New Zealand Journal of Psychology, 1991, 20, 17–24

The Effects of Cooperative and Competitive Learning Methods on the Mathematics Achievement, Attitudes Toward School, Self-Concepts and Friendship Choices of Maori, Pakeha and Samoan Children*

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This study examined the effects of cooperative and competitive learning methods on the mathematics achievement, attitudes toward school, self-concept and friendship choices of Maori, Samoan and Pakeha children. Three hundred and nineteen children, aged seven to eleven, from fourteen classes in four racially-mixed urban primary schools participated in the three week intervention. After stratifying for sex, ethnic membership and mathematics performance, subjects were randomly assigned to either the cooperative or competitive group-learning condition and worked on individualized mathematics programmes. Significant gains in mathematics achievement were found for the sample as a whole. However, no overall effect for learning condition was present on any of the measures, although Samoan children had the most favourable and Pakeha children the least favourable attitudes towards cooperation. For the sociometric measures, same ethnic group friendship choices were over-represented in the competitive, but not the cooperative condition, for Maori and Samoan children.

In recent years the focus of educational research has shifted from emphasis on specific pupil characteristics to the influence of broad situational factors on academic attainment. The teaching process itself has come under closer scrutiny, with many researchers proposing that the "implicit curriculum" of the learning environment (Crockenberg & Bryant, 1978; Thomas, 1979) may have a strong influence on the way pupils interact with each other, their attitudes to school and their academic achievement, as well as their self-concepts. A particularly important element in the "implicit curriculum" is the teaching method. Research has suggested that cooperative, competitive and individualistic teaching methods may produce different educational outcomes and that their overall effectiveness may vary depending on children's ethnic and cultural backgrounds[1].

Slavin and his colleagues have been some of the most noteworthy investigators of implicit curricula and have pioneered a number of cooperative methods which rely on group study with group reward for individual learning: Student Teams Achievement Divisions (STAD), Team-Assisted Individualization (TAI), and the Teams-Games Tournament (TGT). While their cooperative techniques fare well compared to whole classroom instruction (Slavin & Karweit, 1981; Slavin, Leavey, & Madden, 1984; Slavin, Madden, & Leavey, 1984a,b), there is some evidence that achievement gains are greater for minority students than majority group members (Slavin & Oickle, 1981). This pattern of comparative improvement was also observed in an earlier study by Lucker, Rosenfield, Sikes and Aronson (1976) with the cooperative Jigsaw approach based on individuals' contributions to team performance.

The positive impact of cooperative learning methods has not been limited to academic

*The paper is based on thesis data for a Master of Arts degree awarded to the first author.

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[1]Cooperative techniques are dependent upon interactions in which individuals experience the same outcome; an individual can attain her/his goal only if other group members attain theirs. Competition results in individuals achieving different outcomes; when one person is successful in attaining a goal, others are prevented from doing so. Under individualistic conditions, each person's outcome is independent of others (Deutsch, 1949).

achievement. Cooperative strategies have consistently shown beneficial effects on affective variables such as liking for school subjects (Blaney, Stephan, Rosenfield, Aronson, & Sikes, 1977; Humphreys, Johnson, & Johnson, 1982; Slavin & Karweit, 1981; Slavin, Leavey, & Madden, 1984) and have generally been found to be more effective than traditional whole class methods in improving self-esteem (Blaney et al., 1977; Madden & Slavin, 1983; Slavin & Karweit, 1981; Slavin, Leavey, & Madden, 1984). The majority of studies which have examined the consequences of cooperative and competitive learning methods on interpersonal relationships have also reported that more cross-ethnic friendship choices are made by children in the cooperative condition than those in competitive or individual conditions (DeVries, Edwards, & Slavin, 1978; Slavin, 1979; Warring, Johnson, Maruyama, & Johnson, 1985; Ziegler, 1981). However, findings pertaining to the interactive impact of teaching method and student ethnicity on friendship choice have been inconsistent (Slavin & Madden, 1979; Slavin & Oickle, 1981).

A number of researchers have noted that there are salient cross-cultural differences in cooperative and competitive behavior and have cited evidence that children from traditional communities (e.g., Amerindian, aboriginal Australian) tend to be more cooperative than those from transitional (e.g., Mexican-American) or modern (e.g., Anglo-American, Anglo-Australian) communities (Knight & Kagan, 1977; Madsen, 1971; Shapira, 1976; Sommerlad & Bellingham, 1972; Thomas, 1975). While these findings have derived primarily from social psychological gaming research, their relevance to the educational context has been widely recognized. Their import is particularly pertinent to the multicultural classroom in New Zealand where it has been argued that Maori and Polynesian children are taught from a Pakeha perspective (Hunkin, 1985; Smith, 1981; Tauroa, 1982; Thorsen, 1987). Competitive and individualistic behaviours are often emphasised (Thomas, 1975, 1979), despite evidence showing that Maori and other Polynesian people are more familiar with a cooperative style of interaction (Graves & Graves, 1974, 1984; Pitt & Macpherson, 1974; Ritchie, 1963; Thomas, 1975, 1978). In light of Thomas' (1985) study in New Zealand which demonstrated that cooperative strategies produce beneficial effects on achievement and attitudes to school and the overseas research which has substantiated the educational benefits of cooperative techniques for minority children, it seems warranted to further explore the implementation of cooperative learning strategies with Maori, Pakeha and Pacific Island children in this country.

This study was designed to investigate the effects of cooperative and competitive learning methods on the mathematics achievement, attitudes toward school, self-concept and friendship choices of Maori, Samoan and Pakeha children.

The major hypotheses of this study are as follows:

1. The cooperative learning situation, compared to the competitive learning situation will promote greater improvement in mathematics.
2. The cooperative learning situation, compared to the competitive learning situation, will promote more positive self-concepts and attitudes toward school, and more cross-ethnic friendship choices.
3. The cooperative learning situation will produce the greatest impact (improved mathematics scores, more positive self-concepts and school attitudes, and more cross-ethnic friendship choices) on Samoan children and the least impact on Pakeha children.

Method

Participants

Subjects. The initial sample was composed of 376 children (169 boys and 207 girls) from fourteen classes in four racially mixed urban Christchurch primary schools. The final analysis consisted of data from 319 children who identified themselves as either Maori (72), Pakeha (200) or Samoan (47). Seventeen were in Standard 1, 73 in Standard 2, 85 in Standard 3 and 144 in Standard 4. Their ages ranged from seven to eleven years (M= 9.4). All were from lower socio-economic groups (levels 4-6 of the 1981 Elley-Irving socio-economic index). Of the sample analysed, 152 children were in the competitive condition and 167 in the cooperative condition.

Teachers. Teachers volunteered to participate in the study in response to a request from their school principals who had been provided with details of the research by the first author. Of the fourteen teachers, eight were female and six were male, twelve were Pakeha and two were Samoan.

Measures

Mathematics Achievement Tests. These curriculum specific tests consisted of two parallel forms used as a multiplication pretest and post-test.[2] Both tests consisted of 40 multiplication items, including algorithms and word problems, at ten different levels of difficulty. Pretests with Forms A and B with 80 pupils confirmed their equivalence. Internal consistency (Cronbach alpha) for the multiplication achievement tests was .94 and .95.

School Attitude Survey. This measure was adapted from the Minnesota School Attitude Survey (MSAS) suitable for use with six-to eleven-year old children (Ahlgren, 1983). The MSAS consists of three subscales: General School Attitude (28 items), Competition (3 items) and Cooperation (3 items). It contains items relating to basic subjects, student role, other students, academic support, acceptance, academic pressure, personal worth, competition and cooperation. Several items chosen from the Minnesota School Attitude Survey were modified so that they would be idiomatically appropriate for New Zealand school children. Previous studies indicate that the test-retest reliability varies from .80-.90 and that the co-operation and competition subscales are orthogonal (Ahlgren, 1983).

An estimate of the internal reliability of the School Attitude Survey was determined for the sample in this study. Cronbach's coefficient alpha was .80 for the General School Attitude subscale, .68 for the Competition subscale and .47 for the Cooperation subscale.

Student's Perception of Ability Scale (SPAS). The Student's Perception of Ability Scale, developed by Boersma and Chapman (1977), consists of six subscales derived through factor analysis: Perception of General Ability, Perception of Arithmetic Ability, General School Satisfaction, Perception of Reading and Spelling Ability, Perception of Penmanship and Neatness (each of which contain 12 items) and Confidence in Academic Ability (10 items). The Full Scale contains 70 forced-choice "Yes-No" items. Internal consistency (Cronbach alpha) estimated with a New Zealand sample (Chapman & Boersma, 1983) was .92 for the SPAS Full Scale, whereas the subscale alphas ranged from .69 (Confidence) to .86 (Reading/Spelling). The alpha value for the Arithmetic subscale was .84. Boersma and Chapman (1978) reported a test-retest reliability of .83 for the SPAS and a significant correlation between SPAS scores and grade averages.

[2]The authors are indebted to Barry Brooker (formerly the Canterbury Education Board Mathematics Advisor) and Eleanor Burt (previously on staff at Gilberthorpe School). The mathematics tests and individualized instruction units were prepared by the first author in consultation with Barry Brooker and were based on his work with Eleanor Burt and the cyclic approach to mathematics education.

Sociometric Measure. The sociometric measure compared the number of cross-ethnic friendship choices made by children in the different learning conditions and ethnic groups. It was based on a measure used by Thomas (1985) and consists of a list of names of all the children in a particular class. In the present study, subjects were asked to place a tick by the names of six children, under the heading "Be my best friend".

Procedure

Teacher preparation and follow-up. The participating teachers met with the experimenter on two separate occasions for a total of three hours. During the intervention, teachers were initially visited every day, and then every second day, to ensure that the correct procedures were being followed.

Administration of tests and questionnaires. The Mathematics Achievement Tests were administered before and after the intervention. The other measures were taken at the end of the three week period. The sociometric measure took 10-15 minutes to administer. The duration of the other tests and questionnaires ranged from 30 to 75 minutes.

Learning conditions and groups. Each class was divided into two learning conditions, cooperative and competitive, to control for teacher effects. After stratifying for sex and ethnicity and controlling for mathematics ability as assessed in the pretest, children were randomly assigned to either the cooperative or competitive condition. Subjects within each condition were then divided into small groups or clusters of approximately four children.

Children in the *competitive condition* were to try to obtain a higher score than other members of their cluster. They were encouraged to work as much as possible on their own, but they could ask the teacher for help if necessary. No specific instructions were given about helping group members. At the end of each lesson, children with first and second highest scores in each cluster received recognition on a scoring card.

The instructions for children in the *cooperative condition* were based primarily on rules suggested by Burns (1981). Although the children worked on individual worksheets, they were to help other members of their cluster if asked. If they had any difficulty with their own work, they were to ask someone else in their own cluster for help. They were to obtain assistance from the teacher only if no one in their cluster could help, or if their individual scores did not meet the criterion required for them to continue the maths exercises. Their goal was to help their cluster earn a group score which met the criterion set for their cluster that day. Each child participating in a cooperative cluster which met the predetermined criterion received recognition on a scoring card.

Teaching Materials. An individualized mathematics programme was used during the learning intervention to ensure uniformity of

learning materials among classes. The mathematics programme consisted of ten colour-coded units based on the ten steps of a cyclic approach (the repetition of concepts at increasing levels of difficulty). Each unit of the individualized programme included a number of sets of exercises and answer sheets, checkouts (10-item tests to follow each set) and checkout answers.

Implementation. Children in both the cooperative and competitive conditions worked in small groups on the same individualized mathematics programme for one hour per day for a period of three weeks. During each maths lesson the children sat with other members of their cluster. Each worked from an individual copy of a set from an appropriate multiplication unit, but followed the rules for either cooperative or competitive learning. The children marked their own set exercises, but checkouts (to be completed without any assistance) were marked by another child in the same cluster. The minimum criterion for progressing to another set was 80%. If children scored below 80%, they completed parallel items of the same set after a conference with the teacher and then proceeded to the next set.

Rewards were differentially allocated to subjects in the cooperative and competitive conditions. In the cooperative groups individual scores were totalled to obtain and record an average group score; all children in a cluster which achieved the predetermined learning criteria received a star next to their names on a scoring card. In the competitive condition individual scores were recorded on the cluster's card with the first and second placegetters receiving stars by their names. Reward allocation was monitored so that approximately equal numbers of stars were distributed to subjects in the cooperative and competitive conditions.

Results

Mathematics Achievement Test

Data were analysed by a 3 (ethnic group) x 2 (learning condition) x 2 (test) multivariate analysis of variance (MANOVA); means and standard deviations are shown in Table 1.

The sample as a whole showed a significant difference between pretest (M= 12.2) and post-test scores (M= 15.3); $F(1,301)$= 108.51, $p<.0001$. However, there was no evidence to support the predictions that children from the three ethnic groups would differ in their response to the learning situations, $F(2,301)$= 0.69, n.s., or that the cooperative learning situation would promote greater improvement in maths than the competitive learning situation, $F(1,301)$= 0.58, n.s.

Separating the word problems from the other items on the mathematics achievement test, however, produced a significant interaction between ethnicity and test, $F(2,301)$= 2.95, $p<.05$. The mean scores indicate that the Samoan children (Pretest, M= 2.2; Post-test, M= 3.5) showed the most improvement, the Maori children (Pretest, M= 2.4; Post-test, M= 3.6) showed intermediate improvement, and the Pakeha children (Pretest, M= 2.8; Post-test, M= 3.6) the least improvement on the word problems.

School Attitude Survey

A 2X3 analysis of variance did not produce significant main effects for ethnicity, $F(2,283)$= 0.99, n.s., or condition, $F(1,283)$= 2.77, n.s., on general school attitudes, nor was a

Table 1: *Means and Standard Deviations for Mathematics Achievement Test by Condition and Ethnic group*

Condition	Ethnic group	Pretest	Post-test	Difference
	Maori	12.1 (7.5)	15.3 (8.7)	3.2
Competitive	Pakeha	12.1 (8.7)	15.1 (10.4)	3.0
	Samoan	10.8 (7.9)	14.1 (9.3)	3.3
	Maori	11.2 (8.0)	14.7 (9.4)	3.5
Cooperative	Pakeha	13.2 (8.2)	15.9 (10.4)	2.7
	Samoan	10.5 (5.3)	15.4 (8.4)	4.9
Total		12.2	15.3	3.1

Table 2: *Mean Percentages of Friendship Choices by Maori, Samoan and Pakeha Children in the Cooperative and Competitive Learning Conditions*

Condition	Ethnic Group	N	Friendship Choices		
			Maori [a](25.7)	Pakeha (56.9)	Samoan (12.9)
Competitive	Maori	31	37.6*	45.2*	14.0
	Pakeha	80	24.8	59.0	11.7
	Samoan	22	24.2	47.0*	24.2*
Cooperative	Maori	32	30.2	56.3	9.4
	Pakeha	92	26.1	58.0	10.7
	Samoan	21	28.6	41.3*	19.8

Note: The percentage of children chosen from other ethnic groups is not included in this table.

[a]Proportion of children in the classes.

*$p<.05$

significant interaction effect established, $F(2,283)= 1.69$, n.s. However, a main effect for ethnicity was demonstrated on the Cooperation scale, $F(2,299)= 5.97$, $p<.01$, despite the instrument's low internal consistency. Mean scores reveal that the Samoan children had the most positive attitude to cooperation ($M= 7.4$) and the Pakeha children the least positive attitude ($M= 6.2$). The Maori children scored in between the other two groups ($M= 6.5$).

Student's Perception of Ability Scale

Again no significant differences were found between learning conditions, $F(1,303)= .01$, n.s., or ethnic groups, $F(2,303)= 2.17$, n.s., on the overall academic self-concept measures. Significant main effects for ethnic group were observed, however, for the School Satisfaction, $F(2,295)= 9.67$, $p<.001$, and Penmanship/Neatness subscales, $F(2,292)= 3.70$, $p<.05$. The Samoan children ($M= 10.0$ and $M= 9.0$) had the highest mean scores on these subscales and Pakeha children ($M= 8.3$ and $M= 7.7$) the lowest. The Maori children ($M= 8.7$ and $M= 8.4$) scored in between the two groups. A significant main effect, $F(2,285)= 3.08$, $p<.05$, for ethnic group was also found on the Confidence subscale, with both the Samoan ($M= 5.2$) and the Pakeha children ($M= 4.8$) scoring higher than the Maori children ($M= 4.1$). No significant interactions between ethnicity and learning condition were found for overall perception of ability or for any of the subscales.

Sociometric Measure

The test for significance of difference between two proportions was used to compare the proportion of friendship choices made by each ethnic group, within each condition, to the proportion of the ethnic groups in the total sample. The percentages of friendship choices are shown in Table 2. Choices by the Maori children, and to a lesser extent choices by the Samoan children, varied somewhat in relation to learning condition. Same-ethnic friendship choices were over-represented in the case of Maori ($M= 37.6\%$), $Z= 2.97$, $p<.05$, and Samoan children ($M= 24.2\%$), $Z= 3.16$, $p<.05$, in the competitive condition. Choices of Pakeha friends were under-represented in the case of Samoan children in both conditions (cooperative: $M= 41.3\%$), $Z= 3.07$, $p<.05$, (competitive: $M= 47.0\%$), $Z= 1.99$, $p<.05$, but in the case of Maori children, only in the competitive condition ($M= 45.2\%$), $Z= 2.70$, $p<.05$. The proportion of friendship choices made by Pakeha children in both the cooperative and competitive learning conditions was similar to the proportion of ethnic groups in the sample.

Discussion

Although the results revealed that group learning techniques positively affect mathematics achievement, cooperative and competitive learning conditions were not found to differentially affect children's mathematics

attainment, school attitudes, or self-concepts. Furthermore, the hypothesized interactive effects of learning condition and subject ethnicity on these variables was not substantiated. These findings may be examined in relation to the defining characteristics of the learning conditions, the group structures and the implementation of reward procedures.

The methodology used in this research was a variation of the Team-Assisted Individualization approach (Slavin, 1978; Slavin, Leavey, & Madden, 1984). This programme's effectiveness has been repeatedly demonstrated, and Slavin's (1983) review of 27 studies reported significant improvement in students' academic attainment in 24 (89%) of the investigations. In implementing the Slavin technique, however, this research was extended further to eliminate the confounds apparent in some of the previous studies. First, both learning conditions involved group activities. This is in contrast to a number of prior investigations which compared small group (i.e., cooperative methods) learning with large group (i.e., typical classroom) instruction (e.g., Blaney et al., 1977). Secondly, the outcomes of the cooperative and competitive reward structures were equated. Although the cooperative method relied on group reward for individual learning, the overall reward allocation to cooperative and competitive groups was the same. In a number of earlier studies rewards were offered to students in cooperative conditions, but not in control groups (Slavin, 1979; Slavin et al., 1984; Weigel, Wiser, & Cook, 1975) or rewards were dispensed to subjects in cooperative, competitive and individualized conditions without monitoring or equating the allocations (e.g., Humphreys, Johnson, & Johnson, 1982). Thirdly, the intergroup competition imposed on cooperative teams as found in the Team Games Tournament (DeVries et al., 1978) and the Student Teams and Achievement Divisions (Slavin, 1978) techniques was eliminated; in this way more exacting and homogenous criteria for defining cooperative learning were met. We believe that our study represents a more rigorous approach to the investigation of cooperative learning per se. Nevertheless, negative experimental results are always problematic to interpret, and more extensive research of this type should be undertaken to tease out the extraneous influences of group size, reward allocation and intergroup competition on the effects of cooperative group learning techniques.

Although the present study made a number of design improvements on previous research, limitations are also apparent. First, the cooperative and competitive learning methods were only used for one class period each day, over a period of three weeks. The bulk of research on cooperative learning has relied on longer periods of intervention, and some studies have continued for up to 30 weeks (Slavin, 1983). It should be noted, nevertheless, that investigators have frequently documented greater achievement gains in cooperative groups during three week periods (e.g., Sharan, Hertz-Lazarowitz, & Ackerman, 1980) and in some instances, in as few as six one hour sessions (Johnson, Johnson, & Skon, 1979). Indeed, in Slavin's (1983) meta-analysis of field experiments on cooperative learning, half of the three week intervention programmes (four of eight) demonstrated more significant academic improvements in the cooperative condition.

A second point of concern relates to the issue of task structures and reward structures. In this study distinctions are clearly made between the reward allocations in the cooperative and competitive situations. In the cooperative condition group reward is given for individual learning, while in the competitive condition individual reward is given for individual learning. Cooperative incentives also imply cooperative task structures; that is, group members must assist each other in obtaining a group goal. While this did occur regularly in cooperative clusters, teachers reported that a portion of children in the competitive groups also helped each other. These helping behaviours blurred the distinction between cooperative and competitive task structures and weakened the power of the design.

Although this research did not demonstrate a difference in the effectiveness of cooperative *vs.* competitive learning on academic attainment, school attitudes or self-esteem, it does reflect ethnic differences in attitudes toward cooperative behaviour. Samoan children had the most positive attitude to cooperation and the Pakeha children the least positive attitude with Maori children assuming an intermediate position. This reiterates previous research which has concluded that Polynesian children prefer working cooperatively (Graves &

Graves, 1974, 1984; Pitt & Macpherson, 1974; Thomas, 1975, 1978).

One interesting outcome of this research concerns the pattern of friendship choice found in Maori, Pakeha and Samoan children in cooperative and competitive learning conditions. Same ethnic group choices were over-represented in friendship selections of Samoan and Maori children in the competitive, but not the cooperative condition. It was also in the competitive condition that Pakeha friendship choices by Maori children were under-represented. Although these results should be viewed cautiously due to their cross-sectional nature and the possibility of sampling error, they are consistent with other studies in the area (DeVries, Edwards, & Slavin, 1978; Slavin, 1979; Waring, Johnson, Maruyama, & Johnson, 1985; Ziegler, 1981). Group-oriented learning approaches with cooperative reward structures should be further explored with reference to intergroup relationships in the multi-cultural classroom.

In conclusion, the findings of this research indicated that Maori, Samoan and Pakeha children who were exposed to a three week programme of group-oriented learning improved their mathematics performance but that there was no significant difference in the effects of the cooperative and competitive reward allocations on academic achievement, attitudes or self-concept during this period. Although Samoan children indicated the strongest liking for cooperative methods, there were no significant differences across ethnic groups on attitudinal or achievement variables in response to the cooperative and competitive techniques. With respect to sociometric measures, however, cooperative learning was associated with more cross-ethnic friendship choices by minority group children. Given the limitations of research in this area, more investigations are needed to study the effects of cooperation and competition in relation to the specific features of group-oriented individualized programmes and to further explore their suitability for use in the New Zealand multi-cultural classroom.

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