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The Effectiveness of Cooperative and Individualistic Approaches in Teaching Mathematics and English

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ABSTRACT

This paper reports an experimental study into the effects of cooperative and individualistic approaches in teaching Mathematics and English. The study was conducted at a Vacation Learning Camp (VLC) which was held for two weeks in one of the secondary schools in Singapore. This VLC was targeted at Secondary One pupils who were classified as below average based on general ability streaming.

The individualistic teaching approach was assumed to contribute to individual efforts while the cooperative teaching approach was expected to produce cooperativeness among the subjects. The results indicated that there were no significant differences in performances in the main effects classified as the treatment groups and the sex groups in both Mathematics and English; in Mathematics, the individualistic teaching approach was more effective for the male pupils whereas the cooperative teaching approach was more effective with females. However, in English, the results were reversed.

The female pupils in the cooperative group seemed to have improved in their attitude towards learning Mathematics whereas the male pupils in the individualistic group seemed to have a more positive attitude towards learning English.

Introduction

Since the 1920's a great deal of research on the effects of the individualistic and cooperative teaching approaches on achievement has been carried out. Earlier studies in this area of research were mainly confined to the analysis of the main effects. A study by Faw (1949) showed a difference favouring the cooperative (group centred) approach. However, studies by Eglash (1950) showed no significant differences. Dubin and Taveggia (1968) also reviewed experimental studies on the comparison between lecture and discussion approaches. From 36 studies under review, 51% favoured the individualistic (lecture) approach and 49% favoured the cooperative (discussion) approach. This conflicting evidence suggests the need for further isolation of the pertinent variables.

Johnson (1981) had indicated that in current educational practice, teacher-student interaction was emphasized and the possibility of student-student interaction was eliminated in many classrooms. He further emphasized that it was student-student interaction that might be the more important determinant of educational success. In relation to small group and large group approaches, Peterson and Janicki's (1981) study showed that high and low ability

students did better with a small group approach than with the large group approach. Medium ability students did slightly better with the large group approach. It was expected that more cooperation took place in a small group than in a large group.

The Present Study

In this study, two approaches namely, the cooperative and the individualistic approaches were used to teach the Mathematics and English groups. The individualistic approach was assumed to contribute to individual efforts while the cooperative approach was expected to produce cooperativeness among the subjects.

The teaching mode for both the Mathematics and English groups was operationally defined as follows:

(1) The Individualistic Approach had the following features:

   (a) Pupils were instructed to study alone, devoid of interaction with other students;
   (b) A predominantly expository style of instruction was used;
   (c) Limited use of games and activities in the lesson;
   (d) Pupils completed their tasks and worksheets on their own; and
   (e) The lessons were essentially teacher-led, teacher-directed and teacher-centred.

(2) The Cooperative Approach had the following features:

   (a) Pupils were divided into groups of 4–6 members for group activities;
   (b) Group activities included completing worksheets, playing academic games, quiz or a combination of the three;
   (c) Points were awarded to the groups that completed the worksheet correctly, won the game or provided the right answer in the quiz; and
   (d) Pupils were informed beforehand that the group that collected the most points would be awarded prizes at the end of the two weeks.

Within this context, the study investigated treatment x sex interaction effects on pupils' learning, measured by their test performances, and their attitude change, measured by their responses to the questionnaire. A secondary purpose of the study was to determine any significant gains in the pupils' performances and their attitude change for the following classification of groups: all pupils, male, female, individualistic, cooperative, individualistic x male or female and cooperative x male or female.

METHOD

The entire set up of the experimental study was conducted at a Vacation Learning Camp (VLC) which was held for two weeks in one of the secondary schools in Singapore. A total of 152 Secondary One pupils in the Normal stream (below average pupils) from various surrounding schools were selected to participate in the VLC. The VLC was managed by the Further Professional Diploma in Education (FPDE) and the Diploma in Education (Dip Ed) students. The FPDE participants played the role of heads of departments. They were responsible for the planning, implementation, monitoring and evaluation of the various learning activities at the camp, and in guiding and supervising the Dip Ed trainees in their teaching activities. The camp provided an experimental setting for the FPDE and Dip Ed trainees to work collaboratively at improving learning among the Normal stream pupils. Some staff members from the Institute of Education served as resource personnel. The Dip Ed participants were assigned to various curriculum areas. These participants served as learning facilitators.

Subjects

In all 44 male and 55 female pupils from the secondary schools participated in the Mathematics study. Of these 43 male and 50 female pupils from the same schools participated in the English study as well. These pupils were assigned to one of the six classes taught by the Dip Ed students majoring in either Mathematics or English.

Instruments

For the Mathematics group, the Mathematics

Achievement Test and the Mathematics Attitude Questionnaire were used in this study. For the English group, the English Achievement Test and the English Attitude Questionnaire were used.

The Mathematics Achievement Test consisted of 20 objective questions with four options in each item's responses. The topics tested were classified into three: rounding of whole numbers/decimals, estimation and significant figures.

The English Achievement Test consisted of three sections, each with fifteen fill-in-the-blank questions. The topics tested included preposition of time, comparatives, superlatives and adjectives and the indefinite article.

There were 20 items in both the Mathematics and English Attitude Questionnaire. These items each had a 3-point response format with the following alternatives: "agree", "not sure" and "disagree". The scale was scored such that the more positive attitude was represented by a higher score.

Procedures

Achievement tests were used to monitor the pupils' work over the two weeks of the VLC. Pre-tests in Mathematics and English were administered to all pupils who reported to the VLC on the first or second day of the camp before the commencement of any teaching or learning activities held in the camp. Similar tests were administered on the last day of the VLC. To ensure the validity of the test the areas tested in both tests (Mathematics and English) covered all aspects taught during the two-week VLC.

The data obtained from the tests were analysed by comparing pupils' performances measured by achievement scores using the technique of analysis of variance on the pupils classified by treatment (individualistic and cooperative approaches) and sex (male and female) on both the Mathematics and English scores. 't' tests were used to analyse if there was any gain in pupils' achievement after the two approaches were administered.

Besides the achievement tests, attitude questionnaires were also used to monitor the pupils' behaviour. Specifically, an investigation was undertaken to find out if the alternative strategy had any influence on their attitudes towards learning Mathematics and/or English. On the first or second day of the camp, two attitude questionnaires (Mathematics and English) were administered to all pupils who participated in the camp. Their attitudes towards English and Mathematics based on their previous experiences were used for comparison. Similar tests were administered on the last day of the VLC.

One of the objectives of this study was to find out if the cooperative teaching approach could enhance pupils' positive attitudes towards learning. The effectiveness of the cooperative approach over the individualistic approach was measured by the quantitative scores of the pupils who responded to the attitude questionnaires administered to the respective groups (individualistic and cooperative). A comparison of their behaviour measured by the quantified scores was analysed using the analysis of variance technique on the pupils classified by treatment (individualistic and cooperative approaches) and sex (male and female) on both the Mathematics and English scores.

RESULTS

Achievement Tests in Mathematics and English

The Mathematics and English pre-test and post-test scores were analysed by means of 2 x 2 univariate analysis of variance. In this analysis, the treatment (cooperative and individualistic approaches) and the sex of pupils were the factors. The t-test was also used to find out if there were any gains in pupils' achievements in Mathematics and English.

Pre-tests results in Tables 1B and 2B show that the various groups classified by treatment, sex and treatment x sex were comparable in both Mathematics and English.

In all cases, the differences between respective groups were not significant at the 5% level.

TABLE 1A: ANALYSIS OF VARIANCE OF THE PERFORMANCES OF PUPILS, CLASSIFIED BY VARIOUS TREATMENTS AND SEX ON PRE-TREATMENT MATHEMATICS ACHIEVEMENT (N = 99)

Source of Variation	D.F.	Sum of Squares	Mean Squares	F ratio	Level of Significance
Treatment	1	7.926	7.926	1.45	$p > 0.05$
Sex	1	15.291	15.291	2.79	$p > 0.05$
Treatment x Sex	1	20.088	20.088	3.66	$p > 0.05$
Within	95	520.698	5.481		
Total	98	564.00			

TABLE 1B: MEAN SCORES OF MATHEMATICS ACHIEVEMENT

Treatment	Sex	No.	Pre-Treatment Mean Scores
I	—	48	12.62
C	—	51	12.06
—	M	44	12.77
—	F	55	11.98

Interactions	No.	Pre-Treatment Mean Scores
I x M	23	12.52
I x F	25	13.12
C x M	21	13.04
C x F	30	11.36

I — Individualistic Approach
C — Cooperative Approach
M — Male
F — Female

TABLE 2A: ANALYSIS OF VARIANCE OF THE PERFORMANCES OF PUPILS, CLASSIFIED BY VARIOUS TREATMENTS AND SEX ON PRE-TREATMENT ENGLISH ACHIEVEMENT (N = 93)

Source of Variation	D.F.	Sum of Squares	Mean Squares	F ratio	Level of Significance
Treatment	1	0.074	0.074	0.00	$p > 0.05$
Sex	1	80.062	80.062	2.95	$p > 0.05$
Treatment x Sex	1	5.320	5.320	0.19	$p > 0.05$
Within	89	2438.216	27.396		
Total	92	2524.473			

TABLE 2B: MEAN SCORES OF ENGLISH ACHIEVEMENT

Treatment	Sex	No.	Pre-Treatment Mean Scores
I	—	49	31.10
C	—	44	31.04
—	M	43	31.77
—	F	50	31.94

Interactions	No.	Pre-Treatment Mean Scores
I x M	22	29.81
I x F	27	32.14
C x M	21	30.33
C x F	23	31.69

I — Individualistic Approach
C — Cooperative Approach
M — Male
F — Female

Analysis of the post-treatment result, Table 3A shows that, in Mathematics, there was no significant F ($p > 0.05$) resulting from the performance differences with respect to the treatment, sex and the interaction between treatment and sex.

TABLE 3A: ANALYSIS OF VARIANCE OF THE PERFORMANCES OF PUPILS, CLASSIFIED BY VARIOUS TREATMENTS AND SEX ON POST-TREATMENT MATHEMATICS ACHIEVEMENT (N = 99)

Source of Variation	D.F.	Sum of Squares	Mean Squares	F ratio	Level of Significance
Treatment	1	0.075	0.075	0.01	$p > 0.05$
Sex	1	2.200	2.200	0.36	$p > 0.05$
Treatment x Sex	1	1.239	1.239	0.20	$p > 0.05$
Within	95	588.667	6.197		
Total	98	592.182			

TABLE 3B: MEAN SCORES OF MATHEMATICS ACHIEVEMENT

Treatment	Sex	No.	Post-Treatment Mean Scores
I	—	48	14.27
C	—	51	14.22
—	M	44	14.41
—	F	55	14.11

Interactions	No.	Pre-Treatment Mean Scores
I x M	23	14.30
I x F	25	14.23
C x M	21	14.52
C x F	30	14.00

I — Individualistic Approach
C — Cooperative Approach
M — Male
F — Female

With respect to the English test, Table 4A shows that there was a significant F ($p<0.05$) for the interaction group only (treatment x sex). Hence there was a relationship between performance in the test and the combination of the treatment (cooperative and individualistic) and sex (male and female) variables.

TABLE 4A: ANALYSIS OF VARIANCE OF THE PERFORMANCES OF PUPILS, CLASSIFIED BY VARIOUS TREATMENTS AND SEX ON POST-TREATMENT ENGLISH ACHIEVEMENT (N = 93)

Source of Variation	D.F.	Sum of Squares	Mean Squares	F ratio	Level of Significance
Treatment	1	6.046	6.046	0.26	$p > 0.05$
Sex	1	59.942	59.942	2.61	$p > 0.05$
Treatment x Sex	1	123.531	123.531	5.38	$p > 0.05$*
Within	89	2042.093	22.945		
Total	92	2231.613			

TABLE 4B: MEAN SCORES OF ENGLISH ACHIEVEMENT

Treatment	Sex	No.	Post-Treatment Mean Scores
I	—	49	33.69
C	—	44	34.21
—	M	43	33.07
—	F	50	34.68

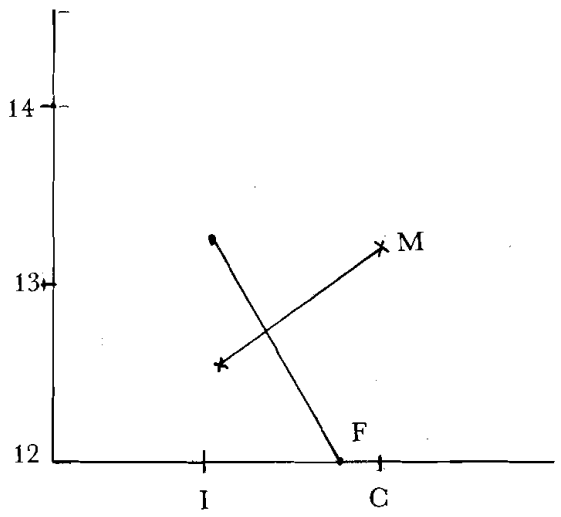
Interactions	No.	Pre-Treatment Mean Scores
I x M	22	31.59
I x F	27	35.40
C x M	21	34.61
C x F	23	33.82

I — Individualistic Approach
C — Cooperative Approach
M — Male
F — Female

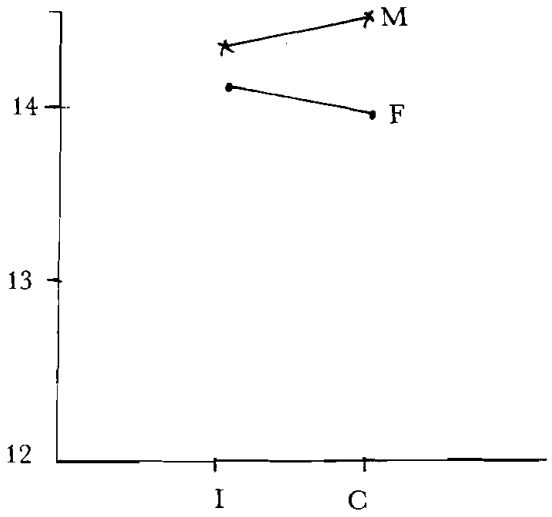
The graphs below Figures 1 and 2 also show the presence of interaction between the treatment variables and sex variables of the English post-treatment group.

The superiority of the individualistic approach for the female pupils could be further confirmed by comparing the post-treatment English achievement results classified by interaction subgroups. Table 5 shows the results of t-tests on the differential performance between the various subgroups.

FIGURE 1: GRAPHICAL REPRESENTATIONS OF DATA REPRESENTING THE INTERACTION AND MAIN EFFECTS OF THE MATHEMATICS GROUPS OF ACHIEVEMENT MEAN SCORES

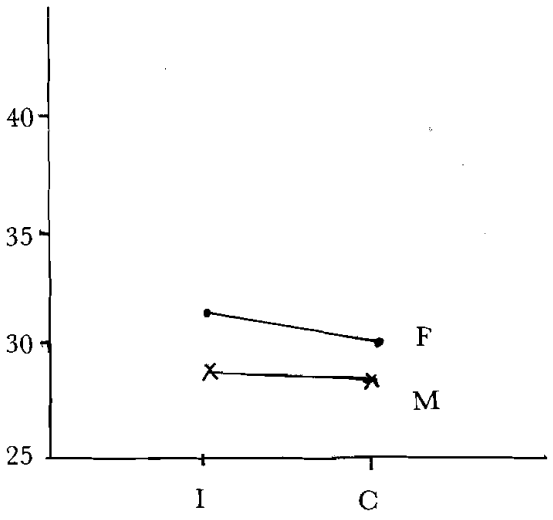


Mathematics Group Pre-Treatment

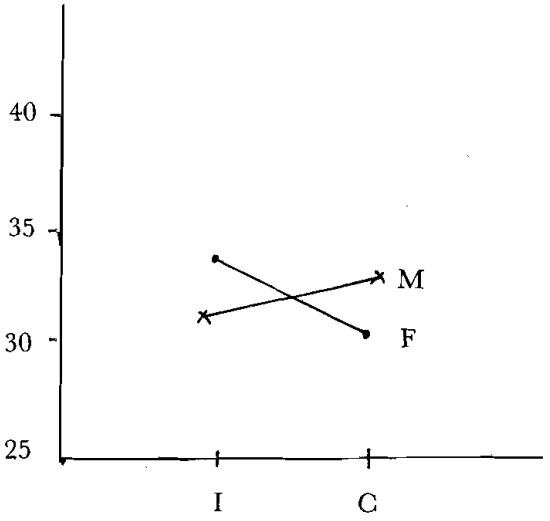


Mathematics Group Post-Treatment

FIGURE 2: GRAPHICAL REPRESENTATIONS OF DATA REPRESENTING THE INTERACTION AND MAIN EFFECTS OF THE ENGLISH GROUPS OF ACHIEVEMENT MEAN SCORES



English Group Pre-Treatment



English Group Post-Treatment

TABLE 5: A COMPARISON OF POST-TREATMENT ENGLISH ACHIEVEMENT PERFORMANCES CLASSIFIED BY INTERACTION SUBGROUPS

Interaction Subgroups	$*\bar{X}_1$	1	$*\bar{X}_2$	σ^2	t	Level of Significance
I x F vs I x M	31.59	5.33	35.4	2.92	3.00	$p < 0.01$*
I x F vs C x F	31.59	5.33	34.61	3.27	2.24	$p < 0.01$*
I x F vs C x F	31.59	5.33	33.82	6.46	1.26	$p > 0.05$
I x M vs C x M	35.4	2.92	33.82	6.46	-0.82	$p > 0.05$
C x F vs C x M	34.61	3.27	33.52	6.46	-0.52	$p > 0.05$
I x M vs C x F	35.4	2.92	34.61	3.27	0.86	$p > 0.05$

* X1 refers to the Second Interaction Group
X2 refers to the First Interaction Group

The results show that significant differences were only observed for the I x F vs I x M and I x F vs C x F at the 1% level. This seems to confirm the superiority of the individualistic approach for the female pupils in the English achievement tests.

With respect to the Mathematics group, analysis of variance results show that there was no relationship between the achievement scores and the individual group (male and female) or the cooperative group (male and female). This result was reflected in Table 6 below:

TABLE 6: A COMPARISON OF POST-TREATMENT MATHEMATICS ACHIEVEMENT PERFORMANCES CLASSIFIED BY INTERACTION SUBGROUPS

Interaction Subgroups	$*\bar{X}_1$	1	$*\bar{X}_2$	σ^2	t	Level of Significance
I x M vs I x F	14.3	1.94	14.23	2.7	0.11	$p > 0.05$
I x M vs C x M	14.3	1.94	14.52	2.1	0.35	$p > 0.05$
I x M vs V x F	14.3	1.94	14.00	2.74	0.47	$p > 0.05$
I x F vs C x F	14.23	2.7	14.00	2.74	0.32	$p > 0.05$
I x F vs C x M	14.23	2.7	14.52	2.1	0.4	$p > 0.05$
C x M vs C x F	14.52	2.1	14.00	2.74	0.77	$p > 0.05$

It should be noted that significant differences were not observed in any two subgroups at the 5% level. The combination of the independent variables (approach and sex) does not seem to contributte any effect on the Mathematics achievement scores of the pupils.

Results of T-tests

The pre-test and post-test scores of the pupils who sat for the Mathematics and English achievement tests were analysed using the student's t-test to determine if there was any significant gain at the end of the treatment. The results are summarised in Table 7 and Table 8.

Table 7 shows that, for the Mathematics Achievement Tests, the gains in performance in the tests were significant at the 1% level for the overall group, the sex groups (male and female) and the treatment groups (individualistic and cooperative). However, in considering the interaction group, the differential gains were only significant (at the 1% level) for the individualistic x male and the cooperative x female groups. The other two groups (individualistic x female and cooperative x male) gains in performance were not significant. This seems to suggest that for Mathematics the individualistic approach was more suitable for the male pupils whereas the cooperative approach was appropriate for the female pupils.

Table 8 shows the summary of the analysis of the English Achievement Tests. An inspection of the analysis shows that like the Mathematics group, the differential gains in performance in the pre- and post-tests were significant for the overall group, the sex groups (male and female) and the treatment groups (individualistic and cooperative). However, there is a difference in the interaction group. Significant gains were observed (at the 1% level) in the pupils' performances in the interaction group (individualistic x female and cooperative x male). The other two interaction groups (individualistic x male and cooperative x female) were not significant in the gains in performances.

Using the results of t-tests on English achievement performances for the interaction group, it is possible to explain the results on the Analysis of Variance of the Performance on post-treatment English achievement (Table 4). A significant F ($p<0.05$) was observed for the

TABLE 7: A COMPARISON OF PRE AND POST MATHEMATICS ACHIEVEMENT PERFORMANCES CLASSIFIED BY TREATMENT SEX, OVERALL GROUP AND INTERACTION GROUP

Classification	N	$\bar{X}_1$ (pre)	$\bar{X}_2$ (post)	t	Level of Significance
All students	99	12.33	14.24	7.96	$p < 0.01$*
Male	44	12.77	14.41	4.43	$p < 0.01$*
Female	55	11.98	14.12	6.76	$p < 0.01$*
Individualistic Group	48	12.63	14.27	5.6	$p < 0.01$*
Cooperative Group	51	12.06	14.22	5.77	$p < 0.01$*
Individualistic x male	23	12.52	14.3	2.94	$p < 0.01$*
Individualistic x female	25	13.12	14.23	1.27	$p > 0.05$
Cooperative x male	21	13.04	14.52	1.94	$p > 0.05$
Cooperative x female	30	11.36	14.00	4.22	$p < 0.01$*

TABLE 8: A COMPARISON OF PRE AND POST ENGLISH ACHIEVEMENT PERFORMANCES CLASSIFIED BY TREATMENT SEX, OVERALL GROUP AND INTERACTION GROUP

Classification	N	$\bar{X}_1$ (pre)	$\bar{X}_2$ (post)	t	Level of Significance
All students	93	31.08	33.94	6.29	$p < 0.01$*
Male	43	30.07	33.07	4.03	$p < 0.01$*
Female	50	31.94	34.68	4.90	$p < 0.01$*
Individualistic Group	49	31.10	33.69	4.81	$p < 0.01$*
Cooperative Group	44	31.05	34.20	4.18	$p < 0.01$*
Individualistic x male	22	29.81	31.59	1.06	$p > 0.05$
Individualistic x female	27	32.14	35.4	3.84	$p < 0.01$*
Cooperative x male	21	30.33	34.61	2.92	$p < 0.01$*
Cooperative x female	23	31.69	33.82	1.21	$p > 0.05$

interaction (treatment x sex) indicating a relationship between the English achievement and the combination of strategies used on (individualistic and cooperative) sex of pupils (male and female). The results from Table 8 using the t-tests analysis seem to indicate that the main contributing factors were the individualistic x female and cooperative x male groups.

Attitude Questionnaire in Mathematics and English

The Mathematics and English attitude scores were also analysed by means of a 2 x 2 univariate analysis of variance and the t-test technique to find out if any significant differences were observed between various groups.

Pre-attitude tests (Tables 9B and 10B) show that within the treatment groups and the interaction groups the Mathematics and English attitude scores were comparable except for the Mathematics sex group. The F ratio was found to be significant at 1% level when the Mathematics male and female scores were compared.

The results of the post-treatment analysis are shown in Tables 11 and 12.

Analysis of the above results seems to indicate that the only main-effect differences in the analysis of variance were the sex variable in the Mathematics group. The male pupils seem to have more positive attitudes towards Mathematics than the female pupils. This study shows consistency in the male pupils' positive attitude before and after attending the VLC. As far as this sample is concerned, the cooperative group did not seem to have any advantage over the individualistic group in their attitudes towards learning Mathematics and English after they had undergone different approaches of teaching and learning. Similarly, there was also no significant F ($p < 0.05$) for the interaction in the attitude differences.

The graphs in Figures 3 and 4 do not show any interacting effects of the Mathematics and English groups.

TABLE 9A: ANALYSIS OF VARIANCE OF THE SCORES OF PUPILS, CLASSIFIED BY VARIOUS TREATMENTS AND SEX ON ATTITUDES TOWARDS MATHEMATICS (N = 99)

Source of Variation	D.F.	Sum of Squares	Mean Squares	F ratio	Level of Significance
Treatment	1	125.46	125.46	1.62	$p > 0.05$
Sex	1	690.18	690.18	8.93	$p < 0.001$*
Treatment x Sex	1	0	0	0	$p > 0.05$
Within	95	7345.25	77.32		
Total	98	8143.96			

TABLE 9B: MEAN SCORES OF ATTITUDES TOWARDS MATHEMATICS

Treatment	Sex	No.	Pre-Treatment Mean Scores
I	—	48	45.96
C	—	51	43.71
—	M	44	47.75
—	F	55	42.44

Interactions	No.	Pre-Treatment Mean Scores
I x M	23	49.56
I x F	25	43.04
C x M	21	46.23
C x F	30	41.93

I — Individualistic Approach
C — Cooperative Approach
M — Male
F — Female

TABLE 10A: ANALYSIS OF VARIANCE OF THE SCORES OF PUPILS, CLASSIFIED BY VARIOUS TREATMENT AND SEX ON ATTITUDES TOWARDS ENGLISH (N = 93)

Source of Variation	D.F.	Sum of Squares	Mean Squares	F ratio	Level of Significance
Treatment	1	8.89	8.89	0.569	$p > 0.05$
Sex	1	15.78	15.78	0.45	$p > 0.05$
Treatment x Sex	1	40.06	40.06	0.229	$p > 0.05$
Within	89	2427.09	27.27		
Total	92	2491.81			

TABLE 10B: MEAN SCORES OF ATTITUDES TOWARDS MATHEMATICS

Treatment	Sex	No.	Pre-Treatment Mean Scores
I	—	44	40.73
C	—	49	40.35
—	M	43	44.81
—	F	50	45.64

Interactions	No.	Pre-Treatment Mean Scores
I x M	22	44.40
I x F	27	46.48
C x M	21	45.23
C x F	22	45.80

I — Individualistic Approach
C — Cooperative Approach
M — Male
F — Female

TABLE 11A: ANALYSIS OF VARIANCE OF THE SCORES OF PUPILS, CLASSIFIED BY VARIOUS TREATMENT AND SEX ON POST-TREATMENT ATTITUDES TOWARDS MATHEMATICS (N = 99)

Source of Variation	D.F.	Sum of Squares	Mean Squares	F ratio	Level of Significance
Treatment	1	10.16	10.16	0.13	$p > 0.05$
Sex	1	699.66	699.66	9.14	$p < 0.01$*
Treatment x Sex	1	46.28	46.28	0.60	$p > 0.05$
Within	95	7275.55	76.59		
Total	98	8031.66			

TABLE 11B: MEAN SCORES OF ATTITUDES TOWARDS MATHEMATICS

Treatment	Sex	No.	Post-Treatment Mean Scores
I	—	48	46.56
C	—	51	45.92
—	M	44	49.20
—	F	55	43.85

Interactions	No.	Pre-Treatment Mean Scores
I x M	23	50.13
I x F	25	43.28
C x M	21	48.19
C x F	30	44.53

I — Individualistic Approach
C — Cooperative Approach
M — Male
F — Female

TABLE 12A: ANALYSIS OF VARIANCE OF THE SCORES OF PUPILS, CLASSIFIED BY VARIOUS TREATMENTS AND SEX ON POST-TREATMENT ATTITUDES TOWARDS ENGLISH (N = 93)

Source of Variation	D.F.	Sum of Squares	Mean Squares	F ratio	Level of Significance
Treatment	1	1.83	1.83	0.05	$p > 0.05$
Sex	1	8.09	8.09	0.24	$p > 0.05$
Treatment x Sex	1	2.30	2.30	0.07	$p > 0.05$
Within	89	3060.29	34.39		
Total	92	3072.52			

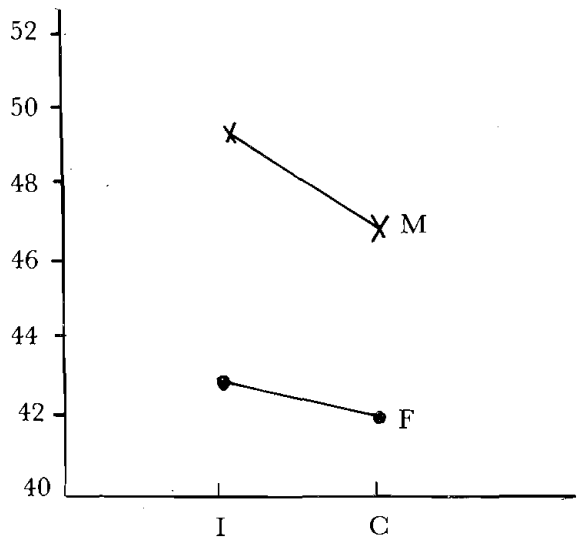
TABLE 12B: MEAN SCORES OF ATTITUDES TOWARDS ENGLISH

Treatment	Sex	No.	Post-Treatment Mean Scores
I	—	44	45.33
C	—	49	45.14
—	M	43	45.51
—	F	50	45.82

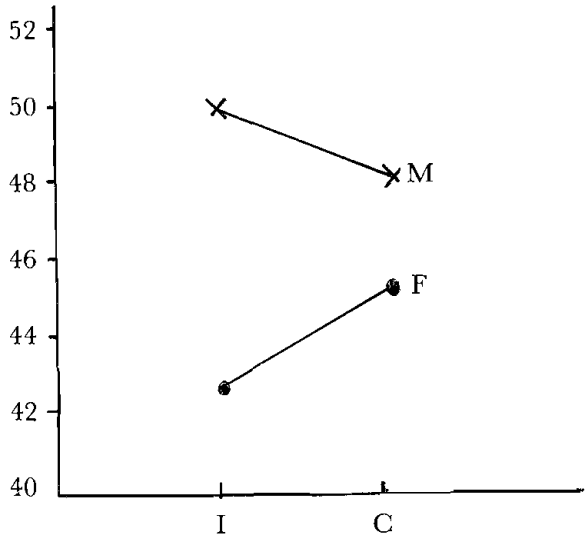
Interactions	No.	Pre-Treatment Mean Scores
I x M	22	45.50
I x F	27	45.80
C x M	21	45.52
C x F	22	44.95

I — Individualistic Approach
C — Cooperative Approach
M — Male
F — Female

FIGURE 3: GRAPHICAL REPRESENTATIONS OF DATA REPRESENTING THE INTERACTION AND MAIN EFFECTS OF THE MATHEMATICS GROUPS OF ATTITUDES MEAN SCORES

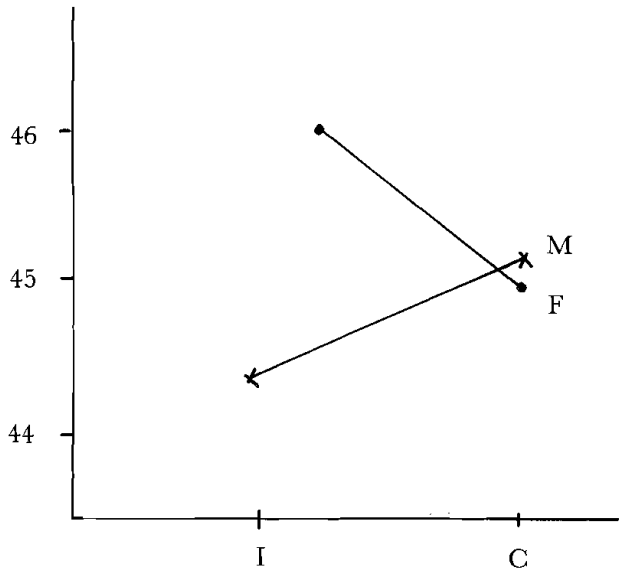


Mathematics Group
Pre-Treatment

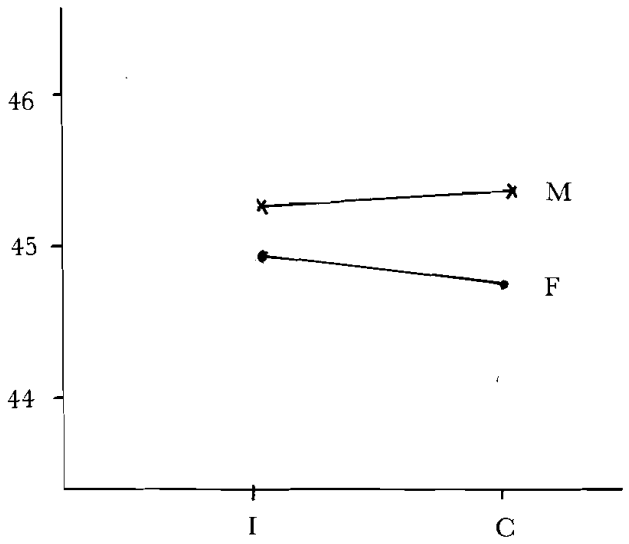


Mathematics Group
Post-Treatment

FIGURE 4: GRAPHICAL REPRESENTATIONS OF DATA REPRESENTING THE INTERACTION AND MAIN EFFECTS OF THE ENGLISH GROUPS OF ATTITUDES MEAN SCORES



English Group
Pre-Treatment



English Group
Post-Treatment

Results of T-tests

The pre-treatment and post-treatment attitude scores of the pupils who responded to the Mathematics and English attitude questionnaires were analysed using the t-tests to determine if there was any difference in the attitude change at the end of the VLC. The results are summarised in Tables 13 and 14.

Table 13 shows that, for the Mathematics group, the change of attitude was found to be significant for the female category ($p<0.05$), cooperative category ($p<0.01$) and the overall student category ($p<0.01$). The other categories (male, individualistic and other subgroups) were found to be not significant ($p>0.05$) with respect to their change of attitude after the treatment. This seems to suggest that the cooperative strategy in teaching could change the pupils' attitude in this short period of study although there is no indication in this study that their change of behaviour could sustain after the VLC. The female pupils seem to have improved in their attitudes after they have attended the VLC.

Examining the results from Table 14, it was found that there was no significant t ($p>0.05$) for the change in attitude in any of the categories, treatments, sex and interaction subgroups. This seems to suggest that the English group of pupils' attitudes were unchanged at their VLC participation.

CONCLUSION

The following paragraphs summarise the results from the analysis of the quantitative data of the achievement tests and attitude questionnaire.

Achievement Tests on Mathematics and English

(1) MATHEMATICS

(a) For mathematics, there were no significant differences in performances between the treatment groups and the sex groups. There was also no relationship between performance on the test

TABLE 13: A COMPARISON OF PRE- AND POST-MATHEMATICS ATTITUDE SCORES CLASSIFIED BY TREATMENT, SEX, OVERALL GROUP AND INTERACTION GROUP

Classification	N	$\bar{X}1$ (pre)	$\bar{X}2$ (post)	t	Level of Significance
All students	99	44.79	46.23	2.89	$p < 0.01$*
Male	44	47.75	49.20	1.75	$p > 0.05$
Female	55	42.44	43.85	2.34	$p < 0.05$*
Individualistic Group	48	45.96	46.56	0.88	$p > 0.05$
Cooperative Group	51	43.71	45.92	3.16	$p < 0.01$*
Individualistic x male	23	49.56	50.13	0.17	$p > 0.05$
Individualistic x female	25	43.04	43.28	0.1	$p > 0.05$
Cooperative x male	21	46.23	48.19	0.78	$p > 0.05$
Cooperative x female	30	41.93	44.53	1.12	$p > 0.05$

TABLE 14: A COMPARISON OF PRE- AND POST-ENGLISH ATTITUDE SCORES CLASSIFIED BY TREATMENT, SEX, OVERALL GROUP AND INTERACTION GROUP

Classification	N	$\bar{X}1$ (pre)	$\bar{X}2$ (post)	t	Level of Significance
All students	93	45.25	45.19	0.12	$p > 0.05$
Male	43	44.81	45.51	0.96	$p > 0.05$
Female	50	45.64	44.92	0.97	$p > 0.05$
Individualistic Group	49	45.55	45.32	0.27	$p > 0.05$
Cooperative Group	44	44.93	45.05	0.18	$p > 0.05$
Individualistic x male	22	44.4	45.5	0.53	$p > 0.05$
Individualistic x female	27	46.48	45.18	0.93	$p > 0.05$
Cooperative x male	21	45.23	45.52	0.2	$p > 0.05$
Cooperative x female	22	45.8	44.95	0.16	$p > 0.05$

and combination of treatment (co-operative and individualistic) and the sex (male and female) variables.

(b) Significant gains in performances were observed for the following groups/sub-groups: all students, male, female, individualistic, cooperative, individualistic x male and cooperative x female.

(c) It seems that for this particular sample, the individualistic approach was more effective for the male pupils whereas the cooperative approach was more effective for the female pupils.

(2) ENGLISH

(a) For English, there were also no significant differences in performances between the treatment groups and the sex groups. However, there was a relationship between performance in the test and the combination of treatment (cooperative and individualistic) and sex (male and female) variables. Analysis in depth shows that the main effect was due to the I x F subgroup.

(b) Significant gains in performances before and after the treatments were observed for the following groups/sub-groups: all students, male, female, individualistic, cooperative, individualistic x female and cooperative x male.

(c) It seems that for this particular sample the individualistic approach was more effective for the female pupils whereas the cooperative approach was more effective for the male pupils.

Attitude Scores in Mathematics and English

(1) MATHEMATICS

(a) There was no significant difference in the attitude change between the treatment groups (individualistic and co-operative) and the interaction groups (treatment by sex). However, the difference in attitude was significant between the male and female pupils. The male pupils were more positive towards Mathematics than the female pupils.

(b) The result which is in favour of the male pupils in their positive attitude towards Mathematics could not be due to the treatment alone as the same result was also shown before the implementation of the programme.

(c) Significant gains in attitude scores were observed for the following groups/sub-groups: overall students, cooperative group and the female group.

(d) The cooperative approach seems to be effective in changing pupils' behaviour and the female pupils seem to have improved in their attitude in learning Mathematics after they have attended the VLC.

(2) ENGLISH

(a) For English, there was no significant difference from the attitude difference of the main effects (treatment and sex) and the interactive group.

(b) Significant gains were not observed for the change in attitude in any of the categories, treatment, sex and interaction subjects.

The Matrix Tables below summarise the interaction groups which benefit most from the various interaction groups, male and female, individualistic and cooperative.

FIGURE 5: SUBGROUPS OF THE MATHEMATICS GROUP WHICH SHOW MORE EFFECTIVE RESULTS

Achievement

	Individualistic	Cooperative
Male	*	
Female		*

Attitude

	Individualistic	Cooperative
Male		
Female		*

FIGURE 6: SUBGROUPS OF THE ENGLISH GROUPS WHICH SHOW MORE EFFECTIVE RESULTS

Achievement

	Individualistic	Cooperative
Male		*
Female	*	

Attitude

	Individualistic	Cooperative
Male	*	
Female		

With respect to achievement Figures 5 and 6 show that the results obtained between the Mathematics and English groups seem to contradict each other.

In Mathematics the individualistic approach was more effective for the male group while the cooperative approach was more effective for the female group.

Similarly with respect to attitude, the results of the Mathematics group also contradicted the results obtained from the English group. In Mathematics, the female x cooperative group seems to gain most whereas the male individualistic category of the English group seems to have more positive attitude.

There are two possibilities to explain the contradictory results. The approach, although named as individualistic and cooperative to both groups, used by the English group could be slightly different from the Mathematics group as the nature of the subject (English) is quite different from Mathematics. Hence this inconsistency could lead to different results. Secondly, the experiment was only carried out using a small sample. The selection of the sample was beyond the control of the VLC Steering Committee because the site of the school, and hence the 'feeder' schools where the pupils were from, was selected for convenience.

RECOMMENDATIONS

The present study raised some questions which may be resolved by further research.

(1) Systematic study with a larger student population to confirm the effectiveness of these two approaches to teaching, viz. cooperative and individualistic approaches, in Mathematics and English and other subject areas. As the results in this study are apparently very encouraging, any future study should incorporate ways to control the other variables which might affect the external validity of the study.

(2) The implementation of the two teaching approaches should not be constrained by the demands of any Department in the Institute of Education, for example, student teachers who prepared the English teaching materials had to conform to the (CS01) Curriculum Studies Options assignment criteria. These teaching materials were more oriented to the course assignments than the specific requirements in the VLC.

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