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ABSTRACT

The purpose of this study was to compare the effects of assigning students to a version of an instructional program (cooperative learning version or individual version) that either matched or did not match their pre-assessed preferences for cooperative and individual learning. Students' preferences for cooperative and individual learning were assessed by survey two weeks prior to instruction. Subjects were 135 students enrolled in an urban southwestern high school. Data from 104 students was used in the analyses. All students were given instruction on how to work cooperatively, and directions to facilitate cooperative learning were incorporated into the cooperative learning version of the instructional program. Results indicate that a preference for group work did not predict better performance under group work. Rather, the data on interactions and off-task behaviors suggest that it is a predictor of desire to interact with others or sociability. Analysis of time spent in the program also seems to support the idea that the preference for group work measure was more a predictor of sociability than performance. The results raise the possibility that students' sociability may influence the effectiveness and efficiency of cooperative learning as an instructional treatment for them. Four tables show results. (Contains 18 references.) (AEF)

Title:

The Effects Of Matching Learner Preference For Instructional Method On Achievement And Attitude

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Background

Cooperative learning has been heavily investigated as an instructional method in the last few decades. Johnson and Johnson (1991) claim that when students learn cooperatively, they learn more, like school and each other more, have higher self-esteem, and have improved social skills. Slavin (1983) reported that cooperative learning has a positive effect on student self-esteem, liking of classes and classmates, time-on-task, cooperativeness and many other variables. Other researchers (Crooks, Klein, Jones, & Dwyer, 1994; Klein, Erchul, & Pridemore, 1994; Klein & Pridemore, 1992; Snyder & Sullivan, 1995) have found less success with cooperative learning in promoting greater student achievement and better attitudes.

Many advocates of cooperative learning point to benefits other than instructional effectiveness per se as being sufficient reason to use cooperative methods. Several researchers have found students who work cooperatively had better attitudes toward their group members and group work (Mevarech, Stern, & Levita, 1987), liked working with computers more (Johnson, Johnson, & Stanne, 1986), had higher goal orientation (Johnson, Johnson, & Stanne, 1985), were more satisfied with the instruction, and had higher continuing motivation (Klein & Pridemore, 1992) . Others (Klein, et al., 1994; Crooks, et al., 1994) have found that students have higher continuing motivation for computer-based instruction when working alone or that there were no differences in attitudes between students working cooperatively or individually (Mevarech, Silber, & Fine, 1991; Dalton, Hannafin, & Hooper, 1989). The mixed results from cooperative learning studies indicate that there is still much to be learned about cooperative learning.

Several researchers have suggested that personal characteristics and preferences of the learners may be an important factor in determining the effectiveness of cooperative learning. Chan (1981) and Klein and Pridemore (1992) have studied the relationship of need for affiliation to performance and attitudes under cooperative learning. Slavin (1983) indicated that a predisposition to cooperate may influence the occurrence of cooperative behaviors.

One approach that could conceivably influence the effects of cooperative learning is to match students' assessed preferences for cooperative and individual learning with the type of program they receive, either cooperative or individual. Freitag and Sullivan (1995) found that matching learners to their preferred amount of instruction increased achievement and produced more confidence and satisfaction with the instruction. Shute and Gluck (1995) reported that students who exhibited high exploratory behavior in an instructional program performed better in an inductive type program that matched their learning style, whereas those who exhibited low exploratory behavior performed better in a rule-based program that matched their learning style. It seems likely that matching students preferences for cooperative and individual learning with the type of program they receive could also maximize their potential performance.

The purpose of this study was to compare the effects of assigning students to a version of an instructional program (cooperative learning version or individual version) that either matched or did not match their pre-assessed preferences for cooperative and individual learning. Students' preferences for cooperative and individual learning were assessed two weeks prior to the instruction using a Learning Preference Survey created for this study. The study permitted investigation of the following research questions.

1. Do students achieve more when their preference for group work is matched with their instructional treatment than those who receive a contrasting treatment?
2. Does cooperative or individual learning yield higher achievement scores and better attitudes?
3. Does matching or not matching student preference for group work affect interaction patterns within cooperative dyads?

Method

Subjects were 135 students enrolled in an urban southwestern high school. Data from 104 students were used in the analyses. Scores from 31 subjects were discarded due to absences during the experiment. Subjects were blocked by preference for group work and then randomly assigned to an instructional method (cooperative or individual) which either matched their preference (matched) or did not match their preference (unmatched). Achievement was measured by a 36-item posttest referenced to the instructional objectives of the instructional program, and attitude was measured by a 12-item survey that assesses liking of the program, liking of cooperative learning, effort, and continuing motivation. En-route behaviors were tracked by the computer, and student interactions recorded by trained observers.

All students were given instruction on how to work cooperatively and directions to facilitate cooperative learning were incorporated into the cooperative learning version of the instructional program. Each student was also given a Learning Preference Survey to determine their preference for group work. A median split was used to classify students as having a high or low preference. Students were then assigned to an instructional method (cooperative or

individual) which either matched (matched) or did not match (unmatched) their preference in a 2 x 2 (matching condition x instructional method) posttest only experimental design.

Students spent approximately three 50-minute class periods working either individually or in pairs to complete a CAI lesson about basic geometry concepts such as lines, rays, angle, and polygons. Each lesson contained information, examples, exercises, review, and practice problems. After completing the CAI lesson, each student completed the posttest and the attitude survey individually.

A Pearson product-moment correlation coefficient was calculated to determine whether a significant relationship existed between preference for group work and student ability as measured by IOWA test scores for Reading. The Pearson correlation coefficient of -0.16, $p<.16$, revealed a non-significant relationship. Therefore, it was not deemed necessary to adjust posttest scores for difference in ability between students with a high preference for group work and students with a low preference for group work.

The posttest data were analyzed using an analysis of variance (ANOVA). A multivariate analysis of variance (MANOVA) was used to analyze the student attitude data, followed by univariate analyses for each question on the attitude survey. Time in program was recorded and analyzed using analysis of variance (ANOVA). Learning efficiency ratios were computed by dividing the each student's posttest score by the student's time in-program and were analyzed using analysis of variance (ANOVA). Differences in student in-program behaviors were analyzed using chi-square. All analyses were conducted at an alpha level of .05.

Results

The mean scores and standard deviations for achievement by preference and matching condition are shown in Table 1. Students in the unmatched conditions ($M = 21.77$) had higher significantly achievement scores than students in the matched conditions ($M = 19.15$), $F(1,100) = 5.04$, $p < .05$. The mean achievement score for students with a high preference for group work ($M = 20.50$) was only slightly higher than for students with a low preference ($M = 20.42$), a non-significant difference. The preference by matching condition interaction also was not significant. The overall mean achievement score was 20.46 or 57 percent.

The matching condition variable yielded an effect opposite to the predicted one -- that is, unmatched subjects scored significantly higher than matched ones, thus indicating that matching subjects to their preferred condition does not produce a positive achievement effect. Therefore, the decision was made to perform a second 2 x 2 analysis of variance for achievement using learner preference and the actual experimental treatments of cooperative and individual learning received by the subjects, rather than the experimenter-derived matched and unmatched conditions. Given the lack of positive predictive value of the matching variable, it was felt that analysis using the actual treatment conditions of cooperative and individual learning would be more useful for understanding and explaining the results than those using matching condition.

The preference (high, low) by program type (cooperative, individual) data are reported in Table 2. This analysis resulted in re-arrangement of the mean scores from two cells in Table 1 and, consequently, different ANOVA results. Subjects under cooperative learning had a mean score of 21.46, and those under individual learning had a mean of 19.46, a non-significant difference, $F(1,100) = 2.96$, $p < .09$. The mean scores for high-preference subjects ($M = 20.50$) and low-preference subjects ($M = 20.42$) remained the same as in the initial ANOVA, of course, and did not differ significantly from one another. However, the preference by program type interaction was statistically significant, $F(1,100) = 5.04$, $p < .05$.

The significant preference by program type interaction reflected the fact that students with a low preference for group work scored higher ($M = 22.73$) when they worked cooperatively than when they worked individually ($M = 18.11$), whereas students with a high preference for group work scored slightly lower when working cooperatively ($M = 20.19$) than when working individually ($M = 20.81$). Tukey's post hoc method for pairwise comparisons revealed that the achievement score of 22.73 for the students in the low preference-cooperative condition was significantly higher than the achievement score of 18.11 for the students in the low preference-individual condition at the .05 level. All other pairwise comparisons were not significant.

Table 3 shows the mean times in program by preference and program. Students with a high preference for group work averaged 101.45 minutes to complete the program, and those with a low preference for group work averaged 80.35 minutes, a significant difference, $F(1,58) = 9.63$, $p < .01$. Students in the cooperative dyads averaged 84.06 minutes in the program, and students working alone averaged 95.94 minutes, a nonsignificant difference.

The groups with higher, though not significantly higher, posttest scores for each variable (low-preference over high-preference, cooperative over individual) also spent less time in the program than their counterparts. Therefore,

learning efficiency ratios (LERs) were computed for each student and group to determine whether there were significant between-group differences in learning efficiency -- i.e., the amount learned, as measured by posttest scores, per unit of time. Each student's LER was calculated by dividing his or her posttest score by his or her time in program. For example, a student with a posttest score of 20 and a time in program of 80 minutes would have a learning efficiency ratio of .25 (20 ÷ 80). Table 4 shows the mean learning efficiency ratios by preference and program type.

The learning efficiency ratio data in Tables 4 reveal that students with a low preference for group work (LER $\underline{M}$ = .30) had significantly higher LERs than students with a high preference for group work (LER $\underline{M}$ = .22), $\underline{F}(1,79)$ = 7.81, $\underline{p} < .01$. Students in the cooperative treatment (LER $\underline{M}$ = .29) had significantly higher LERs than those in the individual treatment (LER $\underline{M}$ = .22), $\underline{F}(1,79) = 7.83$, $\underline{p} < .01$. The preference by program type interaction for learning efficiency ratios was not statistically significant.

The responses to a 12-item attitude questionnaire administered at the end of the program were scored on a four point scale from 1 (strongly agree) to 4 (strongly disagree). MANOVA revealed a significant difference for program type, $\underline{F}(12,83) = 4.23$, $\underline{p} < .001$, but not for preference or the preference by program type interaction. Therefore, item-by-item univariate analyses were performed only for program type. The univariate analyses for program type revealed significant differences for three statements. Students working alone agreed significantly more strongly than students working cooperatively with the statement "I would like to learn more about geometry", $\underline{F}(1,94) = 7.63$, $\underline{p} < .01$. Students who worked cooperatively agreed more strongly with the statement "I would like to learn new math concepts with a group", $\underline{F}(1,94) = 7.46$, $\underline{p} < .01$, than students who worked individually agreed with the statement "I like to learn new math concepts by myself". Similarly, students who worked cooperatively agreed more strongly with the statement "I liked working in groups", $\underline{F}(1,94) = 18.31$, $\underline{p} < .001$, than the students who worked individually agreed with the statement "I liked working alone".

Chi-square was used to analyze number of observer-recorded cooperative interactions for differences between groups. The high-preference cooperative dyads had more instances of each of the four cooperative behaviors and of off-task behaviors than the low-preference pairs. These differences were significant for "asks questions" (99 instances for high-preference subjects and 69 for low-preference subjects), "discussion of lesson content" (203 instances for high-preference and 150 for low-preference), and "shares mouse or keyboard" (17 instances for high-preference and 2 for low-preference), and for off-task behaviors (220 for high-preference subjects and 94 for low-preference subjects).

Discussion

The present study examined the effect of matching student preference for group work with the instructional treatment that students received. Students with a high preference for group work were assigned to work either cooperatively (matched) or individually (unmatched), and conversely, students with a low preference for group work were assigned similarly (cooperatively = unmatched and individually = matched).

It was expected that students whose preferences for group work were matched, rather than unmatched, with instructional treatment would score higher on the posttest. In fact, when students were assigned to an instructional treatment which did not match their preference, they did better. Thus, a preference for group work did not predict better performance under group work. Rather, the data on interactions and off-task behaviors suggest that it is a predictor of desire to interact with others or sociability. Students with a high preference for group work who worked cooperatively exhibited significantly more off-task behaviors, such as talking to their partner or members of other groups about topics unrelated to the computer program, than those with a low preference for group work who worked cooperatively.

The analysis of the time spent in the program also seems to support the idea that the preference for group work measure was more a predictor of sociability than of performance. Students with a low preference for group work, in fact, spent less time in the program than their high-preference counterparts with no significant difference in performance. The smaller amount of time spent completing the program and the fewer number of off-task behaviors for the low-preference groups may indicate a learning approach that is more effective because it is more focused on the learning content and less subject to interference factors resulting from the off-task behaviors.

There is also considerable evidence that students may often prefer an instructional method that does not yield greater achievement. Peterson and Janicki (1979) found that elementary students who expressed a preference for small-group or large-group work had higher retention scores when they received the instructional method that was opposite their preference. Shute and Gluck (1995) found that if students had been assigned to treatments by their stated preference for exploratory behavior, no significant difference in achievement would have occurred between those who were matched to their preference and those who were not. Similarly, Hannafin (1994) found that students who indicated a preference for a lean instructional program had better achievement scores when they were not matched to their preference.

There is a common belief in educational technology, as well as in other areas of education, that students are good judges of the ways they will learn best. This belief was an important factor in the design of the present study. In retrospect, however, it is important to examine why this may not be the case. Students may not be able to readily identify methods which will increase their achievement on school tasks or they may not care much about relatively minor improvements in achievement. Their preferences may be stronger for methods which they think will require less work, be more fun, allow for more social interaction, or give them more freedom of choice.

Although the cooperative students had higher posttest scores, they did not differ significantly from the scores of the students who worked alone. Several factors may account for the fact that cooperative learning did not have a stronger effect. A number of recent studies have shown that cooperative learning may not be as powerful an instructional method as previously thought. Snyder and Sullivan (1995) and Klein et al. (1994) found that students learning alone outscored students who worked cooperatively. Crooks, et al. (1994), Crooks (1995), and Doran (1994) did not find significant differences in achievement between students who worked cooperatively and those who worked alone. With the exception of Snyder and Sullivan (1995), all of the above research was conducted with college students. It may be that older students do not benefit from cooperative learning as much as younger ones. Most of the research which has shown achievement differences in favor of cooperative learning (Johnson et al., 1985, 1986; Slavin, 1983) has been conducted with younger students.

Cooperative learning advocates often attribute the lack of a significant difference favoring cooperative learning to the students not being sufficiently accustomed to working together to benefit from the cooperative learning situation and/or the fact that cooperative learning conditions do not include Johnson and Johnson's (1991) five key elements. These elements are positive interdependence, face-to-face interaction, individual accountability and personal responsibility, interpersonal and small group skills, and group processing. While these explanations may often be true, it also is often true that learners do not have good skills for studying individually and that the best conditions for learning often are not incorporated into individual learning treatments. In the present study positive interdependence, individual accountability and personal responsibility were intended to be fostered by having students take the test individually and receive extra points on the test if the average of the test scores of the partners was above a certain level. The incentive of a good test grade may have not been a sufficient motivator to encourage the students to work together. Most students seemed more inclined just to get through the program than to learn the material well.

The present results raise the possibility that students' "sociability" may influence the effectiveness and efficiency of cooperative learning as an instructional treatment for them. Research that investigates the relationship between a measure of sociability and achievement under cooperative learning could indicate the extent to which sociability impairs or facilitates student learning in cooperative groups and may have implications for group composition in cooperative learning situations. Research of this type may help us better understand the conditions under which cooperative learning is most effective in the schools.

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Table 1

Mean Posttest Scores by Preference and Matching Condition

	Preference		
Matching Condition	High	Low	Totals
Matched	20.19	18.11	19.15
	(6.40)	(5.90)	(6.18)
Unmatched	20.81	22.73	21.77
	(5.96)	(5.45)	(5.74)
Totals	20.50	20.42	20.46
	(6.13)	(6.09)	(6.08)

Table 2

Mean Posttest Scores by Preference and Program Type

	Preference		
Program Type	High	Low	Totals
Cooperative	20.19	22.73	21.46
	(6.40)	(5.45)	(6.02)
Individual	20.81	18.11	19.46
	(5.96)	(5.90)	(6.03)
Totals	20.50	20.42	20.46
	(6.13)	(6.09)	(6.08)

Table 3

Mean Total Time in Minutes by Preference and Program Type

	Preference		
Program Type	High	Low	Totals
Cooperative	98.27	68.43	84.06
	(33.57)	(18.67)	(30.88)
Individual	102.96	86.98	95.94
	(24.46)	(30.73)	(28.19)
Totals	101.45	80.35	91.92
	(27.30)	(28.16)	(29.43)

Table 4

Mean Learning Efficiency Ratio by Preference and Program Type

Program Type	Preference		Totals
	High	Low	
Cooperative	0.24	0.35	0.29
	(0.14)	(0.12)	(0.15)
Individual	0.21	0.24	0.22
	(0.08)	(0.11)	(0.09)
Totals	0.22	0.30	0.26
	(0.11)	(0.13)	(0.13)