraneous variables are nonexistent. In this study, because the participants were a single intact group, differences on the posttests could have been caused by preexisting factors rather than by the treatment effects. The use of multiple posttests compensates for these variables to some degree, but having a control group would have been ideal for making valuable comparisons. Because the results in this study yielded some valuable data, further study in this area using research methodologies that include control groups is recommended.

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