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Impact of cooperative learning strategies upon mathematics achievement: An application of STAD in seventh grade mathematics

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Abstract

Cooperation is a key to success today in our work and personal relationships as adults, yet the traditional classroom, that prepares children for adulthood, has been found to be more competitive than cooperative (Johnson & Johnson, 1975). Traditionally, students have spent their day working individually or receiving instruction in large groups through lecture or class discussion with students being expected to outperform or compete with their peers (Johnson & Johnson, 1975). It has been estimated that over 85 percent of the instruction in schools consists of lectures, seat work, or competition, where students are isolated from one another (Johnson, Johnson, Holubec, & Roy, 1984).

Impact of Cooperative Learning Strategies Upon Mathematics Achievement: An Application of STAD in Seventh Grade Mathematics

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CHAPTER I

Introduction

Cooperation is a key to success today in our work and personal relationships as adults, yet the traditional classroom, that prepares children for adulthood, has been found to be more competitive than cooperative (Johnson & Johnson, 1975). Traditionally, students have spent their day working individually or receiving instruction in large groups through lecture or class discussion with students being expected to outperform or compete with their peers (Johnson & Johnson, 1975). It has been estimated that over 85 percent of the instruction in schools consists of lectures, seat work, or competition, where students are isolated from one another (Johnson, Johnson, Holubec, & Roy, 1984).

According to Reshaping School Mathematics by the Mathematical Sciences Education Board and National Research Council (1990), the changing demographics of the country and changing demands of the work place indicate society's need for mathematics educators to develop an approach to mathematics education that enhances mathematics achievement.

The approach to mathematics education needs to shift from authoritarian models based on transmission of knowledge to student-centered practices featuring stimulation of learning. In the Curriculum and Evaluation Standards for School Mathematics by the National Council of Teachers of Mathematics (1989), it is stated that students should work together to help one another learn. Also, Everybody Counts, A Report to the Nation on the Future of Mathematics Education by the National Research Council (1989) stresses the desirability of mathematics teachers involving students in their own learning. Professional Standards for Teaching Mathematics by National Council of Teachers of Mathematics (1991) proposes that as students accept responsibility for their own work, they will learn how to learn as well as what to learn.

A similar emphasis may be found in the literature devoted to cooperative learning. Reviews of research on the major methods of cooperative learning have been conducted by Slavin (1980) and Sharan and Sharan (1976). These researchers have established cooperative learning as a way to achieve academic and nonacademic goals in the regular classroom (Sharan & Sharan, 1976; Slavin, 1980). In a study done by Good, Reyes, Grouws, and Mulryan (1990), students

working in groups were found to be more active learners and more motivated and enthusiastic about mathematics than students who did not work in achievement groups. Changes need to be made in education. Attention needs to focus on curriculum, as well as pedagogy in the classrooms of today to prepare our students for productive roles in society.

Statement of the Purpose

The purpose of this paper and a collateral field study is to become knowledgeable about several cooperative learning strategies and become familiar with the effects of using them in a mathematics classroom. A review of literature will seek answers to the following questions.

1. What are the characteristics of cooperative learning?

2. What are the purported advantages and disadvantages of using this approach, particularly when compared to conventional teaching arrangements that favor teacher presentation and practice exercises?

3. What contributions do some of the most common cooperative learning strategies make toward improving mathematics achievement in the elementary and junior high

grades? For example, what benefits have been derived from using:

a. TAI-Teams-Assisted Individualization (Slavin, 1989)?

b. Jigsaw (Aronson, Stephan, Sikes, Blaney, & Snapp (1978)?

c. TGT-Teams-Games-Tournaments (Slavin, 1989)?

d. STAD-Student Teams-Achievement Divisions (Slavin, 1978)?

4. Having reviewed the literature, how can STAD be used to teach students cooperative learning skills while helping them become more proficient in one area of the mathematics curriculum?

Significance of the Study

In addition to summarizing previously noted aspects of the professional literature devoted to cooperative learning, the goal of this study is to employ a cooperative learning strategy that has the potential for improving student achievement in mathematics. Various cooperative learning studies will be examined to see if the research supports the use of these methods to increase pupil performance in mathematics. A person who has a firm understanding of

cooperative learning, what it is, how it has been used in the classroom, what strategies are commonly used, and which strategies have been effective in the area of mathematics, will be in a position to use cooperative learning methods. Failure to examine the studies that already exist may lead to losing the potential benefits of using cooperative learning to improve educational achievement in mathematics.

Definitions

For purposes of this paper, important terms are defined as follows:

Cooperative learning. Classroom techniques in which students work on learning activities in small groups and are encouraged to help one another learn academic material or perform a group task. Rewards or recognition are usually based on group performance (Slavin, 1980).

Goal interdependence. Individual efforts contribute to a group goal (Johnson & Johnson, 1975).

Group competition. Prize or recognition is given to the highest scoring groups in the class (Slavin, 1980).

High reward interdependence. Explicit group reward based on the group's performance (Slavin, 1980).

High task interdependence. Students must rely on one another to do their group task (SLavin, 1980)

Individual accountability. A team member's contribution to the team score is separate (Slavin, 1980).

Individualized instruction. Achievement of a goal by a student that is unrelated to the achievement of the goal by other students (Johnson & Johnson 1975).

Interpersonal reward structure. The consequences for an individual of his or her classmates' performance. In a competitive reward structure, such as grading on a curve, one student's success necessitates another's failure. In a cooperative reward structure, one student's success helps another to be successful (Slavin, 1980).

Low reward interdependence. Students are asked to work with one another and are praised as a group, but group performance does not lead to a concrete goal (Slavin, 1980).

Low task interdependence. Individual students could opt to work alone without disrupting the group activity (Slavin, 1980).

Nonacademic outcomes. Changes in emotions, feelings, social behavior, or learning (Slavin, 1980).

Teacher-imposed structure. Degree to which tasks, rewards, and schedules are imposed by the teacher (Slavin, 1980).

Traditional instruction. Classroom instruction that includes large group lecture, working independently, and competition in various forms (Slavin, 1980).

CHAPTER II

Review of Literature

This chapter presents a contemporary review of commonly used cooperative learning methods: Team-Assisted Individualization, Teams-Games-Tournament, Jigsaw, and Student Teams-Achievement Division. The basic similarities and differences of the strategies will be examined. Related research follows the description of each strategy. The chapter will review the advantages and disadvantages of cooperative learning and changes that will need to be made in teacher presentation and student independent practice exercises.

Basic Features of Cooperative Learning

Cooperative learning involves classroom techniques in which small groups of students work at learning activities and are encouraged to help one another learn academic materials or perform group tasks. Group performance usually leads to reward or recognition (Slavin, 1980).

The methods of cooperative learning share three common characteristics. First, students work in small learning

teams that remain stable in composition. The second characteristic common to cooperative learning is that students are encouraged to help one another to learn academic material or to perform a group task. Third, in most of the strategies students are given rewards or recognition for group performances. In essence, if students cooperate in teams on a learning task, the situation is a cooperative learning technique (Slavin, 1980; Sharan & Sharan, 1976). Cooperative learning methods vary from each other along five dimensions: reward interdependence, task interdependence, individual accountability, teacher-imposed structure, and use or non-use of group competition (Slavin, 1980).

Advantages and Disadvantages of Cooperative Learning

Students receive many benefits from cooperative learning. Research has shown positive effects of cooperative learning in the following areas: academic achievement, self-esteem or self-confidence as a learner, intergroup relations, social acceptance of mainstreamed children, and ability to use social skills (Davidson, 1990). Other advantages are immediate feed back and individual help for the students. Students develop a caring positive attitude toward peers, teachers, administrators, and other

school personnel (Johnson & Johnson, 1975). Students become active learners and begin to enjoy mathematics more (Smith, 1987). The advantages for the teacher include fewer discipline problems with more time on task for the students, and large classes become easier to teach because students take on responsibility for their learning.

The disadvantages of cooperative learning are: it may not work for all grade levels, it may not be effective for teaching higher-order conceptual learning (Slavin, 1990), it requires different types of assignments, and it takes class time to teach the cooperative learning methods. Also, the teacher must learn the cooperative method and accept that the students will use him or her as a resource person.

Major Cooperative Learning Methods

Team-Assisted Individualization (TAI)

Team-Assisted Individualization (TAI) is a cooperative learning method developed to improve the outcomes of mainstreaming for mildly academically handicapped students (Slavin, Leavey, & Madden, 1984). TAI combines cooperative learning and individualized instruction to allow use of cooperative learning in heterogeneous classes. In TAI, students are pre-tested and placed in an individualized

curriculum based on their performance level. The students work in four or five member heterogeneous teams on individualized packets at their level. Team members check each others' work and answer questions for their team members. Team scores are based on the average number of units completed by all team members and on the team members' scores on tests taken outside the team. All teams that exceed a criteria previously set receive a certificate. This is an example of low task interdependence and high individual accountability (Slavin, Leavey, & Madden, 1984).

Research on Team-Assisted Individualization (TAI)

Research on TAI in controlled studies has shown significant improvements in mathematics achievement (Slavin, Leavey, & Madden 1984; Slavin, Madden, & Leavey, 1984; Slavin & Karweit, 1985). One study of Team-Assisted Individualization (TAI) involved 504 students in grades three, four, and five from eighteen classes in six schools (Slavin, Leavey, & Madden, 1984). The schools were randomly assigned either to TAI, to a materials only individualized program (same curriculum material as TAI but students did not work in groups or receive awards), or to an untreated control group for eight weeks. The Comprehensive Test of Basic Skills (CTBS) was used to measure mathematics

achievement. Two eight-item attitude scales and teacher-rated behavior scales were designed for this study. All instruments were used as pre- and post-test measures.

In the areas of classroom behavior, self-confidence, friendships, and negative peer behavior, the results indicated academically handicapped TAI students were rated by their teachers as having fewer problems than handicapped control students ($p < .001$). Marginally significant ($p < .06$) differences were found on the attitudes scale between TAI and control students' liking of class, and TAI students exceeded materials-only students in self-esteem ($p < .06$). The CTBS indicated that the full sample of TAI classes learned significantly more ($p < .03$) than the untreated control students. Achievement differences between TAI and the individualized instruction were not significant (Slavin, Leavey, & Madden, 1984).

Slavin, Leavey, and Madden (1984) conducted a ten-week study comparing TAI to individual instruction and untreated control classes. The subjects were 375 students in grades four, five, and six from sixteen classes in four schools. The treatments and measures were the same as in the study above.

The TAI students scored significantly higher on the CTBS than the control students ($p < .03$). The overall results indicate that the TAI approach has positive effects on student mathematics achievement, behavioral ratings, and student attitudes.

Slavin and Karweit (1985) conducted two studies to see if TAI would help to solve the classroom problem of heterogeneity in student preparation and learning rate. The study randomly assigned 345 students in grades four, five, and six from fifteen classes to three treatments lasting 18 weeks. The treatment consisted of whole class (group-paced mathematics program), ability grouping, and TAI. The Comprehensive Test of Basic Skills (CTBS) was used to measure mathematics achievement. There were significant differences for computation ($p < .018$) in both the ability grouping and the TAI compared to the whole class treatment (Slavin R., & Karweit, 1985). There were no effects on the concept and application scale.

These studies indicate that TAI is appropriate for use in heterogeneous mathematics classrooms. This cooperative learning method meets the needs of the students and gives the students success at their own level.

Jigsaw

Jigsaw is a cooperative learning strategy that assigns students to teams on the basis of academic heterogeneity, sex, and different backgrounds (Aronson, et al., 1978). Academic material is broken into as many sections as there are team members. The students study their sections with members of other teams who have the same sections. They then return to their own teams and teach their sections to other team members. All members are quizzed on the entire unit. The quiz scores contribute to individual grades, not to a team score (Aronson, et al., 1978). Jigsaw is high in task interdependence but low in reward interdependence, as individual performances do not contribute to a group goal (Slavin, 1980). The positive behavior of each group member helps the other team members. Students need each others' information; therefore, it qualifies as a cooperative learning strategy (Aronson et al., 1978). Jigsaw is a cooperative learning method used when students learn from books or other reading materials.

Research on Jigsaw

Studies have found that Jigsaw has positive effects on elementary students' achievement, self-esteem, and attitudes

toward peers and schools (Moskowitz, Malvin, Schaeffer, & Schaps, 1983). A study was conducted by Moskowitz, Malvin, Schaeffer, and Schaps (1983) to investigate Jigsaw's effectiveness in promoting positive changes in students' attitudes and behaviors in the classroom. The sample consisted of 262 students from the fifth and sixth grade. The treatment group participated in Jigsaw, and the control group received traditional instruction. The measures included surveys of teachers, biweekly reports from teachers, classroom observations, and student self-reports. The study indicated that Jigsaw influenced students' impressions of their classroom environment but did not produce the hypothesized benefits.

Learning in Jigsaw classrooms was contrasted with traditional methods in an experiment that included 303 fifth- and sixth-grade students from five schools (Lucker, Rosenfield, Sikes, & Aronson, 1976). Teachers in the Jigsaw classes volunteered to join the project. The traditional control teachers were selected for their competence in the classroom. The groups met for 45-minute periods daily for two weeks. The pre- and post-tests were composed by the teachers. Results indicated the students in the Jigsaw

classes learned significantly more ($p < .02$) than the traditional control classes.

Teams-Games-Tournaments (TGT)

Teams-Games-Tournaments is a cooperative learning method. Students are assigned by the teacher to teams composed of four to five members. Each team is designed to be heterogeneous with regard to academic ability, sex, and race. The function of these teams is to prepare its members, through peer tutoring, to do well in a learning game tournament. An initial class presentation is made by the teacher, then the teams are given worksheets containing academic material similar to that included in the tournament. Teammates use the worksheets to study together and quiz each other to be sure that all team members are prepared for the tournament.

Three students of comparable academic achievement, as determined by prior performance in the same subject area, are placed in the tournament together. Upon completion of the game, the three contestants are ranked and given points: the highest scoring student in each tournament is given 6 points, the middle scoring student gets 4 points, and the lowest scoring student gets 2 points. The scores from the individuals are used to figure the team score, thus creating

reward interdependence. The more that students help each other, the more likely they are to win points in the tournament. Following the tournament, the teacher prepares a newsletter which recognizes successful teams and students with first place scores. Team assignments remain the same for 6 to 10 weeks for the development of positive relationships (Slavin, 1989).

Research on Teams-Games-Tournaments

Research on TGT in controlled studies has shown positive effects on social and academic behavior (Slavin, 1982). A nine week study by Edwards, DeVries, and Snyder randomly assigned four classes in a junior high school to a TGT group or a control group. The same teacher taught two seventh grade TGT groups and two control groups. Students were pre-tested on the computation subtest of the Stanford Achievement Test and a Divergent Solution test designed to measure their ability to think of as many ways as possible to write equations using a given set of numbers and operations. Results from the post-test indicated the TGT students showed significantly more learning on both tests, controlling for the pre-tests (Slavin, 1982).

DeVries and Slavin (1978) reviewed the results of ten classroom experiments in which TGT was used with students in

grades three through twelve. In these studies, students generally achieved better in TGT classrooms than in control classrooms. TGT was particularly effective for increasing achievement in basic skills. DeVries and Slavin also found that use of TGT resulted in an increased mutual concern among students.

Student Teams-Achievement Divisions (STAD)

The cooperative learning method Student Teams-Achievement Divisions uses heterogeneous teams consisting of four or five members to review teacher-taught material (Slavin, 1978). The teacher assigns the students to one of several achievement divisions based on past performances. Each student's scores on a weekly test are compared to that of division members. They are ranked and given 8, 6, 4, or 2 points, which are contributed to the team score. Division groups are changed weekly to maintain equality. STAD requires a highly structured schedule of instructional activities to be repeated twice weekly; 40 minutes of lecture and discussion, 40 minutes of study in teams and a 20-minute quiz (Slavin, 1978). STAD is low in task interdependence and high in teacher-imposed structure and individual accountability.

Research on Student Teams-Achievement Divisions

Research on STAD in controlled studies has shown improvements for outcomes such as student achievement at a variety of grade levels and in many subjects, intergroup relations, and student self-esteem (Slavin, 1986). A seven-week study by Madden and Slavin randomly assigned six classes in an elementary school to STAD or control conditions. A third, fourth, and sixth grade teacher each taught one STAD class and one control class for seven weeks. This study used the same method as used for the TGT study above done by Edwards, DeVries, and Snyder. Students were pre-tested on the computation subtest of the Stanford Achievement Test and a Divergent Solution test designed to measure the students' ability to think of as many ways as possible to write equations using a given set of numbers and operations. The results indicated that students in the STAD classes learned significantly more than the control students as indicated by a test covering the objectives taught in the class (Slavin, 1982).

Mevarech (1985) conducted a fifteen-week study with 134 fifth-grade students randomly assigned to four mathematics classes. All students received the same curriculum material (fraction unit) and the schedule of instruction. The four

treatments were student teams using mastery learning strategy, student teams without mastery learning, mastery learning, and a conventional setting. Mathematics achievement was assessed by a test consisting of 35 computation problems and 13 word problems created for this study. The results indicated that the students working with small group mastery learning strategies significantly out scored those that were not using small group mastery learning ($p < .01$).

Davidson (1990) reviewed about seventy studies in mathematics comparing student achievement in cooperative learning versus whole class traditional instruction. In more than forty percent of these studies, students in small groups significantly outscored the students working individually on mathematical performance measures. In only two of the studies did the students in whole-class traditional instruction perform better, and both these studies had design irregularities according to Davidson (1990). When individuals were held accountable and teams given recognition for achievement, the effects of cooperative learning of mathematics skills were consistently positive.

A study by Zahn, Kagan, and Widaman (1986) looked at the main effects of TGT and STAD showing no significant difference between the two methods. Zahn stated that the cooperative methods, TGT and STAD, appear to improve classroom climate over that of the traditional whole class instruction. Climate was measured in terms of student-to-student social relationships and attitudes toward schoolwork.

There is evidence that cooperative learning such as that defined by Johnson and Johnson (1975) increases social interaction and mutual concern about fellow classmates. The research on cooperative learning indicates that cooperative learning methods do help students to achieve academically and to learn social skills to survive in society. Teachers need to investigate the use of these methods for their classroom.

CHAPTER III

Introduction

Major reforms and recommendations for mathematics have recently been presented in two documents produced by the National Council of Teachers of Mathematics. Curriculum and Evaluation Standards for School Mathematics (1989) is a document that describes what a high-quality mathematics education for students, K-12, should comprise. The central theme for this document is the development of mathematical power for all students. Mathematical power includes the ability to explore, to conjecture, and reason logically; to solve nonroutine problems; to communicate about and through mathematics; and to connect ideas within mathematics and between mathematics and other intellectual activity. Mathematical power also involves the development of personal self-confidence and a disposition to seek, evaluate, and use quantitative and spatial information in solving problems and making decisions. To achieve the goals in this document, the curriculum and environment in which students learn must be changed.

The Professional Standards for Teaching Mathematics (1991), a document produced by the National Council of

Mathematics, states major changes are needed in the mathematics classroom environment. They recommend a shift in the classroom away from the teacher as the sole authority for right answers toward logic and mathematical evidence as verification. The classroom is not a collection of individuals but should move toward a classroom as a mathematical community. It was these documents suggesting relevant reforms in the teaching of mathematics, that contributed to this writer's decision to use cooperative learning methods to improve instruction in one area of the mathematics program.

The research objective was to find an alternative method for presenting the content in a mathematics classroom and cooperative learning seemed to be a promising approach. Implementing cooperative learning was viewed as a desirable direction because research has shown positive effects of cooperative learning in the following areas: academic achievement, self-esteem or self-confidence as a learner, intergroup relations, social acceptance of mainstreamed children, and ability to use social skills (Davidson, 1990).

Why STAD Was Chosen

In comparing the different cooperative learning methods, a structured method was sought that would allow the students to work together and simultaneously call for

individual accountability. Eighteen years' teaching seventh grade mathematics and observing student behavior has shown the teacher that well-structured and organized activities were needed to accomplish the goals assigned. To assess the progress of each child, a method was sought that incorporated individual accountability. Also, with a teaching schedule that included seven mathematics and computer science classes per day with six preparations, the method had to be developed with reasonable preparation time and could be presented in a forty-seven minute class period.

After investigating the student team learning methods, Jigsaw was discounted because it was not recommended for mathematics classes. According to Slavin (1988), Jigsaw is used in social studies, literature, science, or any material when information comes from books or other readings.

According to Slavin (1988), Team-Assisted Individualization (TAI) can be used for mathematics. TAI has the advantage of being an individualized method, providing for the needs of all students and giving students success at their own level. Despite these benefits, TAI was not selected because the method required enormous amounts of preparation time because individual spatial sense activities would need to be developed for all levels of ability in the classroom.

Teams-Games-Tournaments (TGT) is also used for mathematics as well as language arts, science, social studies, foreign language or other material with one right answer (Slavin, 1988). A study by Zahn, Kagan, and Widaman (1986) looked at the main effects of TGT and STAD showing no significant difference between the two methods. Although there were no differences in effects, TGT did require more class time for instruction and more preparation time. For those reasons, TGT was not selected.

The cooperative learning method, Student Teams-Achievement Divisions (STAD) was chosen as the most usable method. This choice was made because the method included less instructional time than the other methods and class materials could be developed without a huge investment of time. STAD is also high in reward interdependence, individual accountability, and teacher-imposed structure. Frequent quizzes give feedback to the students and teacher. The potential of the STAD method to challenge and to reinforce students when they saw their individual scores and the points they had earned for their group were also attractive features (Slavin, 1988). A summary of the activities commonly employed in a STAD based program has been included in Appendix A.

Setting

The cooperative learning unit was taught to two classes of seventh graders in the Lansing Middle School which is part of the Eastern Allamakee Community School District, Lansing, Iowa. The K-12 enrollment is about 530 students. The two seventh grade classes consisted of 34 heterogeneous students. The students move from classroom to classroom being exposed to a variety of teachers for forty-seven minute classes.

Preparing And Teaching The Unit

The content for the two week cooperative learning unit was spatial sense. According to Curriculum and Evaluation Standards for School Mathematics one area of emphasis in fifth through eighth grade mathematics should be spatial sense, an intuitive feel for one's surroundings and the objects in them. Another reason the spatial sense unit was selected to be taught was that over the years the teacher had noticed that there was a need for prerequisite knowledge before starting a unit on geometry. The teacher had found that the students find it difficult to visualize the material taught in the geometry unit.

According to Davidson (1990), cooperative learning lessons consist of two types of objectives: an academic objective and a social skills objective. Social skills are

those specific behaviors performed by all group members which help the group complete the task and like each other when the task is finished (Dishon & O'Leary, 1984). The ten lessons were prepared with both academic and social skills objectives (see Appendix B).

The cooperative learning method STAD is high in teacher-imposed structure. Each lesson was structured in the following order: class maintenance and problem of the day, teaching and modeling the social skill objective, teaching academic objective, cooperative learning activity, and conclusion.

In each lesson the teacher spent five minutes introducing the social skill. The teacher explained the social skill objective to the students, followed by role playing or modeling involving teacher and students to practice the social skill. The social skills that would be addressed were: encourage others, address group members by name, use eye contact, respond to ideas, disagree in an agreeable way, and check others' understanding of work. For a more complete list of social skills, see Appendix C.

In each lesson, the teacher spent ten minutes introducing the academic objectives. The teacher presented the lessons on an overhead projector to the whole group. For a complete list of academic objectives, see Appendix B.

STAD can be used with teacher-made materials. Lessons, activity worksheets, and quizzes were developed for a two-week unit on spatial sense. See Appendix D for a complete lesson with objectives and cooperative learning activity. The classes consisted of social skills and an academic lesson followed by a structured group activity which lasted for about 25 minutes. Each activity engaged students in a group-oriented cooperative learning lesson that included academic aims and social skills. Quizzes were composed of course-relevant questions worth 30 points (see appendix E). STAD calls for high individual accountability, therefore students worked alone on the quizzes (Slavin (1988). Individual student scores were recorded in the grade book to be used to figure the final report card grade.

The cooperative learning method STAD required that the teacher's classroom role be modified. The teacher began to think and act differently. The teacher changed from being primarily the dispenser of information to a facilitator, monitoring and observing the students in their groups to see if they were meeting the objectives for the lesson. The teacher did not answer the students' questions immediately. Rather the teacher encouraged the students to work together in their groups to find the answers.

When monitoring the groups, the teacher's role was one of interacting instead of intervening (Dishon & O'Leary, 1984). If intervention was used to stop inappropriate behavior, the students would have come to depend on the teacher to convince them to keep working and to use the social skills. Interacting would not always produce immediate results because students often spent more time settling arguments and deciding how to work together. Initially, the groups did not reach their goals and did not get the reward. As the students learned to work things out for themselves without relying on the teacher, they began to experience a sense of ownership for their success or failure as a group. Students began to develop a feeling of power. Examples of interaction teacher questions would be: Is this a group question? What does your group think? What has your group done so far? What are you going to do next? For an example of teacher-student discourse on interaction and intervention, see Appendix F.

The cooperative learning method STAD required that the teacher assigns students to teams. To accomplish this, the students were ranked in the class from highest to lowest on past performances (Slavin, 1988). (see Appendix G) The information used were quiz scores, grades, and teacher judgment. To decide on the number of teams in the class, the number of class members was divided by four (Slavin,

1988). Some groups had five members if the division was not even. Each group consisted of high, middle, and low achieving students. It was important to balance the teams so that the students with different performance levels within a team could tutor others and no single team would have an advantage in academic performance (Slavin, 1988). The teams were balanced for race or ethnicity, sex, and social compatibility according to teacher judgment. Team summary sheets were filled out leaving the name of the group blank to be determined eventually by the group members (see Appendix H).

Each student was assigned a base score which is the minimum raw score the teacher expects the student to get on a 30 point quiz. The ranked list of students was used to make base score assignments. According to Slavin (1988), if the class had 24 or less students, the top two students on the ranked list received a base score of 20; the next two students, 19; and so on. The base score of the students on the bottom were checked to make sure that the minimum base score was an obtainable score for the students and adjustments were made. The base scores would be adjusted after every two quizzes. When adjustments were made, the base score was five raw score points below the student's average past quiz scores (Slavin, 1988).

As soon as possible after a quiz, individual and team scores were returned. Points that students earned for their teams were the difference between their quiz scores and their base scores which were called improvement points. Students earned a maximum of 10 improvement points per quiz. A perfect paper, regardless of their base score, received the ten point maximum. The minimum number of improvement points that students could earn was zero even if their quiz scores were below their base (see Appendix I). Team scores were received by adding up the improvement score for each team member. If a group had five members instead of four, the score is prorated (Slavin, 1988).

STAD is high in reward interdependence. Recognizing teams' accomplishments was important. Newsletters recognized the teams with the highest scores and published names of students who exceeded their own base scores or who completed perfect papers (Slavin, 1988). (see Appendix J)

Quizzes were used to measure individual academic achievement. Social skills objectives were measured by teacher observation of student behavior as they worked on cooperative learning activities. Verbal and nonverbal actions were considered in the observation. A tally mark was placed on the social skill observation form each time a student accomplished the social skill objective. (see Appendix K) The form was duplicated so the teacher could

keep a record. The sheet was cut apart by groups and returned to the students for processing.

A change in classroom procedure can help students to begin to see learning activities as social instead of isolated, fun instead of boring, under student control instead of teacher control (Slavin, 1988). Cooperative learning strategies can make activities more appealing to the students. Students gain self-confidence and control over their own learning. The review of literature and my analysis of the experience teaching the spatial sense cooperative learning unit has shown that STAD can improve academic achievement and the use of social skills. The results are discussed in chapter four.

CHAPTER IV

Conclusion

The purpose of a literature review and collateral field study was to become knowledgeable about several cooperative learning strategies and to become familiar with the effects of using them in a mathematics classroom. The study was also done so the investigator could make comparisons with cooperative learning studies reviewed in the literature and one using cooperative learning while teaching a two week unit on spatial sense.

The review of the literature attempted to answer four questions. First, what are the characteristics of cooperative learning? Cooperative learning consists of small learning teams, working together, helping each other to achieve, and receive awards when they meet their goals. Cooperative learning methods vary from each other along five dimensions: reward interdependence, task interdependence, individual accountability, teacher-imposed structure, and use or non-use of group competition.

Second, what are the purported advantages and disadvantages of using this approach; particularly when compared to conventional teaching arrangements that favor

teacher presentation and practice exercises? Research has shown positive effects of cooperative learning in the following areas: academic achievement, self-esteem or self-confidence as a learner, intergroup relations, social acceptance of mainstreamed children, and ability to use social skills (Davidson, 1990). Other advantages of cooperative learning are immediate feedback and individual help for the students. Students become active learners and begin to enjoy mathematics more (Smith, 1987). It was my decision based on analysis of my teaching experience and research on cooperative learning methods to strive to accomplish two cooperative learning advantages in the spatial sense unit. The cooperative learning spatial sense unit incorporated the advantages of academic achievement and use of social skills. Collected data from quizzes and teacher social skills observation forms showed these advantages were achieved.

One other advantage that was observed was a change in student attitude. There were observed changes in the students' behavior in the classroom which indicated a change in attitude. The students entered the classroom wanting to know what they were going to do in their groups. Their enthusiasm for the activities was shown when they asked if they could repeat activities. At the end of the spatial

sense unit they asked if they could work in groups again. The cooperative learning unit offered a change from the routine of traditional whole-class instruction.

The disadvantages of cooperative learning are: it may not work for all grade levels, it may not be effective for teaching higher-order conceptual learning, teachers must change their role to that of facilitators, and more time is needed in and out of the classroom preparing for the cooperative learning unit (Slavin, 1990). In the development and teaching of the spatial sense unit, the teacher noted two disadvantages. The cooperative learning unit required a great deal of teacher preparation time for developing both the academic and social skills objectives and new materials, keeping records of student performance, and preparing newsletters. Class time was needed to instruct the students on the social skills objectives. The materials can be used again; but each time the cooperative learning unit is taught, extra time must be set aside for keeping records of social skills, preparing newsletters, and instructing students on social skills. It was especially important to keep track of improvement scores, adjust the base scores, and get the newsletters out on time so the improvement scores had meaning for the students. This extra

time would not be needed by a teacher in a traditional class setting.

The other disadvantage was that the classroom teacher's role had to change from dispenser of information to facilitator. The change was beneficial to the students because they learned to accept the responsibility for their own learning, but it was a difficult change for a traditional classroom teacher. I found it difficult to not answer the students' questions immediately and to give up part of the control of the classroom to the students so they would accept the responsibility for their own learning and behavior. Learning interaction instead of intervention takes conscious effort and practice by the teacher.

Third, what contributions do some of the most common cooperative learning strategies make toward improving mathematics achievement in the elementary and junior high grades? The major cooperative learning strategies discussed included Team-Assisted Individualization (TAI), Jigsaw, Teams-Games-Tournaments (TGT), and Student Team-Achievement Divisions (STAD). Research on the various cooperative learning techniques has been conducted wherein investigations compared experimental cooperative learning groups with control groups who were instructed using other methods. The studies varied in method so it was difficult

to compare results from one study to another but there was wide agreement among researchers that cooperative learning strategies have positive effects on student achievement. The positive academic outcomes of each cooperative learning research effort are not conclusive in themselves, however, the results of many studies have provided evidence that the strategies of cooperative learning do affect achievement. Best results have been obtained when achievement depends on two features of cooperative learning. The group must work for a common goal, and the students must be held individually accountable (Slavin, 1980). The teacher as the facilitator had to guide students, through interaction, to reach the group goal. The students are held accountable by individual testing.

Fourth, how can Student Team-Achievement Divisions (STAD) be used to teach students cooperative learning skills while helping them to become more proficient in one area of the mathematics curriculum? In the field study, STAD was used to teach a two-week spatial sense unit to seventh grade students. The activities of STAD include teach, work in groups, test, and reinforce. Each lesson included an academic and social skill objective. The lesson was divided into teaching the social objective and the academic objective followed by the cooperative learning activity.

Based on test results and teacher observation, the overall results indicate that STAD approach had positive effects on mathematics achievement and use of social skills. The students showed improvement on their individual test scores. The teacher-made pre- and post-tests consisted of ten questions worth 30 points (see Appendix E). The mean of the pretest was 5.5. The results of the post-test showed an improvement with a mean of 22.4 (see Table 1). Part of the improvement was due to students not being familiar with the vocabulary and content of the unit prior to taking the pretest. Also, improvement in the scores could have been due to the high interest in the variety of activities from the unit. When comparing the improvement made by the high, middle, and low achieving students, this study showed that all ability groups improved about the same number of raw score points.

During the cooperative learning activities, the teacher observed the students working in their groups to see if their behaviors indicated that they were using the social skills objectives for the lesson. A record of their behaviors was kept on a social skills observation form (see Appendix K). A tally was made on a social skill observation form each time the social skill for the lesson was observed by the teacher. Verbal as well as non-verbal behaviors,

such as hand gestures, eye contact, body position, and nodding, were considered. The overall data collected was sufficient to indicate that students were working on the social skills. The students received a copy of the form for their group to process the next day. Groups could share with other groups if they chose to but the results of the social skills use were not reported in the newsletter. The data collected and tallied from the observation forms indicated an increase in the use of social skills as the unit progressed. The group that had the highest test scores on the post-test was observed to be using the social skills more often than the other groups.

Team improvement scores were recorded and printed in the newsletter (see Appendix J). The teams that were at the top consisted of the groups that used their time to complete the task. These groups appeared to organize the work that needed to be done and seemed to develop their social skills more quickly than the other groups. Although a balance of social skills was a criteria for setting up the groups, it seemed that a few groups were able to adapt to the cooperative learning groups very quickly. The groups that did not do as well were groups that at first struggled with the responsibility to direct their group to complete a task and showed the poorest development of the social skills.

When looking over the cooperative learning unit, there are changes to be made before I attempt the unit again. First, although a newsletter was sent to the parents prior to the unit being taught, most parents were not well informed. The reasons could be the students did not take the newsletter home or the letter did not give enough information. Cooperative learning units need to be preceded with more instructions for the parents. This could be done with a better newsletter or at a meeting. Second, the seventh grade classes that were used for this spatial sense unit consisted of very cooperative students. Some students did not get involved immediately with the groups but there were not any students that refused altogether to work in the group. Again cooperation could be due to an exceptional group of students or could be due to the types of activities and the newness of the content. The teacher needs to be prepared to handle the student who would refuse to work in the group and deal with the group if they knew they had a member who would not contribute to the success of the group. Third, recognition was given in the newsletter for top-scoring teams and individuals who had a perfect paper or exceeded their base score. STAD should be high in group competition, and this I did not incorporate in the unit. More incentives or rewards could be offered for the top

teams such as extra-credit points, free time, or computer time which would bring in more group competition. Fourth, the group success did not affect individual grades. STAD is high in individual accountability, therefore individual test scores were awarded and kept in the grade book. Although the students were cooperative this year working to complete the cooperative learning activities, in other years students might feel that because the group performance did not effect their grade they might not be willing to help others. The grading process needs to be changed to incorporate group success. Again extra credit points could go to each member of the best group. Fifth, attendance was not a big factor during the time the unit was being presented. During the year, absentee rates can increase substantially due to illness, weather, or other conditions. Since the team score depends on individuals' performances, some type of compensation or extra work sessions would have to be made for the absentees. Also in the groups the students can brainstorm a solution to a problem and the members of the group will begin to see and view the problem from many different perspectives that could lead to many possible solutions to the problems. Sixth, with the change in the special education departments, the teacher needs to be prepared to use the cooperative learning methods more in the

classroom because research has shown one advantage of the cooperative learning method is social acceptance of mainstreamed students.

Other questions have arisen and need to be answered about cooperative learning. Is cooperative learning effective for teaching higher-order conceptual learning? I believe that high order learning skills could be taught with cooperative learning methods because sharing ideas and encouraging of each other in the group gives encouragement to the students to become better problem solvers in our society. When students work in groups they can get a different perspective of a problem. Brainstorming possible solutions or ways to think about a problem can begin to open insights to situations that individuals may not think of on their own. Students who have a good understanding of the material can tutor other students to give them the one-on-one help and attention some students need.

Do the benefits of cooperative learning transfer from one unit to another or from one classroom to another? I feel that the experience the students received in one unit would not be adequate exposure and practice for the students to transfer what they have learned to other units. The spatial sense cooperative learning unit was short, and students quickly forget what they do not use. Although some

students had joked about the social skills in the spatial sense unit, they would, for example, refuse to answer another student unless they were addressed by name. Experiences were soon forgotten, to be replaced by other experiences at this fast-changing time in the students' lives. Some type of maintenance program should be in place if students are going to return to cooperative learning units. I do believe that if many teachers in a school system used cooperative learning units, there would be a noticeable carry-over from one classroom to another.

Another question that needs to be researched is: what would be the effects if cooperative learning played a primary role in the classroom? Many teachers use cooperative learning methods, but it is thought that few use cooperative learning strategies as their primary way to organize instruction (Slavin, 1983). I believe there would be many benefits from using the cooperative learning method for all classes and units. Many benefits that we may not realize yet could arise because most of the research involves a short time period.

The field study had positive results; and as a professional I am seeking different ways to instruct my students so they will be successful as life-long learners. The students seemed happy and willing to work on the

activities which made my job easier. My positive experience leads me to want to develop more units and to share my experiences with other teachers in our school.

Professionally and personally, the cooperative learning unit provided a change from the routine of the traditional whole-class. Change created variety and keeps my enthusiasm up for the teaching profession. Also, when I show more enthusiasm, the students seem to sense my mood and become more enthusiastic.

One concern I had when starting the unit was discipline. I wondered how the students would react to this new method. The noise level seemed to bother the teacher more than it disrupted the students in the class. There was no noticeable difference in the way the students behaved although there was more noise because the students were working together.

In cooperative learning, the students were to take control of their learning, but I did not know if they were ready for the responsibility or if I was ready to relinquish my control to the students. I was concerned that students might get left out of their groups, missing out on the learning objectives.

The one big disadvantage of the cooperative learning method is the tremendous amount of time it takes. This one

disadvantage would keep some teachers in our school from trying a cooperative learning unit. The next time I teach the cooperative learning method I will be better prepared because the lessons and activities have been used and adjusted. Help could be sought from other sources to help with keeping records and typing newsletters to bring the time element in line.

Society and the future depends on students being prepared in the classrooms of today. Cooperation is a key to success in our work and personal relationships as adults (Johnson & Johnson, 1975). Teachers must change the methods they are using to instruct students. Working individually can be replaced with cooperative learning groups so the students learn the social skills necessary to cope with the demands that will be placed on them in society. The research on cooperative learning methods and the experience I have had with STAD leads me to believe that cooperative learning is a valid method to use in the classroom to prepare the students for productive roles in the future. Cooperative learning methods provide an effective means of achieving academic and nonacademic goals. Improvement in our educational system may result from the use of cooperative learning. The cooperative learning method STAD

will be used again in my classroom because the observed behavior and academic achievement were positive.

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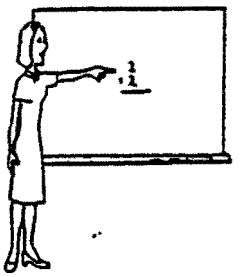
Appendix A

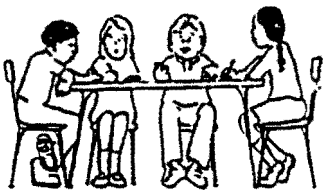
Basic Schedule of Activities for

STUDENT TEAMS-ACHIEVEMENT DIVISION (STAD)

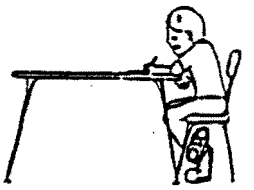
TEACH



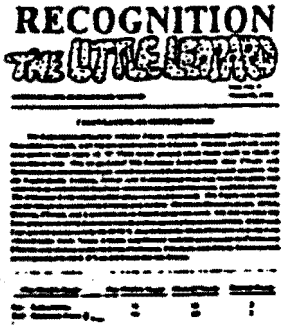
TEAM STUDY



TEST



TEAM RECOGNITION



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Appendix B

Spatial Sense Unit
Objectives by Lesson

Lesson 1.

Academic Objective: The student will be able to describe orally and in written form what he/she sees.

Social Skills Objective: The student will address group members by name and use eye contact.

Lesson 2.

Academic Objectives: The student will be able to develop the rule for a pattern and give the next object in a pattern. The student will be able to state orally or in written form the rule for the pattern.

Social Skills Objective: The student will be able to encourage others.

Lesson 3.

Academic Objective: The student will be able to develop a pattern to cover a region.

Social Skills Objective: The student will be able to check others' understanding of the work.

Lesson 4.

Academic Objective: The student will be able to describe orally or in written form the results of cutting a pattern on a folded paper.

Social Skills Objective: The student will be able to encourage others.

Lesson 5.

Academic Objectives: The student will be able to name the tangram pieces. The student will be able to cover drawings with tangram pieces.

Social Skills Objectives: The student will be able to respond to ideas.

Lesson 6.

Academic Objectives: The student will be able to define the word congruence. The student will be able to recognize congruent figures and what attributes make figures different.

Social Skills Objective: The student will be able to disagree in an agreeable way.

Lesson 7.

Academic Objective: The student will be able to show congruency by covering an object with pentominoes, demonstrating rotation or flips with the pentominoes.

Social Skills Objective: The student will be able to check others' understanding of the work.

Lesson 8.

Academic Objective: After observing examples of optical illustrations, the student will be able to describe orally or in written form what he/she sees.

Social Skills Objective: The student will be able to encourage others to talk and contribute ideas.

Lesson 9.

Academic Objectives: The student will be able to describe orally three-dimensional figures. The student will be able to draw on dot paper three-dimensional figures.

Social Skills Objectives: The student will be able to address group members by name and check for others' understanding.

Lesson 10.

Academic Objective: The student will be able to draw on isometric dot paper representations of three-dimensional figures.

Social Skills Objectives: The student will be able to address group members by name and encourage others.

Appendix C

Additional Social Skills

Task Skills

Lower Elementary	Upper El/Jr. High	Senior High/Adult
Check others' understanding of the work	Check others' understanding of the work	Check others' understanding of the work
Give ideas	Contribute ideas	Give information & opinions
Talk about work	Stay on-task	Stay on-task
Get group back to work	Get group back to work	Get group back to work
Repeat what has been said	Paraphrase	Paraphrase
Ask questions	Ask questions	Seek information & opinions
Follow directions	Follow directions	Follow directions
Stay in seat	Stay in own space	

Maintenance Skills

Lower Elementary	Upper El/Jr. High	Senior High/Adult
Encourage	Encourage	Encourage
Use names	Use names	Use names
Invite others to talk	Encourage others to talk	Encourage others to talk
Respond to ideas	Respond to ideas	Acknowledge contributions
Look at others	Use eye contact	Use eye contact
Say "Thank you"	Show appreciation	Express appreciation
Share feelings	Share feelings	Share feelings
Disagree in a nice way	Disagree in an agreeable way	Disagree in an agreeable way
Keep things calm	Keep things calm	Reduce tension
		Practice Active Listening

Dishon, D. & O'Leary, P. (1984). A guidebook for cooperative learning: A technique for creating more effective schools. Holmes Beach: Learning Publications, Inc.

Appendix D

Spatial Sense
Lesson 9

Time 47 Minutes

Academic Objective: The student will be able to describe orally three-dimensional figures. The student will be able to draw on dot paper representations of three-dimensional figures.

Social Skills Objective: The student will be able to address group members by name and check for others' understanding.

Class Maintenance and Problem of the Day: 2 Minutes

Social Skills Lesson 5 Minutes

State the social skills objectives for the students. Give an example of objectives. (Example: John, do you understand the problem? John, what did you get for an answer? John, compare your isometric drawing to mine to see if we agree.) Role play between teacher and student for a demonstration.

Academic Lesson: 10 Minutes

The student will be asked to communicate verbally what he/she sees. The students will need to relate back to a previous lesson on optical illusions. Is what you see what actually is there?

Show the students Figure 12 on overhead transparency. A circle, a rectangle, and a triangle with a part missing are a cup, a brick, and a sandwich when viewed from a different angle. Have the students discuss what else the figures could represent.

Show the students figures 13 and 14 on the overhead projector and repeat the process.

Cooperative Activity: 25 Minutes

Have the students arrange the blocks on the desk as they appear on the handout. The students will describe in words to the other students what they see from the side of the table they are sitting. Remind the students to check top view.

The students will make a copy with blocks of a three-dimensional figure that is on display in the room. The students will draw what they see on dot paper. The students will rotate the figure and papers to check for others' understanding.

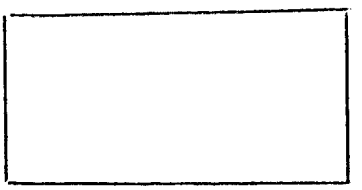
Conclusion or Questions: 5 Minutes

Evaluation: Classroom Observation Sheet for Social Skills. Collect drawings from the groups.

Materials: Puzzle of the Day, Overhead, Overhead transparencies, Cubic Blocks (one set per group), Isometric Dot Paper

Puzzle of the Day
(Information on the Bulletin Board)

How many rectangles do you see?



How many rectangles do you see?

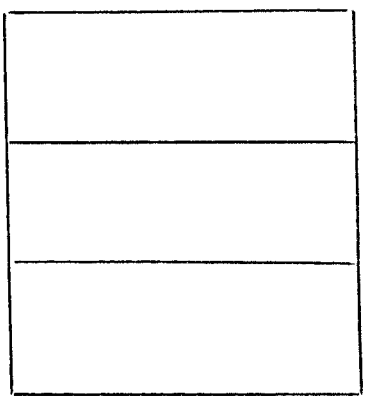


Fig. 12

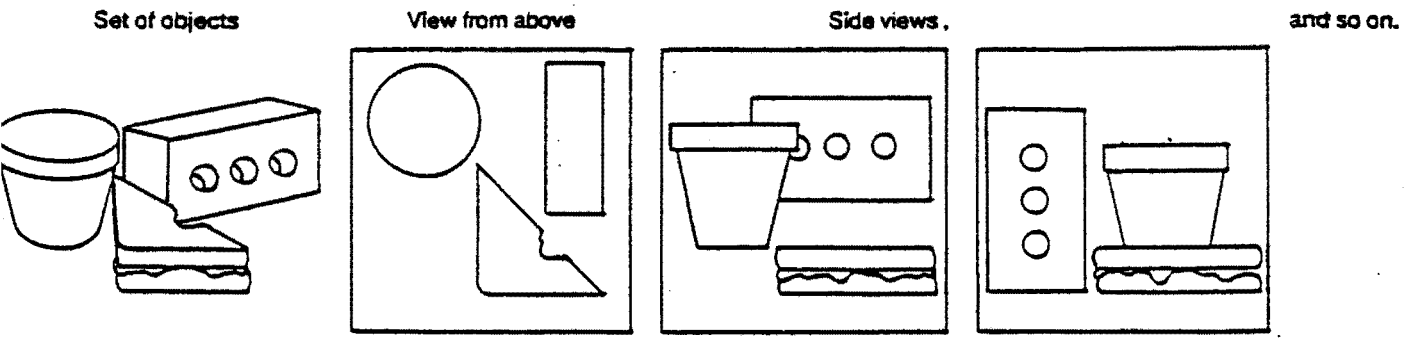


Fig. 13

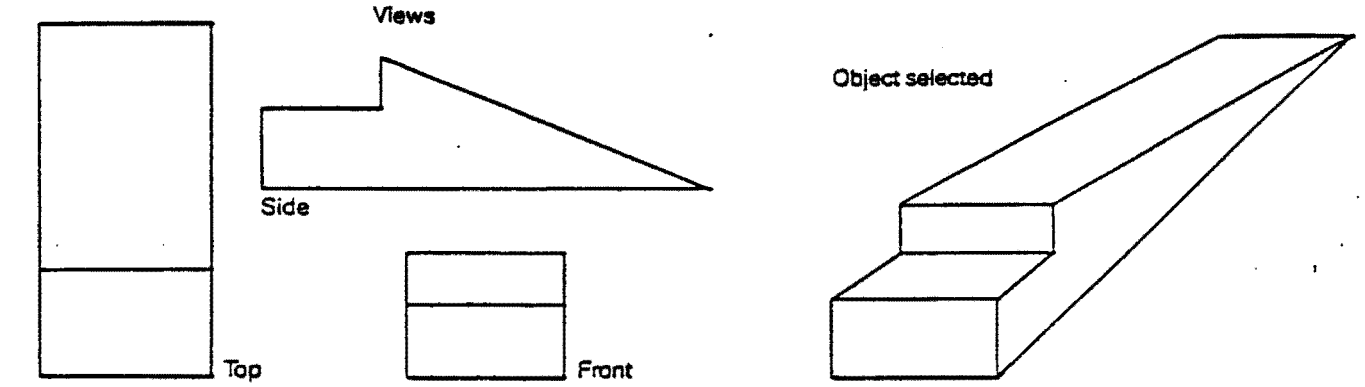
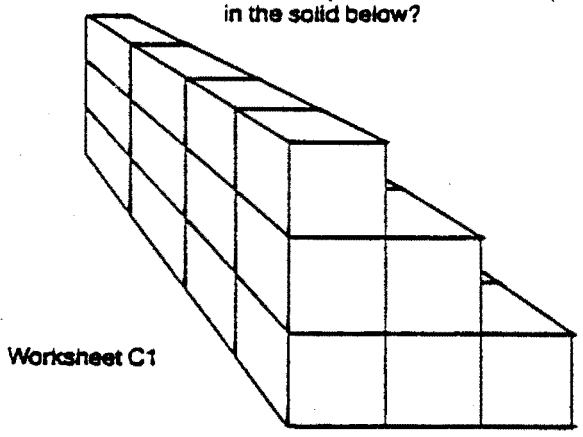


Fig. 14

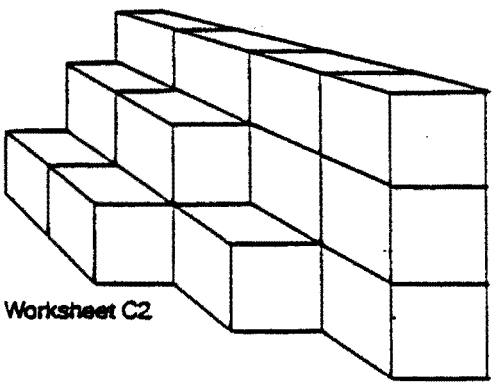
How many cubes are stacked up in the solid below?



Worksheet C1

Fig. 15

How does your answer to C1 change if you are also given the back view below?



Worksheet C2

Cooperative Learning Activity
Lesson 9

Materials: One set of cubic blocks for each group. Several sheets of isometric dot paper per student. One worksheet per student.

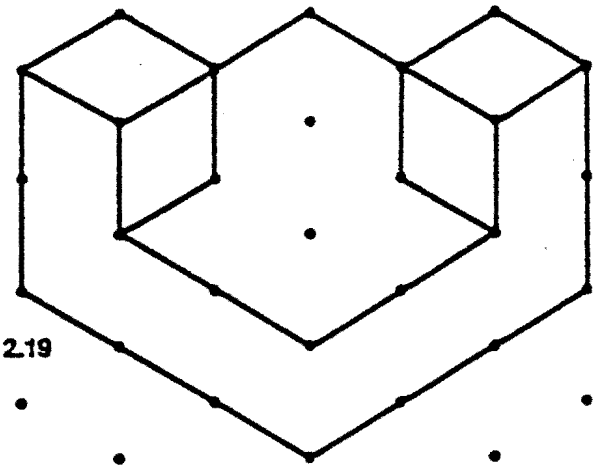
1. Students will get in groups and send one student per group to get the materials needed for the activity.

2. Students will remember to use social skills discussed in class.

3. Students will arrange the blocks on the desk as they appear on the handout. (Do one drawing at a time.) The students will describe in words to the other students what is see from the side of the table they are sitting. Remember to check the top view.

4. Students will make a copy of the three-dimensional figure on display with blocks. There are three different displays in the classroom. Do one at a time. Students will draw what they see on dot paper, then rotate the figure and papers to check for others' understanding.

5. At the end of the cooperative activity time, one student collects the papers to be turned in to the teacher. One student returns materials to appropriate position. All students return to assign places.



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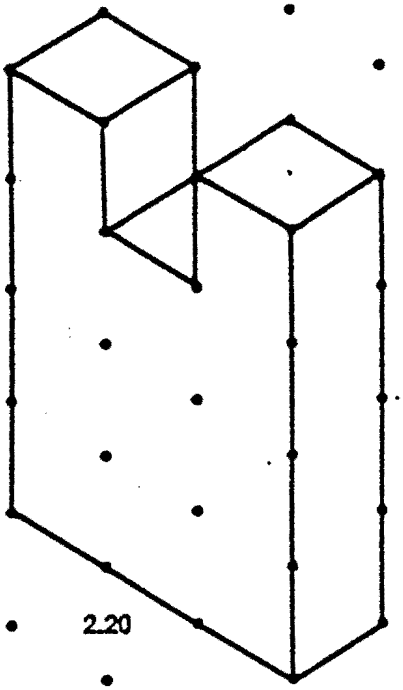

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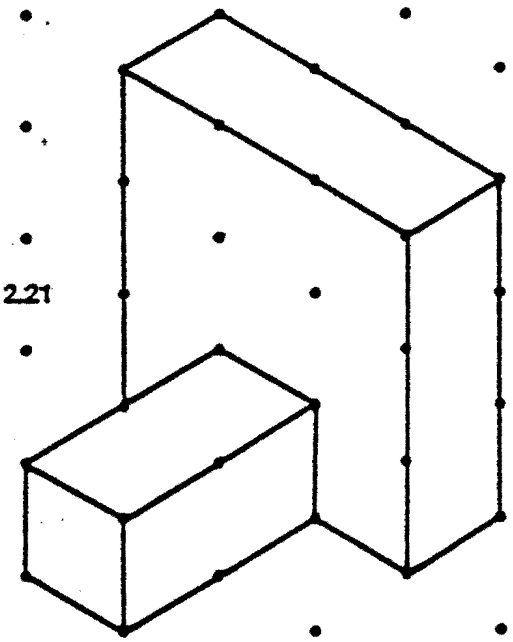

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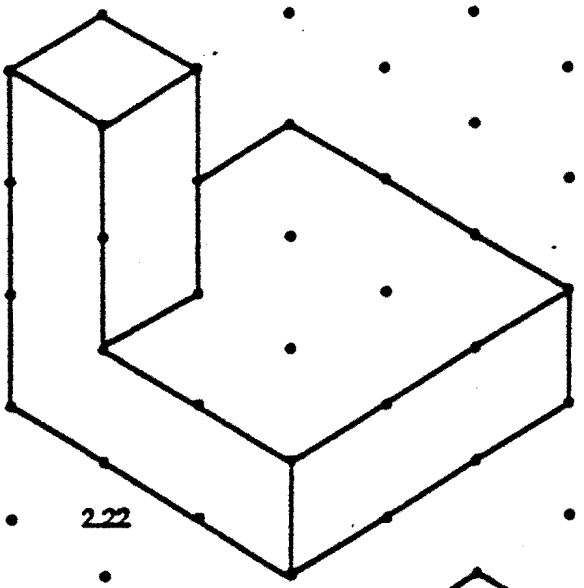

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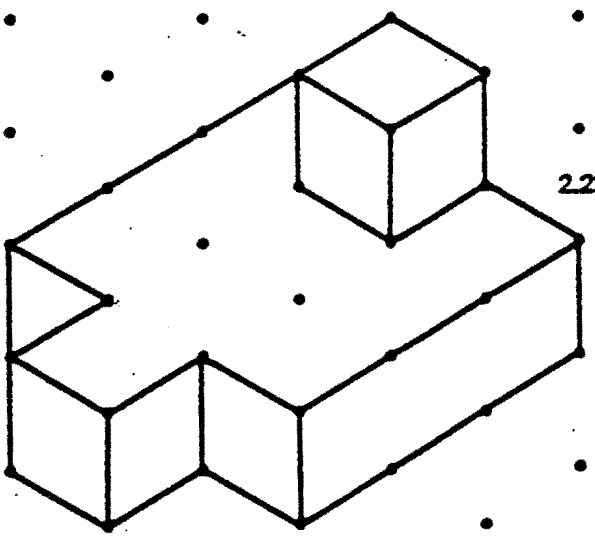
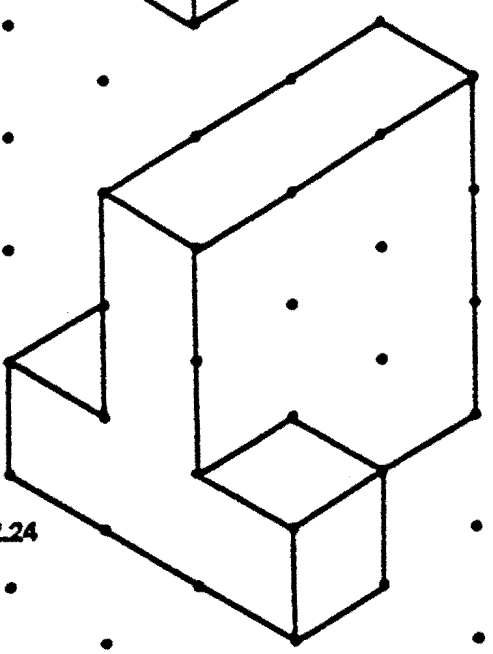


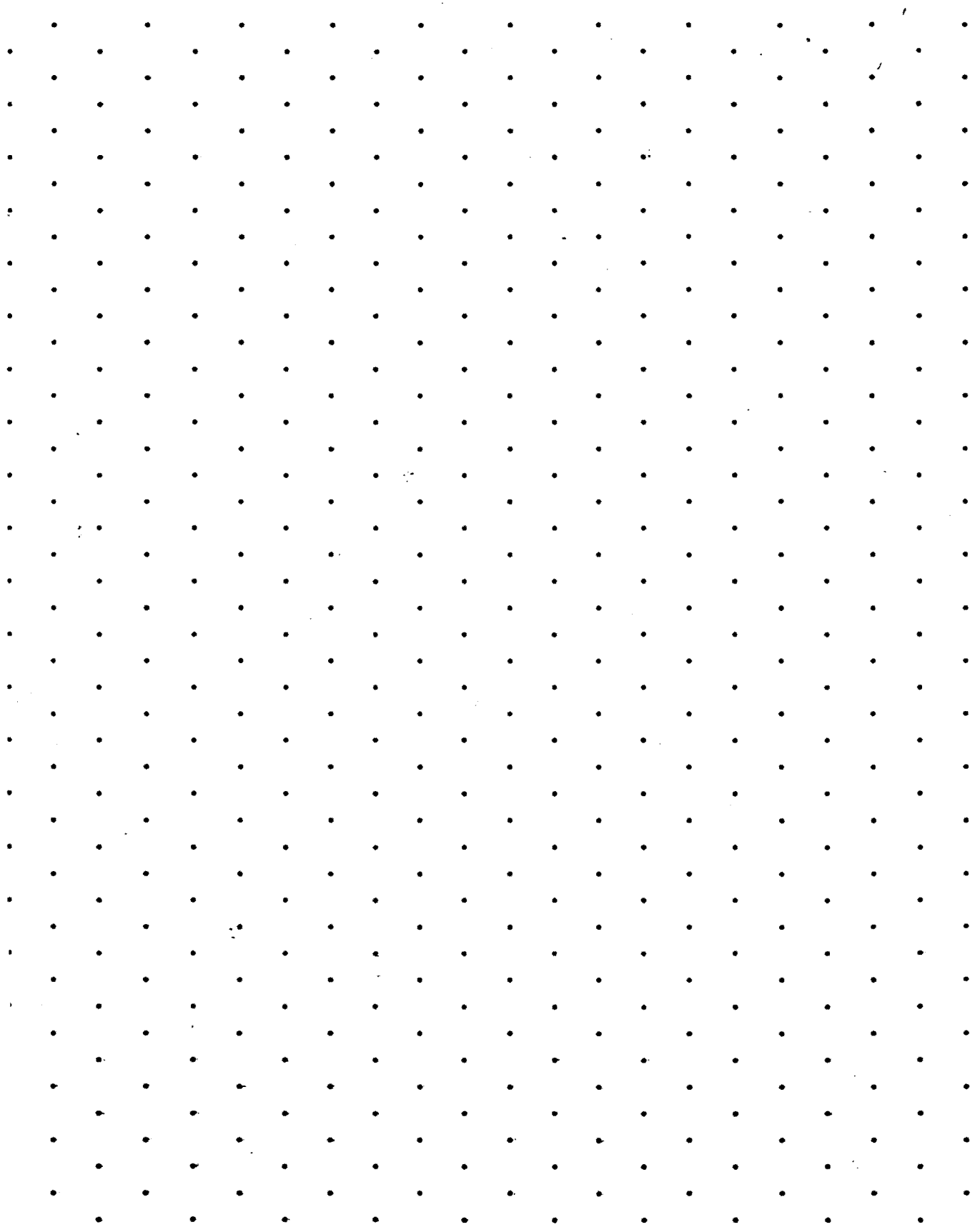
2.23



2.24

Materials 5-1

Isometric Dot Paper



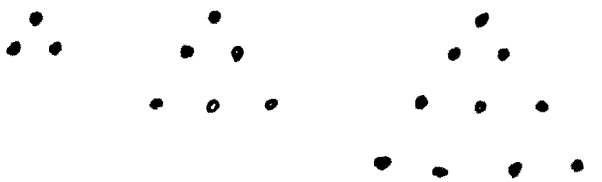
Appendix E

Name _____

43 Minutes

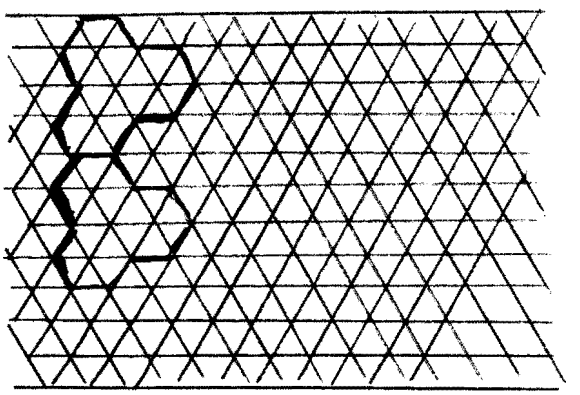
Post-Evaluation

1. Triangular numbers represent a collection of dots in ever-increasing-size triangles. Draw the next pattern.

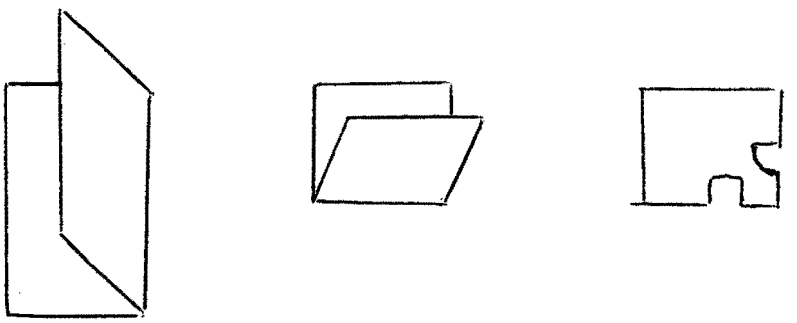


2. How many dots are used to represent the 6th triangular number.

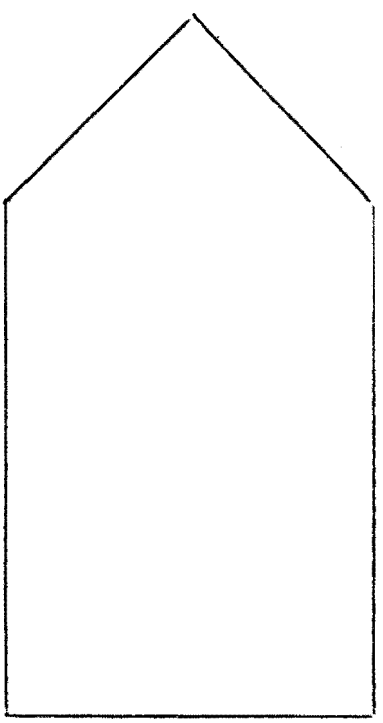
3. Complete a tessellation of these shapes across the page. Color your finished tessellation with three colors. Do not have two shapes of the same color touch each other.



4. If a square sheet of paper is folded in half, in half again, and cut as shown, draw what the unfolded sheet would look like.

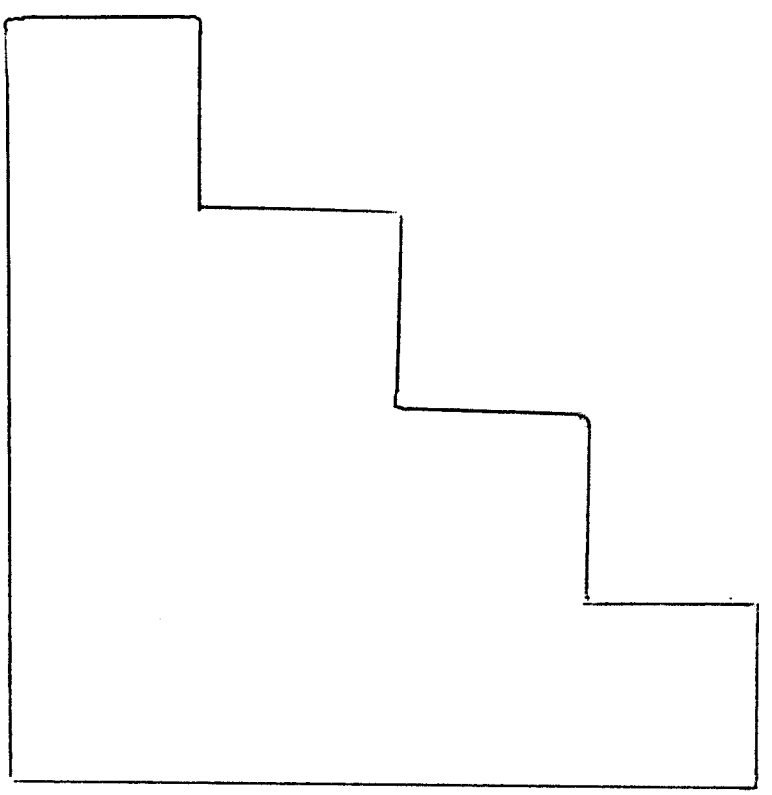


5. Cover the drawing with tangram pieces. Trace them on the paper when you have them in position. Label the shape of each piece.

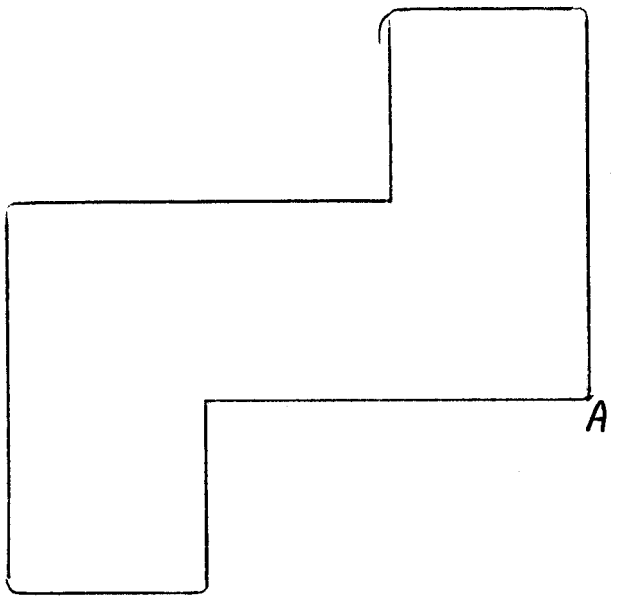


6. Use either tangrams or pentominoes. Draw two congruent figures. Give the shape name if it is a tangram piece or give the letter if it is a pentomino.

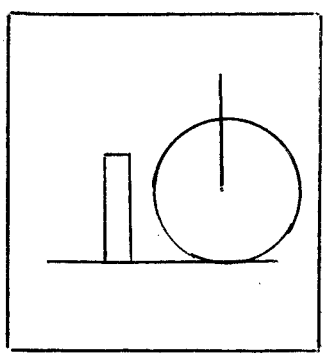
7. Cover the figure with pentominoes. Trace the figures and give the letter of each shape.



8. Draw this figure rotated to the right 90 degrees. Use A as the point of rotation



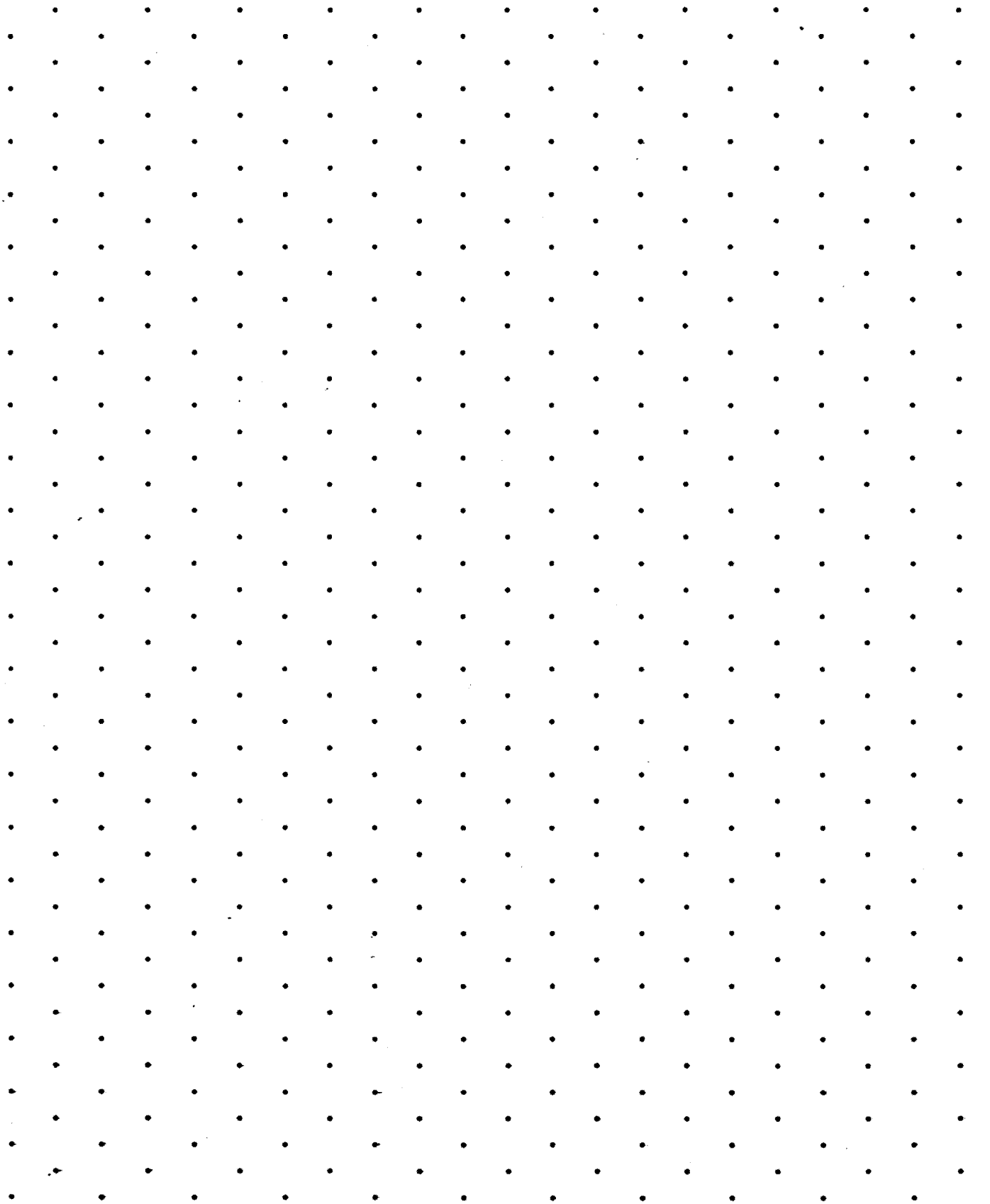
9. Write complete sentences that will describe how I would draw this figure on the paper if I could not see the figure.



10. On dot paper, draw the top view, the view from the right, and front view of the figure constructed of cubic blocks in the front of the room. On your desk, you may place an exact replica of the figure.

Materials 5-1

Isometric Dot Paper



Appendix F

Teacher-Student Discourse

Intervening

Student 1 What is the correct drawing for the top view of this three-dimensional figure? What I have on my paper or what Student 2 has on the paper?

Teacher Student 2 is correct.

Interacting

Student 1 What is the correct drawing for the top view of this three-dimensional figure? What I have on my paper or what Student 2 has on the paper?

Teacher Is this a group question?

Student 1 Yes. (If answer is no, the teacher encourages the student to consult with the other members of the group. Teacher interaction stops.)

Teacher What does the group think?

Student 2 I think I am correct.

Student 3 I think Student 2 is correct.

Student 1 I think Student 1 is correct.

Teacher What have you done so far to prove which is correct?

Student 1 Looked at the figure.

Teacher Is there anything else you could have done?

Students No response.

Teacher What could you do next?

Once the students start to brainstorm what to do next, the teacher moves away.

Appendix G

Assigning Students to Teams

Cooperative Learning

Spatial Sense Unit

	Rank Order	Team Name
High-Performing Students	1	A
	2	B
	3	C
	4	D
	5	E
	6	F
	7	G
	8	H
Average-Performing Students	9	H
	10	G
	11	F
	12	E
	13	D
	14	C
	15	B
	16	A
	17	
	18	
	19	A
	20	B
	21	C
	22	D
	23	E
	24	F
	25	G
	26	H
Low-Performing Students	27	H
	28	G
	29	F
	30	E
	31	D
	32	C
	33	B
	34	A

Appendix H

Team Summary Sheet

Team Name _____

Team members						Total

Total Team Score
Team Average*
Team Award

*Team Average = Total Team Score / Number of Team Members

Improvement Point Criteria

Quiz Score	Improvement Points
More than 10 points below base score	0
10 points below to 1 point below base score	10
base score to 10 points above base score	20
more than 10 points above base score	30
perfect paper (regardless of base score)	30

Slavin, R. (1986). Using student team learning
Baltimore: The John Hopkins Team Learning Project.

Appendix I

Example of Base Scores and Improvement Points
Date:

Student	Base Score	Quiz Score	Improvement Points
John	16	23	7
Mary	18	30	10
Tanya	23	30	10
Sam	16	27	10
Cheryl	17	17	0
Jose	21	23	2
Frank	18	17	0

Figure 4

Slavin, R. E. (1988). Student team learning: An overview and practical guide. Washington: National Education Association.

Appendix J

Spatial Sense Newsletter

Issues No 2

Teams

Brains	Calculators	Just Us	Fantastic Four
Names	Names	Names	Names
_____	_____	_____	_____

Calculators out figure class!

The calculator punched into first place with a near-perfect score of 38 points. Way to go Calculators! The Fantastic Four and Brains were very close to a tie. They were separated by two points. (Fantastic Four 35 and Brains 33.) Brains struggled very hard to improve from last place. Keep going Brains! Just Us had 28 points. Keep working to get back up to second place again. You can do it.

Ten point scorers
Student name (Calculators)
Student name (Calculators)
Student name (Fantastic Four)
Student name (Brains)
Student name (Brains)

Rank	
Calculators	1
Fantastic Four	2
Brains	3
Just Us	4

Appendix K

Cooperative Learning
Social Skill
Observation Form

Lesson: 9
Date:

Student Names	Social Skills	
	Check for Understanding	Use names
Group name		
Group name		
Group name		
Group name		

Make a tally by each name when the social skill is observed (Hear a student use another student's name, students exchange papers to check for understanding). Copy sheet for teacher's records. Cut apart and give each group their copy for processing.

Dishon, D. & O'Leary, P. (1984). A guidebook for cooperative learning: A technique for creating more effective schools. Holmes Beach: Learning Publications, Inc.

Table 1

Test Results
Spatial Sense Unit

	Pretest	Post-Test
Raw Score	Number of Students	Number of Students
30	0	1
29	0	1
28	0	1
27	0	1
26	0	2
25	0	3
24	0	4
23	0	5
22	0	4
21	0	6
20	0	1
19	0	1
18	0	2
17	0	0
16	0	0
15	0	0
14	0	0
13	0	0
12	1	0
11	1	1
10	1	1
9	3	0
8	1	0
7	5	0
6	5	0
5	5	0
4	4	0
3	3	0
2	2	0
1	1	0
0	2	0
	Total 34	Total 34