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ABSTRACT

The effects of a form of cooperative group instruction called Team Assisted Individualization on students in a high school Algebra II class were examined. Sixty-two (31 female and 31 male) 11th-grade students were randomly assigned to either a cooperative learning (32 students) or traditional lecture (30 students) group. Students completed an instrument that assessed efficacy, intrinsic valuing, and goal orientation on 3 occasions: at the beginning of the school term, after the first 18 weeks of the project, and at the end of the school term. Algebra achievement was assessed at the same times using teacher-made examinations. Students in the cooperative classroom exhibited significantly higher gains than did the control group in algebra achievement, efficacy, intrinsic valuing of algebra, and learning goal orientation. Surprisingly, the achievement and motivational gains were completely reversed when the cooperative class was switched to traditional instruction for the last 18 weeks of the project. The implications of these findings for motivational theory and cooperative group structures are discussed. Four tables present study data. (Author/SLD)

Cooperative Learning and Student Motivation

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Abstract

We examined the effects of cooperative group learning on students in Algebra II. Sixty-two students were randomly assigned to either a cooperative learning or traditional lecture group. Students completed an instrument which assessed efficacy, intrinsic valuing, and goal orientation on three occasions: at the beginning of the school term, after the first 18 weeks of the project, and at the end of the school term. Algebra achievement was assessed at the same times using teacher-made exams. Students in the cooperative classroom exhibited significantly higher gains then the control group in algebra achievement, efficacy, intrinsic valuing of algebra and learning goal orientation. Surprisingly, the achievement and motivational gains were completely reversed when the cooperative class was switch to traditional instruction for the last 18 weeks of the project. The implications of these findings for motivational theory and cooperative group structures are discussed.

Cooperative Learning and Student Motivation

Cooperative group learning has been shown to be effective in increasing academic achievement when used properly (Johnson & Johnson, 1989; Slavin, 1990). However, the mechanisms by which these achievement gains occur are as yet unclear. The purpose of the present study was to examine the impact of one type of cooperative group environment on several motivational variables which might underlie the achievement gains noted in previous research.

Slavin (1984) has argued that one factor influencing the success of cooperative learning group environments is the positive motivational impact of peer support for learning. Slavin's Team-Assisted Individualization Program (TAI) began as an attempt to improve individualized instruction. It provides small groups of four to five students the opportunity to work jointly to accomplish learning objectives. When peers recognize that their rewards are dependent on the success of their teammates, they are more likely to provide emotional and tutorial support for learning. Such support for learning is not typical of traditional classrooms.

We hypothesized that peer support for learning could alter the goal orientations (Dweck & Leggett, 1988; Nicholls, 1989) of students. The peer support for learning found in cooperative groups may direct students toward improving their knowledge or skills (learning goals) rather than finding ways to

look capable to others or finding ways to avoid looking incapable (performance goals). Students who adopt learning goals accept challenging tasks and expend effort in the face of task difficulty, while students with performance goals avoid challenge and are less persistent when difficulties are encountered (Elliot & Dweck,1988). Such behavior may account for the achievement benefits associated with cooperative learning.

Ames (1984) has found that students' self-perceptions of ability (i.e., self-efficacy) increase following group success in cooperative learning activities. This was true even for group members who performed at low levels by objective standards. Based on this research, we expect students in cooperative learning groups to have higher levels of self-efficacy regarding the achievement task they face than students in traditional classes dealing with the same content. Bandura (1986) argues that the amount of effort an individual invests in an activity and the level of persistence at difficult tasks are also linked to efficacy. The greater our self-efficacy the greater our effort and persistence should be; two factors which can lead to improved achievement.

In addition to the impact that learning goals and self-efficacy can have on achievement, there is empirical evidence indicating that both are related to students' intrinsic valuing of the subject matter they are studying. Several studies (Ames & Archer,1988; Meece, Blumenfeld & Hoyle, 1988; Miller, Behrens, Greene & Newman, 1993) have indicated a positive relationship

between students' learning goal scores and their intrinsic valuing of the subject matter they are studying, while their performance goal scores were not. Additionally, several studies have found a positive relationship between students' self-efficacy scores and their perceptions of the intrinsic value of the task (Meece, et al., 1988; Miller, et al., 1993; Pintrich & DeGroot, 1990; Pokay & Blumenfeld, 1990). If cooperative learning activities have the effect on goal orientation and self-efficacy that we propose, then we would expect students in the cooperative groups to also display greater intrinsic valuing of the subject matter.

In the present study we examined the effects of a form of cooperative group instruction, Team Assisted Individualization (TAI), on motivation and achievement in a high school Algebra II class. We used a self-report questionnaire to assess changes in student's self-efficacy, goal orientation, and their intrinsic and extrinsic valuing of algebra over the course of one academic year in both a TAI and traditional (lecture format) classroom. We used a teacher-made test to determine algebra achievement.

We hypothesized that students in the cooperative learning condition would: (a) be more learning goal oriented; (b) have more positive self-efficacy beliefs regarding algebra II performance; (c) display greater intrinsic valuing of algebra II; and (d) display higher levels of algebra II achievement.

Method

Subjects. The subjects were 31 female and 31 male eleventh and twelfth grade students from a middle class high school in the Midwest. All students had completed Algebra I and Geometry prior to enrollment in an Algebra II course. Students were randomly enrolled in the control (15 males, 15 females) or experimental group (16 males,16 females) from a pool of approximately 390 Algebra II students. At the time of enrollment, counselors and students had no knowledge that some classes would be lecture format classes (control group) while others would be cooperative group format (experimental group). The school population was 92% Caucasian with students of various ethnic backgrounds accounting for the remainder of the student body. The control group included two Black females and three Hispanic males while the experimental group contained one Black female, one Hispanic male student and two males from Native American backgrounds. All subjects had been in the current school system for several years and had experienced similar mathematics instruction.

Treatments. Subjects were randomly assigned to either a cooperative learning or a traditional Algebra II class during a standard pre-enrollment period for the fall term. Team Assisted Individualization (TAI) was selected as the method of instruction from among several cooperative learning strategies (Slavin, Leavey, & Madden,1986). TAI consists of assigning four to five

students to heterogeneous groups to accomplish learning objectives provided by the instructor. Achievement in previous Algebra I classes was used to assign students to these groups. Each group consisted of a low achievement student (grade of D), a low-medium achievement student (grade of C), a high-medium achievement student (grade of B) and a high achievement student (grade of A).

The first author was the teacher in both the traditional and cooperative learning classrooms. He had been teaching algebra II at this school for 14 years. The traditional lecture materials and methods had been developed and used by the teacher over several years. The TAI methods and materials were adapted by the researchers from the traditional materials used previously.

Students placed in the cooperative group environment received brief whole class instruction from the teacher at the beginning of each class period. After this initial engagement, students moved to their respective groups and worked on individualized assignments, receiving tutoring from their fellow group members. The instructor made an effort to move about the room offering assistance to individual groups when necessary. The goal of both styles of instruction was to have the students gain an equal balance of conceptual and computational understanding of Algebra II. A standard curriculum was followed with the cooperative group students covering the same amount of material as the lecture group. Cooperative group students were allowed to work at an individual pace on assignments and could take tests whenever they

had completed prerequisite assignments. Students in cooperative groups were also allowed to retest on a parallel form of the test if they were not satisfied with their initial score. The control group students did not have the opportunity to retest.

Students in cooperative groups worked on individual assignments and received individual grades, however, the individual performances of team members' were combined at the end of each week for a team score. Team recognition was determined by the individual team members improvement from the previous week (rather than total achievement). The team with the best score was acknowledged at the beginning of each week. Subjects in the traditional lecture class received more in depth instruction from the teacher over the same material and worked independently on assignments rather than in teams. Both classes used the same text as a resource, however, the lecture class was not allowed to move at an independent pace. Instead all students completed assignments and took tests at the same time.

Because the cooperative learning treatment was an experimental program, the school district recommended that the cooperative learning intervention last only 18 weeks (the first semester). At the beginning of the next semester the cooperative learning condition was ended and both classes received traditional lecture-style instruction. We felt this 18 week intervention was sufficient to produce the anticipated motivational effects. Additionally, the

return of the treatment group to traditional instruction during the second semester enabled us to test for generalization of any effects produced by cooperative learning.

Instrument. A 31-item questionnaire was used to assess various aspects of student motivation. The items on the questionnaire were based on the Attitude Towards Statistics questionnaire developed by Miller (Miller,et al.,1993). The items were reworded to reflect algebra II rather than statistics. The items were Likert-type questions using a five-point scale with "strongly agree" and "strongly disagree" at the extremes. The questionnaire contained the following subscales: learning and performance goal orientation toward the algebra II class (eight items, four for each subscale); self-efficacy regarding computation and understanding of algebra II problems (10 items); intrinsic (five items) and extrinsic (four items) valuing of algebra II; and sense of ownership for performance in the class (four items). The ownership scale was not used in this study.

Mathematical achievement was measured using both standardized and teacher-made tests. The Elementary Algebra Diagnostic Test (EADT) from the California State University Mathematics Diagnostic Teating Project served as the standardized measure of entering algebra achievement. The EADT, a 50 question multiple choice test, was administered during the first week of school. Students had one hour to complete the test which included problems of the type

that are normally included in a standard algebra curriculum (e.g., solve $3x+4=2(x-5)$).

In addition, two teacher-made tests were also administered. The first was a 40 question multiple choice test with items derived specifically from the objectives students had been working on in both the treatment (TAI) and control groups. This was administered at the end of the first 18 week grading period. The students' scores were part of their semester grade. The second teacher-made test was similar in nature. There were 40 items covering the objectives of instruction and students' scores were part of the semester grade. The test was administered following the second 18 week grading period. At each testing period, students had one hour to complete the exam.

Procedure. Students and their parents were informed at the beginning of the year that participation was voluntary and that student responses would be confidential. The students completed the motivation survey on the same day at the end of August during the first week of school, and again in December after the first 18 week grading term. The Algebra Diagnostic Test was also administered during the first week of school. Students took the teacher-made comprehensive final exam in December. At the beginning of the new semester in January, the cooperative group instruction for the experimental group was replaced with the traditional lecture format instruction congruent with the control group. Both groups received similar lecture style instruction until May

when all subjects completed the motivation survey again and also took the teacher-made final exams at the end of the second semester.

Results

Reliability Analysis. The items on the questionnaire which were intended to measure the psychological constructs of goal orientation for the algebra class, intrinsic and extrinsic valuing of algebra, and sense of self-efficacy regarding performance were analyzed to determine subscale reliabilities. Coefficient alpha was used for this purpose. All of the reliabilities were reasonably high except the performance goal subscale. The performance goal subscale's reliability was the only subscale to show a lower reliability, ranging from r=.32 on the posttest to r=.50 on the pretest. Reliabilities of the other subscales on the pretest questionnaire ranged from r=.70 to r=.82. Reliabilities on the posttest questionnaire ranged from r=.83 to r=.90 while the reliabilities for the post-post questionnaire ranged from r=.81 to r=.88. The Kuder-Richardson, formula 20, was used to determine the reliabilities for the two teacher-made semester tests. Reliabilities for the first semester and second semester teacher-made tests were .73 and .80 respectively.

Data Analysis. The means and standard deviations are reported in table 1. Next we will report the correlations among variables as a check on some fundamental predictions from the theories on which the instrument was based. Finally we will report the effects of the treatment on student goal orientation,

valuing, efficacy and achievement.

Insert table 1 about here

Correlational Analysis. Correlations among the variables on the Attitude Toward Algebra II questionnaire are reported in Tables 2, 3, and 4. The consistency of these correlations with theoretical predictions and previous empirical findings provide support for the construct validity of the subscales. Most noteworthy are the significant correlations between learning goal scores and intrinsic valuing scores (.64 and .48 on the pre and posttest measures respectively), the correlation between learning goal and performance goal scores (.21 on the pretest, which was not significant, and -.34 on the posttest), the nonsignificant correlations between performance goal scores and intrinsic valuing (.12 and -.14 on the pre-and posttests respectively), and the positive correlation between self-efficacy scores and intrinsic valuing (.67 on the posttest).

Insert tables 2, 3, and 4 about here

Treatment Effects. Using the corresponding pretest measure of each dependent variable as a covariate, ANCOVA revealed that students in the

cooperative group setting for the first 18 weeks of the study had a significant ($p<.01$) increase in learning goals $F(1,59)=20.18$, $MSE=.308$, intrinsic motivation $F(1,59)=17.92$, $MSE=.233$, and efficacy $F(1,59)=13.61$, $MSE=.063$. No significant differences between groups were found for performance goals or extrinsic valuing of algebra II.

Using the diagnostic algebra test (EADT) as a covariate, ANCOVA showed that cooperative group students had significantly ($p<.05$) higher achievement scores compared to lecture format students on the teacher made semester final $F(1,59)=5.60$, $MSE=150.50$.

Students' scores on the second semester teacher made semester test were analyzed to determine if placing cooperative (treatment) group students into a lecture format class would have any significant effect on the variables of interest. First semester scores on the dependent measures were used as a covariate. ANCOVA revealed a significant ($p<.05$) effect in that cooperative group students placed into a lecture format class showed significantly lower learning goals $F(1,59)=71.36$, $MSE=.27$ efficacy $F(1,59)=38.53$, $MSE=.127$ and intrinsic motivation to learn $F(1,59)=51.73$, $MSE=168.02$ than the control group. Former cooperative groups also performed significantly lower than the lecture format students on the second semester final $F(59,1)=8.53$ when controlling for first semester achievement.

Discussion

The results of this initial investigation into the motivational factors influencing achievement in cooperative learning groups provide support for each of the hypotheses outlined earlier. First, the use of cooperative learning (Team Assisted Individualization) resulted in higher algebra II achievement than the traditional lecture method. This finding is consistent with the work of Slavin and his colleagues (Slavin, Leavey, & Madden,1984; Slavin, Madden & Leavey, 1984) who also found achievement gains in mathematics with younger age groups. Second, students in the cooperative learning class were more learning goal oriented, and expressed greater intrinsic valuing of algebra II than students in the traditional lecture class. These results are consistent with our hypotheses that the team support for learning found in cooperative groups fostered greater orientation toward learning goals, and that increased learning goal orientations would lead to increased intrinsic valuing of algebra II. Finally, students in the cooperative learning class had higher levels of self-efficacy regarding algebra II than students in the traditional class, which is consistent with Ames' (1984) hypothesis that cooperative learning fosters improved self-efficacy.

While we view these results as encouraging, we recognize that they are tentative. Two important design limitations in this study warrant cautious interpretation of the results. First, both the cooperative learning and traditional

classes were taught by the same instructor, one of the researchers. While the instruction in the traditional class had been used successfully by the teacher in the past, it is conceivable that experimenter bias may have influenced the results (e.g., Rosenthal & Fode,1963). To test any obvious effects of such bias we compared the first semester achievement scores of the traditional class in our study to the scores of students in previous years classes who received traditional instruction and took the same final. A t-test revealed that the two groups did not differ significantly in their performances (the means were 70.2 for the control group subjects and 73.9 for the previous years students). While this finding reduces the plausibility of the bias explanation, it does not rule it out. Additional research, using more classrooms and teachers will be needed to verify our results.

Another design consideration which will need to be addressed in future research is the availability of "retesting" in the cooperative group class but not the traditional class. The option of being able to retake an exam undoubtedly is one element of instruction that would support adoption of learning goals. Because this option was available only to students in the cooperative learning condition, the retesting variable may have been the causative factor in changes seen in students in the cooperative condition, not the cooperative nature of student interactions in the class. A total of 12 quizzes were administered in the TAI class throughout the first 18 weeks of the project. Fifty-four retests were

given with 5 being the maximum number of retakes by a single student. Fifteen students in the TAI class (n=32) did not retest at all or only retested a single time during the study. While it seems unlikely to us that the limited retesting alone would be the cause of the observed differences in our study, systematic manipulation of the retesting variable seems to be in order.

Viewed as a whole, we belive this study provides important evidence regarding the possible motivational mechanisms underlying the success of certain types of cooperative groups. Our study employed a variation of Slavin's (1986) Team Assisted Individualization, a cooperative group structure which includes individual accountability and group reward. While we suspect our results would generalize to other cooperative group structures which included group rewards and individual accountability (e.g., STAD or TGT), they may not generalize to cooperative groups using other structures (i.e., no group reward or no individual accountability). Further research is needed to determine which aspects of cooperative learning environments contribute to the motivational effects we uncovered.

A surprising finding for us was the complete reversal of achievement and motivation when the cooperative group students were switched to the traditional lecture format. While we anticipated that the change would cause some reaction among the students we did not expect the extreme reaction found. Unsystematic anecdotal accounts of the students are consistent with

empirical data we collected. The students were quite unhappy with the change in class proceedings, most wishing to stay with the cooperative learning format. Their displeasure with the change is evident in their achievement and their scores on the motivation questionnaire. We would recommend that future research not employ this switch in methods, if anything, the switch should occur from traditional to cooperative learning.

In summary, we believe our results provide support for the hypotheses claiming that the peer support for learning found in cooperative groups like TAI leads students to adopt learning goal orientations, and that working in cooperative groups leads to higher levels of self-efficacy. Additional research needs to be conducted which avoids possible experimenter bias, systematically investigates the impact of the option of retesting on student motivation and searches for these motivational effects with other cooperative group structures.

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Table 1

Motivation subscale and achievement means and standard deviations for treatment and control groups

Pretest Variables	Treatment		Control	
	M	SD	M	SD
Learning Goal	2.23	.70	2.12	.60
Intrinsic Motivation	3.06	.49	2.95	.49
Performance Goal	2.94	.71	2.34	.59
Extrinsic Motivation	3.12	.42	3.00	.38
Efficacy	2.89	.29	2.85	.29
Posttest				
Learning goal	1.70	.60	2.23	.74
Intrinsic Motivation	2.41	.60	2.85	.45
Performance Goal	3.03	.54	2.60	.72
Extrinsic Motivation	2.92	.36	2.95	.30
Efficacy	2.63	.35	2.85	.22
Achievement	78.19	11.85	70.20	12.54
Post-Posttest				
Learning Goal	2.97	.82	2.23	.70
Intrinsic Motivation	3.05	.56	2.79	.49
Performance Goal	3.61	.76	2.68	.72
Extrinsic Motivation	2.89	.35	2.87	.39
Efficacy	2.89	.40	2.80	.26
Achievement	67.16	13.73	73.73	14.20

Table 2

Correlations among pre test scores

Variables:	1	2	3	4	5
1. Pre Learn Goal	--				
2. Pre Intrinsic	.64*	--			
3. Pre Perfor Goal	.21	.12	--		
4. Pre Extrinsic	.27	.20	-.03	--	
5. Pre Efficacy	.12	.20	.25	.13	--

*p<.001

Table 3

Correlations among posttest scores

Variables	1	2	3	4	5	6
1. Post learn goal	--					
2. Post Intrinsic	.48**	--				
3. Post Perform	-.34*	-.14	--			
4. Post Extrinsic	-.21	-.18	-.11	--		
5. Post Efficacy	.52**	.67**	-.18	-.14	--	
6. Post Achievement	.18	.35*	.08	.18	.32*	--

*p<.01 and **p<.001

Table 4

Correlations among post-post scores

Variables	1	2	3	4	5	6
1. Post-Post Learn goal	--					
2. Post-Post Intrinsic	.39*	--				
3. Post-Post Perform goal	.20	.24	--			
4. Post-Post Extrinsic	-.10	-.14	.01	--		
5. Post-Post Efficacy	.28	.34*	.24	-.16	--	
6. Post-Post Achievement	.14	.17	.28	.04	.12	--

*p<.01 and **p<.001