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Source: *The Journal of Educational Research*, Vol. 87, No. 5 (May - Jun., 1994), pp. 280-291
Published by: Taylor & Francis, Ltd.
Stable URL: http://www.jstor.org/stable/27541931
Accessed: 14/09/2014 14:46

Perceptions of Intermediate Students' Cooperative Small-Group Work in Mathematics

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ABSTRACT **Research on student thought processes has given an important new dimension to the area of research on teaching. In this study, an attempt was made to examine student thought processes in the context of cooperative small-group instruction in mathematics. Fifth- and sixth-grade students and teachers were interviewed about their perceptions of general aspects of cooperative small-group instruction. Student interview responses were compared with those of teachers, and comparisons were made between high and low achievers and girls and boys. Students' and teachers' perceptions were fairly well aligned, although important differences were also found. A rich picture of some important dimensions of cooperative small-group instruction emerges from this study.**

Research on student thought processes, or student mediation research, represents a relatively new focus in research on teaching (Wittrock, 1986). It is based on the belief that teaching is mediated by student thought processes and that teachers influence student achievement, not directly, but by causing students to think and behave in certain ways. According to this view, improvement in teaching and in understanding teaching can result if the effects of teaching on students' thinking are known (Wittrock).

Most of the research on student thought processes has been carried out in the context of whole-class classroom instruction. The findings of studies in this area have provided valuable insights and understandings into the learning process and have raised important questions for teachers and other educators. Winne and Marx (1982), for example, found that a one-to-one correspondence did not exist between instructional stimuli or cues for particular cognitive responses provided by teachers and the actual cognitive processing engaged in by students. Students frequently misinterpreted advance organizers and often tried to memorize the content of these cues. On the other hand, students actively searched for cues from the teachers to indicate appropriate cognitive responses, sometimes finding cues where none were intended. Peterson, Swing, Braverman, and Buss (1982) found that students' reported understanding of mathematics lesson content and use of specific cognitive strategies were significantly related to achievement.

Recent experimental studies (Johnson & Johnson, 1981; Schmuck & Schmuck, 1983; Sharan & Sharan, 1976; Slavin, 1983, 1989) have indicated that the use of cooperative small-group teaching methods at the elementary school level can result in positive cognitive and noncognitive outcomes for students, including the improvement of students' achievement and the improvement of race relations and interpersonal relations generally. In recent times, cooperative small-group instruction has been recommended as a possible means of enhancing students' higher order thinking skills and problem-solving ability, especially in the area of mathematics (Noddings, 1989; Taylor, 1989).

Studies of student thought processes in the context of cooperative small-group work have been extremely scarce. Studies by Peterson and Swing (1985) and King (1989) indicate how this research approach might provide greater understanding and insight into important aspects of this instructional format. Peterson and Swing investigated students' perceptions of helping behavior during cooperative small-group activity as well as the relationship between help giving and achievement. The study supported earlier research findings on help seeking that showed a positive relationship between giving and receiving help and achievement (Webb, 1985). A positive relationship was also found between students' perceptions of the nature of a good explanation and their likelihood of giving such an explanation.

In a study by King (1989), high achievers reported more task-oriented interactive thoughts than did low achievers during cooperative small-group work. Low

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achievers had considerable difficulty in explaining group tasks and were relatively passive in cooperative groups.

The findings of a study of cooperative small-group process by Good, Reys, Grouws, and Mulryan (1989) showed that students working in cooperative small groups in mathematics tended to be more active learners and were more highly motivated than students working in whole-class settings. However, many students tended to work independently and individually instead of cooperatively and needed particular kinds of tasks if cooperation was to take place. There was a tendency for some students to dominate group interaction or to manifest passive withdrawing behavior in this setting.

Cohen (1982) provided a theoretical framework, based on expectation states theory (Berger, Cohen, & Zelditch, 1972), which tries to explain why some students, and especially low achievers, may be relatively passive in cooperative learning groups. According to Cohen, status differences based on achievement are likely to become more salient in cooperative groups. When this occurs, high achievers are likely to be relatively passive. This finding was borne out by experimental research on student interaction in cooperative small groups (Cohen, 1982; Humphreys & Berger, 1981; Rosenholtz, 1985; Stulac, 1975).

Studies of student perceptions provide important understandings and information in the context of classroom instruction. Because teachers' perceptions influence the sort of learning opportunities that they provide for their students (Good & Brophy, 1987; Peterson, Fennema, & Carpenter, in press), investigations of teachers' perceptions in the context of different instructional formats would likely provide valuable information about the instructional process.

An important, and as yet unexplored, direction for research is the study of teacher and student understandings and perceptions in relation to cooperative small-group instruction and the way in which these understandings and perceptions are related to each other and to students' behavior and learning in the cooperative small-group setting. Because differential responding of students in the cooperative small-group setting has been highlighted in previous research, investigations of the perceptions of high and low achievers and of boys and girls would make a valuable contribution to the field.

Purpose and Nature of the Study

Mulryan (1989) examined a range of factors relating to the involvement and participation of elementary school students in cooperative small groups in mathematics as well as student and teacher perceptions of aspects of this instructional format. The study was exploratory in nature, generating concepts and understandings that would provide a basis for further research. An important focus of the study was to examine differences between high and low achievers in their response to the demands and opportunities of cooperative small-group instruction. Differences between girls and boys were also explored.

The behavior and perceptions of high- and low-achieving fifth- and sixth-grade girls and boys were investigated. Student behavior was observed in cooperative small-group mathematics, whole-class mathematics, and reading-group settings; comparisons were made across settings. I conducted taped individual interviews with teachers and students. The interviews were intended to provide some insight into the way in which students and teachers perceive aspects of the cooperative small-group instructional setting and the differences and overlaps between them in this regard. The interviews were also used to examine the way in which both groups actively tried to make sense of their experience and the way in which they interpreted the perceptions and behavior of one another. Student and teacher perceptions were related to student behavior in cooperative small groups. In the present article, I focus on the interview, or qualitative, section of the study. Other findings of the study are reported elsewhere (Mulryan, 1989).

Method

Subjects

I chose five sixth-grade classes and one fifth-grade class, in which students worked in cooperative small groups for mathematics at least once a week, from a school in a small midwestern city in the United States. Students were middle class to upper middle class. The majority were White, Anglo, and from English-speaking homes. A sample of 48 students (8 from each class) was chosen for the study to facilitate comparisons between high and low achievers and between girls and boys. Two high-achieving girls, 2 high-achieving boys, 2 low-achieving girls, and 2 low-achieving boys were chosen from each class.

Procedure

I conducted student interviews (a) at the beginning of the study (i.e., prior to the commencement of classroom observations), (b) at the end of the study, and (c) after individual lesson observations. Teachers were interviewed at the beginning and at the end of the study. Each classroom was visited for one mathematics period per week over a 7-week period. During observations, teachers organized their mathematics lessons according to the following plan:

1. Approximately 30 min teacher presentation with the entire class
2. Approximately 30 min with students working in small groups of between 3 and 5 students on cooperative learning tasks
3. Approximately 5 to 15 min of discussion and summarization of cooperative small-group work[1]

Teachers were free to change the sequencing of the whole-class and cooperative small-group work. Students were observed in the reading group setting on three occasions during the latter 3 weeks of the study.

The type of cooperative small-group instruction used in this study was similar to Burns's (1981) "groups of four" and the type used in the study of Good, Reys, Grouws, and Mulryan (1990). Students worked on cooperative problem-solving tasks in groups of 4. Cooperative groups were heterogeneous by achievement and gender. Students were asked by the teacher to work together on learning tasks, to decide as a group on procedures and roles, to contribute to group activity by providing suggestions, opinions, and ideas, and to ask questions and ask for clarification when required. Asking for teacher assistance was to be a last resort, that is, only when group resources had been exhausted. Mutual support and encouragement were promoted. All students in each group were expected to participate, and each group member was responsible for being able to describe how the group arrived at a solution and/or engaged in the task. To create a climate in which students would feel free to express ideas and request help, I did not use rewards or other extrinsic motivators. Group composition was changed frequently and was determined randomly.

During mathematics lesson observations, 4 target students in each class were selected for observation for periods of 8–10 min in both the cooperative small-group and the whole-class mathematics settings. Four other students (from the 8 target students) were observed during each visit. For each of the seven cooperative small-group lessons during which students were observed, teachers arranged for students to work on one of seven group tasks (see Appendix).

Data Analysis

Students' responses were transcribed into interview questions (Mulryan 1989). Response categories, based on these responses, were then devised, and the frequency of occurrence of each response type was identified. Data from the teacher interviews were typed verbatim from interview tapes.

I analyzed the data and reported study findings for the total student group (N = 48) across the six sample classrooms. This level of analysis was chosen for three reasons. First, the study was primarily exploratory in nature, and I believed that the across-class level of analysis would enable important patterns and trends to be identified. Second, because important similarities among students across study classrooms existed, including age, grade level, socioeconomic status, school and classroom environment, and amount of experience of cooperative small-group work, I determined that an across-class level of analysis was justified. Finally, I thought that by adopting an across-class level of analysis in this study, findings could be usefully related to those of other studies in this area that have adopted similar analysis procedures.

My decision to analyze the data and to report findings for the total target sample across the six classrooms in this study may have caused important between-class differences and within-class differences to be masked. A systematic examination of these differences would, most likely, have highlighted the influence of a range of important teacher and student variables on students' responses to cooperative small-group instruction that are likely to have been overlooked in the across-class analysis. Further data analysis needs to examine the effects of some of these variables.

Findings

Observational findings: A selection. Students manifested more time-on-task in the cooperative small-group setting than in the whole-class mathematics and reading-group settings (Mulryan, 1989). This finding is similar to the finding in previous research (e.g., Ziegler, 1981) that students are more active during small-group cooperative work than in other instructional settings. However, in the present study, all students did not benefit in the same way from increased involvement during small-group work. High achievers engaged in significantly more high-level, on-task behavior than did low achievers in cooperative small groups. High achievers spent 5% of their time in cooperative small groups off task; low achievers were off task 13% of the time.

High achievers interacted more with their peers in cooperative small groups than did low achievers. Differences in interactive behavior, however, reached significance only in the case of suggestion and direction giving; high achievers provided significantly more suggestion and directions than did low achievers. On the other hand, low achievers asked more questions than high achievers did in cooperative small groups. This finding is consistent with Webb's (1982) finding that question asking in cooperative small groups is associated with low achievement.

Interview findings. The findings reported here are from the student and teacher interviews that occurred before observations began and after the observational section of the study.

Teachers' and students' perceptions of the purpose and benefits of cooperative small-group work in mathematics

Students' Perceptions

Student interview responses regarding their perceptions of the purpose of cooperative small-group work indicate that the social dimension of the experience in cooperative small groups was very much to the fore in their minds. The themes of collaboration and sharing ran through the various responses (see Table 1).[2] Most high achievers' responses ranged across more than one category, whereas

low achievers' responses could be recorded under one category only.

Categories 7, 8, and 9 refer to the learning of social skills not specifically related to learning tasks in cooperative groups. Over 25% of all responses fell into these categories; 23% of students expressed the view that an important purpose of cooperative small group was for students to earn to work with one another. In the remaining six response categories, students referred to interaction with peers in the context of cooperative learning tasks. Students noted learning from each other and combining skills and information for task completion. Approximately 1 in 5 students (21%) mentioned learning from one another and having the opportunity to learn more and better (19%) as a purpose of cooperative small-group work. More high achievers and more girls mentioned the former reason and more low achievers and more boys mentioned the latter. Low achievers were underrepresented in Response Categories 2, 3, and 4, which referred to helping one another and sharing opinions, skills, and ideas.

When asked to indicate the benefits of cooperative small-group work, the students gave a variety of responses. As shown in Categories 1, 4, and 9 in Table 2, some students said that the cooperative small-group setting provided a context in which error could be minimized by the exchange of information between peers and the freedom to ask questions and check solutions. More high achievers than low achievers gave responses that could be included in these categories (9 high achievers, compared with 6 low achievers), perhaps indicating a greater concern among high achievers solving the problems correctly and being successful.

Responses included in Categories 3 and 10 show that there was an interest among some students with the challenge level of cooperative small-group work. Some students (4 high achievers and 2 low achievers) noted that being able to get different ideas and opinions about work from each other in cooperative groups was a major benefit of this instructional format. Two other high achievers said that the cooperative small-group instructional format provided a context in which it was possible to do harder, more challenging work. Low achievers were underrepresented in Category 3, and none of their responses were included in Category 10.

The social dimension of cooperative small-group work was also mentioned in student responses about potential benefits of this instructional format. Responses in Categories 2, 7, and 8 summarize the nature of these social replies. Social-type responses were distributed equally between high and low achievers and between girls and boys. Ten percent of the students noted that the cooperative small-group setting provides a fun way to learn or an easier way to learn (Categories 5 and 6). More high achievers than low achievers mentioned these factors as benefits of this instructional format.

Teachers' Perceptions

When asked to cite reasons why they used cooperative small groups to teach mathematics in their classrooms, Teachers a, b, c, and f indicated that they perceived the cooperative small-group setting as a context in which students have the opportunity to learn from one another. Lower achievers can benefit by having mathematics content explained to them in a way that is sometimes more comprehensible to them than the teacher's explanation. Higher achievers can consolidate their own learning by teaching others. Teachers a, c, and e perceived the cooperative small-group setting as one in which students have the opportunity to share ideas in an unthreatening context and, through exposure to the ideas of others, can learn new strategies and approaches to mathematical problems.

Table 1.—Students' Perceptions of the Purpose of Cooperative Small-Group Work: Frequency of Occurrence of Each Response Category

	High achievers		Low achievers		
Response category	Girls (n = 12)	Boys (n = 12)	Girls (n = 12)	Boys (n = 12)	Total (%) (N = 48)
1. To learn from each other	4	2	2	2	21
2. To help each other	3	5	2	1	23
3. To share ideas/opinions	3	4	0	0	15
4. To combine skills for harder work	0	3	1	0	8
5. To learn different approaches to tasks	2	0	0	1	6
6. To learn more and better	1	2	2	4	19
7. To learn to work with others	3	3	5	0	23
8. To get to know each other	0	0	1	1	4
9. To learn to get along with people	2	1	0	0	6
10. Don't know	2	0	0	1	6

Table 2.—Students' Perceptions of Benefits of Cooperative Small-Group Work: Frequency of Occurrence of Each Response Category

Response category	High achievers Girls (n = 12)	High achievers Boys (n = 12)	Low achievers Girls (n = 12)	Low achievers Boys (n = 12)	Total (%) (N = 48)
1. Can ask others if you don't know	2	2	2	2	17
2. Can learn to work well with others	4	4	3	4	31
3. Can get different ideas about the work	3	1	1	1	13
4. Can help each other	3	1	0	2	13
5. It's easier to learn this way	1	2	1	1	10
6. A fun way to learn	1	2	2	0	10
7. Get to understand different people	2	0	3	1	13
8. Can work with friends	0	2	0	0	4
9. Can check your answers	0	1	0	0	2
10. Can do harder work	1	1	0	0	4
11. Don't know	0	0	1	1	4

Table 3.—Students' Perceptions of Teacher Expectations for Appropriate Student Behavior During Cooperative Small-Group Work: Frequency of Occurrence of Each Response Category

Response category	High achievers Girls (n = 12)	High achievers Boys (n = 12)	Low achievers Girls (n = 12)	Low achievers Boys (n = 12)	Total (%) (N = 48)
1. To give help to others	4	2	2	0	17
2. To get help from others	2	3	1	2	17
3. To work with others and not alone	5	5	10	7	56
4. To share/compare answers	2	4	1	1	17
5. To share/compare approaches	1	1	0	3	8
6. To get the correct answer	1	1	0	0	4
7. To split up the work	0	1	1	1	6
8. To give/get opinions and ideas	2	2	1	1	13
9. To talk with others about the task(s)	4	1	7	3	31
10. To get along with one another	1	1	0	0	4

Some personal and social benefits of cooperative small-group work were mentioned by Teachers a and e. Teacher a said that cooperative work can improve classroom atmosphere and provide teachers with a useful opportunity to get to know students better. In Teacher e's view, experiences in cooperative small groups give students confidence in other learning contexts and provide them with an opportunity for the enhancement and development of social skills. Teacher b indicated that cooperative small groups can help to build confidence in those students who are hesitant and unsure in their approach to mathematics. For Teacher d, cooperative work can be a means of enhancing student achievement by creating positive dependence among students. It also gives students confidence in problem solving. For Teacher f, cooperative small-group work provides a useful means of adding variety to mathematics instruction.

Students' perceptions of teacher expectations for appropriate student behavior during cooperative small-group work and teachers' expressed expectations

Students' Perceptions

The social dimension of cooperative small-group work was emphasized strongly by students when they were asked to indicate what they considered to be their teacher's expectations for student behavior in cooperative small groups (see Table 3). The responses to this question indicate the social norms that the students considered appropriate in the cooperative small-group setting. Most students (56%) noted that they were expected to work with peers rather than by themselves in cooperative small groups (Category 3). Talking about the task with others (Category 9) was also perceived as important expected behavior in cooperative groups by a relatively large num-

ber of students (31%). Smaller proportions of students mentioned other expected behaviors in cooperative groups, including helping one another, exchanging opinions and ideas with one's peers (Categories 1, 2, and 8), sharing or comparing answers and approaches (Categories 4 and 5), getting the correct answer (Category 6), dividing the work (Category 7), and getting along with peers (Category 10).

Working and talking with peers about learning tasks was mentioned by considerably more low achievers than by high achievers (27 low achievers, compared with 15 high achievers). On the other hand, giving and receiving help and information was perceived by more high achievers (15) than by low achievers (7) as being important expected behaviors in cooperative small groups. Finding the correct answer and getting along with peers were mentioned by two high achievers but no low achievers.

A larger proportion of girls than boys (26 girls, compared with 16 boys) perceived that working with peers and talking together on task were expected behaviors in cooperative groups. More boys than girls mentioned the sharing or comparing of answers or approaches as expected behavior in cooperative groups (9 boys, compared with 4 girls).

Teachers' Perceptions

Teachers were asked to indicate the kinds of behaviors and thinking processes that they intended their students to engage in during cooperative small-group work in mathematics. All the teachers expected their students to engage in considerably more interaction and verbalization in this instructional setting than in the whole-class mathematics setting. Students were expected to discuss group assignments and explore ideas and solutions in collaboration with one another. The sharing of ideas, approaches, and opinions, the acknowledgment and discussion of alternative viewpoints, and the presentation and justification of one's position were all deemed by teachers to be important cooperative behaviors. Students were to feel free to ask for the opinions and ideas of others and were to be open to the suggestions and opinions of others.

The expectation that students in cooperative small groups would help one another was expressed by Teachers c, d, e, and f.

The importance of students remaining focused on task in the cooperative small-groups setting was emphasized by Teachers b, e, and f. Teachers c and e expected students to figure out as many ways as possible to solve a mathematics problem or to complete a group assignment. Although Teacher b expected students to help one another, she also expected each student to be responsible for ensuring that he or she could accomplish the task(s) alone as well as with the group. Teacher (b) also expected students to pay attention to the vocabulary used during discussion in cooperative small groups, ensuring that correct mathematical terms were used whenever possible. In the view of Teacher c, cooperative small-group work should engage students "in much more in-depth problem-solving thinking" than is possible in the whole-class mathematics setting. In Teacher d's view, students who were competent in the subject matter related to the cooperative small-group task had the responsibility to teach it to others who did not understand. The importance of good in-group organization, for which the students were responsible, was mentioned by Teacher f.

Table 4.—Students' Perceptions of Characteristics of Good Cooperative Tasks: Frequency of Occurrence of Each Response Category

	High achievers		Low achievers		
Response category	Girls (n = 12)	Boys (n = 12)	Girls (n = 12)	Boys (n = 12)	Total (%) (N = 48)
1. All kinds	2	2	0	2	13
2. Where you can split up the work	2	2	0	1	10
3. Where you can't split up the work	1	0	0	0	2
4. Tasks that suit all ability levels	0	0	1	0	2
5. Tasks that need many contributions	2	2	1	2	15
6. Tasks involving manipulatives	1	4	5	2	25
7. Tasks involving work with shapes	5	2	3	4	29
8. Challenging activities	1	2	0	0	6
9. Pencil and paper activities	2	0	0	0	4
10. Games	0	0	0	1	2
11. Depends on the group/person	2	1	0	1	8
12. Experiments	0	0	1	0	2

Students' and teachers' perceptions of the characteristics of cooperative small-group tasks that are desirable for effective cooperative activity in small groups

Students' Perceptions

Most students noted that tasks that worked best in cooperative small groups were those that involved work with shapes (29%) and those that involved the use of manipulatives (25%) (see Table 4). Next in order of preference were tasks that needed many contributions (15%) and tasks that could be divided among members of the group (10%). Some students considered that the nature of the task did not matter (13%). Pencil-and-paper tasks were preferred by only 2 high-achieving girls and by no boys or low achievers. Most high achievers cited more than one characteristic of good cooperative tasks, whereas low achievers cited only one preferred characteristic.

Teachers' Perceptions

Cooperative small-group tasks, according to Teachers a, c, and f, should require the contribution of all students and the need for students to share information. Teachers b, d, e, and f considered that, so far as possible, cooperative small-group tasks should involve the use of manipulative materials. The importance of linking cooperative tasks with the curriculum content that has already been taught or is currently being taught, including the reinforcement of mathematical skills, was mentioned by Teachers a and b. Teachers c and f believed that cooperative tasks should be enjoyable and motivating for students. Suitable cooperative small-group tasks, in Teacher c's opinion, should involve problem solving and discovery on the part of students. A similar view was expressed by Teachers d and f, who considered that the emphasis in cooperative tasks should be on thinking and reasoning rather than on finding solutions or answers. Teacher c believed that an appropriate cooperative task should be capable of subdivision.

Students' and teachers' perceptions of the characteristics of cooperative small groups that are important for successful cooperative activity in small groups

Students' Perceptions

When students were asked to indicate the characteristics of a good (effective or one that worked well) cooperative group, the social dimension of cooperative small-group work was again emphasized by the number of responses included in Categories 1, 4, 8, 11, and 12 in Table 5). Many students were concerned about the sharing of work by group members and good organization (Categories 2, 3, and 10). Most students were concerned about the group's remaining on task and completing assigned work effectively (Categories 5, 6, 7, and 13). A small but notable number of students (8%) noted that a good cooperative group has students within it who are good at mathematics.

More high achievers mentioned social factors as important in good cooperative groups than did low achievers (31 vs. 24 mentions), and girls noted this dimension slightly more often than did boys (30 vs. 25 mentions). Sharing and good organization were mentioned in the responses of slightly more girls than boys (14 vs. 11 mentions). There was no notable difference in this dimension between high and low achievers. High achievers mentioned the importance of the groups's remaining on task and completing work more often than did low achievers (20 vs. 16 mentions) and girls made notably more mention of this than did boys (21 vs. 13 mentions). Three low achievers (2 girls and 1 boy) and 1 high-achieving boy indicated that if a cooperative group was to work well, some per-

Table 5.—Students' Perceptions of the Characteristics of a Good Cooperative Small-Group: Frequency of Occurrence of Each Response Category

	High achievers		Low achievers		
Response category	Girls (n = 12)	Boys (n = 12)	Girls (n = 12)	Boys (n = 12)	Total (%) (N = 48)
1. Group members like each other	3	3	3	2	23
2. Everybody does equal work	5	4	4	4	35
3. Group is well organized	1	2	1	0	8
4. People work well together	5	6	5	2	38
5. Group remains on task	6	3	3	2	29
6. No fooling about/fighting	4	3	4	2	27
7. Group completes the work	1	0	0	2	6
8. People help each other	4	0	1	1	13
9. People who are good at mathematics in group	0	1	2	1	8
10. People who share/listen	1	0	2	1	8
11. Good atmosphere/fun	3	2	4	2	23
12. Know each other but not best friends	2	3	0	4	19
13. People talk about mathematics	1	2	2	1	13

sons who were good at mathematics should be in the group. Overall, high achievers included more dimensions and considerations in their responses (65 vs. 53), and girls included more dimensions and considerations than did boys (64 vs. 53).

Teachers' Perceptions

All teachers perceived a good cooperative group to be one in which students are collaborating and cooperating with one another. In such groups, students are encouraging, discussing, explaining, and sharing information, ideas, and strategies; finding the answer is not the key task. However, in Teacher f's view, the good group produces "a good product." In a good cooperative small group, according to Teachers a, b, c, and f, students fully participate in the task, and they are goal oriented and conscientious about doing their own part in the work. In the view of Teachers a, c, d, and e, students in a good cooperative group must take responsibility to ensure that everyone understands the group task and the different stages of the group work. The importance of students' listening well to one another, constructively evaluating others' ideas, and being supportive and caring with one another was emphasized by Teachers a, b, and c. Students need to help one another when necessary and also must feel free to ask for help or clarification from others. A cooperative small group, according to Teachers a, b, and f, should be well organized. Students need to take some time at the beginning of the group session to determine how the group would proceed with the work and, in some cases, what roles different group members would assume.

For Teacher b, students need to clearly understand the mathematics concept(s) involved in the task(s), and they must be able to relate it (or them) to other mathematics taught previously. In a good cooperative group, according to Teacher (c), there is a lot of discussion and even controversy. Students look for different possibilities and ways of approaching tasks. Students should know exactly what they are expected to do. Students in a good group enjoy challenge.

Students' and teachers' perceptions of the extent to which individual and group accountability exist in the cooperative small-group instructional setting

Students' Perceptions

Only 8% of the students perceived that individual accountability did exist in cooperative groups, whereas the others were unsure. Most students believed that the teacher did not know the extent and nature of individual contributions in cooperative groups (see Table 6). Forty percent of the students agreed that the teacher definitely did not hold individuals accountable for group work, 15% said that the teacher only "sometimes" held students accountable, and 6% held that the teacher usually did not maintain accountability.

Findings relating to students' perceptions of whether cooperative groups were held accountable for cooperative small-group work showed a pattern quite different from the above. Only 4% of the students believed that group accountability did not exist for cooperative small-group work, whereas 77% indicated that groups were held accountable for this work. The remaining students expressed uncertainty about this issue.

Teachers' Perceptions

Teachers agreed that it was possible to know how well individual students were working in cooperative small groups by walking around the room observing and monitoring during group work sessions. Teacher c indicated that she generally moved from group to group during cooperative group work and sat down next to groups, listening and watching. She said, "I can really tell who is doing what and who is playing what part. I get a real good idea about who understands and about who is sitting there not making an effort." In Teacher b's class, an individual student's work was sometimes monitored by having individuals produce a separate recording of group problem solutions or other group products. Teacher d sometimes had students rank each other on a 1-to-5 scale, indicating the extent to which they cooperated and worked well in groups.

Table 6.—Students' Perceptions of the Degree of Individual Accountability Existing in the Cooperative Small-Group Setting: Frequency of Occurrence of Each Response Category

	High achievers		Low achievers		
Response category	Girls[a] (n = 12)	Boys (n = 12)	Girls (n = 12)	Boys (n = 12)	Total (%) (N = 48)
Individual accounting exists	0	0	1	3	8
Individual accounting does not exist	3	4	6	6	40
Sometimes	3	2	1	1	15
Not sure	0	2	2	2	13
Usually not	1	2	0	0	6
Don't know	2	2	2	0	13

[a]Only 9 of the 12 high-achieving girls had an opinion on this issue.

All the teachers believed that they had a good idea of how much work each cooperative small group accomplished during a mathematics period as well as the nature of this work. This knowledge was obtained by having students report on group work at the end of the group session and by examining group worksheets or other written representations.

Students' and teachers' perceptions in relation to the stability of membership of cooperative small groups

Students' perceptions

All the students, except 4 (8%), opted for relatively frequent changing of group membership (i.e., every few days or weeks). Reasons given by students for favoring relatively frequent changing of group membership included the following: "Would get tired or bored with the same group for a long time" (26); "Changing groups gives one an opportunity to work with different people and get different ideas and viewpoints" (18); "If you don't like your group you won't have to stay in it long if group membership is changed frequently" (10). These responses were given by both high and low achievers. The following additional reasons for changing groups frequently were given by low achievers: "By changing groups frequently you can get to know different people" (6); "Somebody in the group might do all the work and leave the others out all the time" (4); "If you change you might get a 'faster' group" (3); "If the group 'fights' you can get away when it changes" (2); "One group might get done first always if groups don't change very much" (2); "If you are not with smart people you might get with them when you change" (3). As can be seen here, there was greater variety in the responses of low achievers than high achievers to this question.

Teachers' Perceptions

When asked about the degree to which cooperative small-group membership should change or remain the same, all the teachers except for Teacher a indicated a preference for the relatively frequent changing of group membership. Teacher c felt that children got bored working with the same group of students all the time. In her view, different students approach problems and learning tasks in different ways, and changing groups frequently gives students an opportunity to perceive a variety of approaches and "to find out how different minds work." Teacher e noted that changing groups frequently gave her an opportunity to get to know the work styles of her students and it provides students with the challenge of getting to know and having to work with different people. Teacher f suggested that changing groups frequently made it likely that even problem students would find a group in which they could work effectively.

Some disadvantages of frequent changing of cooperative small-group membership were cited by teachers. According to Teacher a, if group membership is changed frequently, students do not establish a method of working together, do not become familiar with each others' work style, and do not learn to work out problems and conflicts. Teacher b said that frequent changing of group membership has the disadvantage of allowing students to walk away from problems: "If it does not work today, just hang in there and tolerate it as you will be in a different group tomorrow." Teacher d noted that some possible disadvantages of frequent changing of group membership include the loss of instructional time involved in organizing change and the loss of cohesion in a group that is working well. Teacher c also mentioned the loss of instructional time in organizing changes in group membership.

Teachers' perceptions of the way in which group composition should be determined

At the end of the study, the teachers were asked to indicate, in the light of their experiences with students in cooperative small groups during the study, how they thought small-group membership should be determined. Teacher a suggested that groups include a high-, a low-, and a middle-ability student. In her view, a group also needs a leader, at least one person who is extremely cooperative, and if possible, a protagonist who will challenge ideas and suggestions in the group. For teacher b, the ideal cooperative small group would be composed of "one super-high in each group and the other two chosen arbitrarily." Quiet or hesitant students, she suggested, need to be deliberately placed in a group with one or more encouraging students. Teacher b argued that determining cooperative small-group membership effectively requires that teachers know their students well. Therefore, it is probably not useful to organize cooperative small groups at the beginning of the school year.

Teacher c suggested that, when possible, a cooperative small group should have at least one goal- and task-oriented individual who can adopt a leadership role in the group. This leader need not be a particularly good mathematics student, but rather, one with good motivation and leadership skills. Teacher c also discouraged groups comprising many passive or quiet students or very bright students if productive groups work is required. In her view, passive students together may never get started on learning tasks or may work individually, and bright students will possibly conflict with one another. Mixed-ability grouping for cooperative work is suggested by Teacher c, although she believes that for some group tasks, friendship grouping, random grouping, or other grouping procedures may be more appropriate.

Teacher d indicated that cooperative small groups should include students with a mixture of abilities, genders, and personality types. Teacher e recommended random selection of students for cooperative small groups in most cases, especially if students in the classroom are all

fairly competent mathematics students. In cases in which student ability varies, this teacher suggested that high- and low-ability students should be mixed and that students with "nurturing personalities" should be placed in groups with students who have poor social skills or problems participating in small groups. Teacher f used various procedures to randomly select students for cooperative small groups in her classroom.

Summary

There was general agreement between students and teachers regarding the purpose and benefits of cooperative small-group instruction in mathematics and appropriate student behavior in this learning setting. The themes of collaboration and sharing, student-student help and support, and opportunity for social interaction and active participation were prominent in the responses of both teachers and students. The social dimension, however, was emphasized more by students than by teachers, and task variables were emphasized more by teachers.

Cooperative learning tasks that involved the use of manipulatives were those most preferred by students. Those tasks were also cited by most teachers as having worked best during the study in terms of promoting and facilitating good cooperative involvement among students. Teachers were concerned that mathematical cooperative learning tasks should provide students with challenging learning opportunities and have a strong emphasis on problem solving and exploration. Connectedness with regular curriculum was deemed to be important by most teachers. Cooperative learning tasks, according to teachers, should also be motivating and enjoyable for students. Students did not mention curriculum-related issues.

In stating what they considered to be the characteristics of an effectively working cooperative small group, the students gave primary place to social considerations. A good cooperative group was generally perceived to be one in which students liked each other, shared and helped each other, and completed the work. Teachers placed more emphasis on curriculum and task variables and on the thinking processes that students engaged in. Group organization and procedure, task involvement, and understanding of mathematics content were mentioned by teachers, but not by students.

Teachers and students both agreed that group accountability existed in the cooperative small-group setting in mathematics. However, whereas all teachers agreed that individual accountability also existed in their classrooms, students believed that it did not. There was general agreement between students and teachers, however, in relation to ideal cooperative small-group size and relation to the stability of small-group membership. Most teachers and students were in favor of relatively frequent changing of cooperative small-group membership.

Study findings showed some differences between students and teachers. For example, high-achieving students were more concerned than low achievers with getting correct solutions to cooperative learning tasks. Help giving was mentioned more by high achievers than by low achievers, and high achievers also mentioned more characteristics of effective cooperative small groups than did low-achieving students. Overall, high achievers emerged as having a more complex understanding of cooperative small-group work than did low achievers. Differences between girls and boys in their interview responses were minimal, although the girls emphasized social variables over academic ones more than the boys did.

Some differences in perception existed between teachers. The most notable difference concerned expectations for student behavior in cooperative small groups. Some teachers (a, c, and e) mainly emphasized the opportunities that cooperative small-group work would provide for extended and novel ways of thinking and approaching mathematical content, whereas other teachers (b and f) placed most emphasis on classroom management issues, including group organization and task completion.

Conclusion

This study, which was primarily exploratory in nature, provides some interesting insights into the way in which students and teachers understand the setting in which they work and the differences and overlaps between them in this regard. It shows the extent to which both groups actively try to make sense of their experience and the way in which they interpret the perceptions and behavior of one another.

Teachers and students together paint a rich picture of cooperative small-group work. Generally, the cooperative small-group setting is perceived as one in which students undertake a task or set of tasks collaboratively, giving and receiving help, ideas, opinions, and information that can aid the group in completing the task. The cooperative small-group setting also provides students with opportunities to engage in higher order thinking and problem solving in a way that is not often possible in regular mathematics lessons.

Although there were some differences in the emphasis and in the substance of responses among students and teachers and between students and teachers in relation to aspects of cooperative small-group instruction, there was a larger area in which perceptions, understandings, and expectations were shared.

One major finding that emerged in the observational, or quantitative, section of this study (Mulryan, 1989) was that high achievers manifested more time-on-task and also more quality involvement than did low achievers in cooperative small groups. High achievers were also more active participants than low achievers were in these groups. The interview responses of low achievers, as reported in this article, indicate that these students appear

to have a less complex and less differentiated understanding of the nature of cooperative small-group work. It is likely that this narrow understanding affected their behavior in small groups and caused them to be less active participants. Passivity or withdrawal from all involvement consistently or periodically (Mulryan, 1992) was also more common among low achievers.

Further analysis of data is needed to investigate the relationship between student behavior in cooperative small groups and student interview responses, including responses from interviews held immediately after lesson observation. Between-class differences also need to be explored. For example, how do the perceptions and behavior of students relate to the perceptions and expectations of their own class teacher, and what differences and similarities are there between the perceptions and behavior of students in the different classes.

NOTES

1. The average length of observed mathematics lessons over the period of the study was 55 min.

2. In interpreting student interview findings on the frequency of occurrence of different response categories for interview questions, I found that many students' responses dealt with several categories and they were coded accordingly. As a result, the totals of many table columns are higher than the number of students who responded.

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APPENDIX

Seven Group Tasks Used During Cooperative Small-Group Work in the Study

1. *The Consecutive Sums Problem* (Burns, 1987). Students were asked to work together in their small groups to find all the numbers between 1 and 35 that can be written as the sum of consecutive addends. Students were encouraged to look for patterns as they worked and to use the discovered patterns to make predictions, including predictions about numbers for which it was impossible to find consecutive addends.

2. *Tangrams.* Students were given a set of seven tangram pieces and six different outlines. Working together, they were to cover each of the outlines using all seven tangram pieces. Students were to record their results, and all students were required to be able to fit the pieces on each outline.

3. *Pentominoes* (Burns, 1987). Each small group was given a set of 1-in tiles and sheets of paper ruled in 1-in squares. Students were required to work together to discover all the possible ways in which five tiles could be arranged into pentominoes (i.e., shapes made up of five squares). Shapes discovered had to be different; they could not be congruent or could not be converted one into the other by translation, rotation, or reflection. Students were required to cut out discovered shapes from the squared paper and as follow-up activities to find out which shapes could be folded into boxes. They were also asked to combine all the discovered shapes to make a rectangle.

4. *The Popcorn Lesson* (Burns, 1987). In this lesson, students were given a probability problem that they were required to solve as a group. Students were asked to create a simulation of a situation in which a popcorn company, in trying to boost its sales of popcorn, places one of six

mathematician picture cards in each box of popcorn manufactured, prints an equal number of each card, and places the same number of each mathematician in every store. The problem to be solved was that of finding out the number of boxes that it would probably be necessary to buy in order to get a full set of mathematician cards. Each small group was given a sack and six colored objects to facilitate problem solution. The follow-up to the lesson involved the recording of the results of each group by the teacher and the application of elementary statistics (e.g., mean, median, and mode) to these results.

5. *Palindromes* (Burns, 1987). Students working in small groups were required to convert all the numbers from 0 to 99 into palindromes (i.e., numbers that read the same forwards and backwards). A number that was not already a palindrome was to be converted into a palindrome by reversing the digits and adding it to itself (e.g., 41 + 14 = 55). Some numbers required more than one reversal to make this conversion. Each group was given a sheet of paper for recording the results of computations and the number of steps it took to make conversions, and a 0-to-99 number square on which palindrome patterns were to be recorded using a color code agreed upon by the group. Patterns were to be based on the number of steps it took to convert numbers into palindromes (e.g., green for two-step palindromes).

6. *Word Problems* (Haenisch & Hill, 1985). Students working in small groups were required to work on and solve five multistep word problems. The word problems required the application of computational skills in the area of fractions (i.e., addition and subtraction of fractions and mixed numbers).

7. *Cuisenaire Rod Patterns* (Davidson & Willcutt, 1983). This learning task was an exercise in spatial problem solving using Cuisenaire rods. Each small group was asked to work on four pages of Cuisenaire rod designs, with two designs on each page. Students, working together in their groups, were to fill in each design with Cuisenaire rods according to the specifications given on the top of each page.