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ABSTRACT

The purpose of this study was to better understand teachers' perceptions of collaborative learning and to explicate how they use computer activities to promote cooperative learning experiences. Based on questionnaire responses and group meetings, the Office of Research, Evaluation, and Assessment (OREA) identified seven New York City teachers of various grade levels who appeared to be using computers to encourage student collaboration. Classes ranged from a high school business course using spreadsheets, to special education students using simulations, to elementary school children using word processors for creative writing. OREA staff observed two to three class sessions of each teacher, and later met with them to clarify aspects of the observation and obtain information about related class activities. Of particular interest were the types of activities used, group composition, and the roles of teachers and students in these computer settings. Major findings include: (1) teachers believed that collaborative learning promoted the goals of problem solving and report production; (2) teachers used several types of software in collaborative learning activities; (3) most computer activities were structured so that students worked in pairs; (4) preparation did not involve instruction of students in social skills necessary for collaboration; (5) little or no role or task differentiation was observed; and (6) teachers acted as facilitators of the group work. Among the recommendations is that teachers be provided with further training and support for implementing collaborative learning. Appended are brief profiles of each of the seven class sites. (35 references) (GL)

OREA Report

EVALUATION SECTION REPORT

Collaborative Learning and Computers: What Some New York City Teachers Are Doing 1988-89

EVALUATION SECTION
John Schoener, Chief Administrator
March 1990

EVALUATION SECTION REPORT

Collaborative Learning and Computers: What Some New York City Teachers Are Doing 1988-89

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EVALUATION SUMMARY

Evaluations of the Municipal Assistance Corporation/ Vocational Improvement Program (MAC/VIP) Computer Education Program by the Office of Research, Evaluation, and Assessment (OREA) for the 1985-86 and 1986-87 academic years consistently found that most teachers perceived their role in the computer lab as being that of facilitator of learning rather than lecturer. They also believed that, in many cases, students collaborated with one another in their computer work. The 1987-88 OREA study of the MAC/VIP labs found that, while teachers did facilitate learning by working individually with students in the computer lab, there was little evidence of student collaboration. Further, many teachers used the term collaboration to mean any kind of interchange between students, whereas true collaborative learning involves planning and structuring of collaborative learning situations by the teacher, preparing students in the skills necessary for collaboration, and monitoring students' progress in using these skills.

The purpose of the 1988-89 study was to better understand teachers' perceptions of collaborative learning, and explicate how they use computer activities to promote cooperative learning experiences. Based on questionnaire responses and group meetings, OREA identified seven New York City teachers of various grade levels who appeared to be using computers to encourage student collaboration, and who were interested in participating in this study. OREA staff observed two to three class sessions of each teacher and later met with them to clarify aspects of the observation and obtain information about related class activities. Of particular interest were the types of activities used, preparation of students, group composition, and the roles of teachers and students in these computer settings.

These are the major findings based on questionnaires, observations, and discussions with teachers:

- Teachers identified several goals of collaborative learning, including problem solving and producing products such as reports. They believed that collaborative learning promotes these goals because students learn well from their peers and like to interact with other students.

- Teachers used several types of software in collaborative learning activities, including word processors and page layout programs, databases, spreadsheets, problem solving games, and programming languages.

- Teachers structured computer activities so that, in almost all cases, students worked in pairs. For the most part, groups were self-selected, but teachers selected some groups based on what they believed would constitute effective working relationships.

- To prepare students for collaborative activity, teachers generally told them simply to work together. Preparation did not involve instruction or practice in the social skills necessary for collaboration.

- Whereas in structured collaborative learning, the teacher plans for task and role differentiation and for students to practice taking various roles and tasks, this study found little or no such differentiation.

- Teachers acted as facilitators of group work by circulating around the computer lab in order to check on groups' progress, intervene in case of problems between students, praise or critique student work, and give new assignments.

- The role of students in these activities was to carry out tasks assigned by the teacher. Students were not expected to assume initiative in planning group work or implementing it.

RECOMMENDATIONS

Based on the findings reported here and other information presented in this report, the following recommendations are made:

- In view of many teachers' desire to use computers to promote collaborative learning, they should be provided with assistance in learning about the techniques involved in this instructional approach.

- Since computers are tools that can facilitate the implementation of collaborative learning, teachers should receive instruction on how to use computers effectively to promote collaboration.

- Guidance should be given to teachers in evaluating software in order to decide which programs are best suited for collaborative activity and which are best used in other learning situations.

- In order that teachers interested in using computers for collaborative learning might receive support from their peers, efforts should be made to link educators interested in this approach, through meetings, electronic bulletin boards, or other means.

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I. INTRODUCTION

PROGRAM OVERVIEW

For the past three years, the Office of Research, Evaluation, and Assessment (OREA) has been studying the Municipal Assistance Corporation/Vocational Improvement Program (MAC/VIP) Computer Education Program. In this program, administered by the New York City Board of Education's Division of Computer Information Services (DCIS), high school classes use computer labs for subject area and vocational instruction. One consistent finding of these studies was that a majority of teachers perceived themselves as facilitators of learning when teaching in the computer labs, whereas in regular classrooms, they were more likely to be lecturers. They also believed that students were more independent and responsible for their own learning in the computer labs, and participated more actively in academic activities. In addition, many teachers indicated that the use of computers tended to promote collaborative work among their students.

During the 1987-88 school year, OREA conducted an investigation into the roles of teachers and students in computer labs as compared with the regular classroom, and the kinds of interactions between students in each setting. Findings from this study supported teachers' perceptions about their roles and those of students. In the labs, teachers facilitated learning by working individually with students, while students demonstrated involvement with their work and the ability to work

independently. Evidence of collaborative work among students, on the other hand, was nearly nonexistent, and what collaboration there was tended to be spontaneous and not structured by the teacher.

Another finding of the 1987-88 study was that the term "collaboration" was commonly used by teachers to mean interaction of any kind between students. Collaborative learning, as used by most educators, however, implies joint planning and decision-making directed toward solving some problem or producing some product, such as a student newspaper or research report. It also involves planning and structuring by the teacher in terms of preparing students for collaborative work, setting up situations in which students have collaborative goals, and monitoring and assessing students' progress in achieving these goals. In many cases, however, teachers used the term collaboration when none of these elements was present to describe any situation in which students interacted with each other in the computer lab.

These findings prompted the present investigation, in which OREA studied a group of New York City public school teachers of various grade levels who reported that they used computers to promote collaborative learning. The focus of this study was on teachers' perceptions of student collaboration, the ways in which teachers structured their classes and activities, the teaching strategies they used, and the behaviors of students and teachers in such learning situations.

EVALUATION PROCEDURES

In order to identify a group of teachers who used computers for collaborative learning, descriptions of the proposed study were published in the DCIS newsletter Computalk and in a handout distributed at a conference sponsored by the Association for Computer Educators at the beginning of the school year. Teachers interested in participating in this study were asked to complete an application briefly describing the grade and subjects they taught, and the kinds of collaborative activities they used in the computer lab. OREA received approximately 60 responses from elementary school through high school teachers of a variety of subjects.

Since the number of responses was greater than anticipated, OREA sent each respondent a questionnaire asking them to describe in detail what they meant by collaboration and what role they thought the computer played in promoting it. The purpose of the questionnaire was to get a better picture of teachers' perceptions and practices concerning computers and student collaboration, with a view toward selecting a subset of respondents for site observations.

Approximately 20 teachers returned these questionnaires. Of these, 16 appeared to be incorporating some collaborative learning strategies into their instructional approach. In order to give these teachers a chance to meet and talk with others who were pursuing similar objectives and for OREA to question them more closely about aspects of their responses to the

questionnaires, OREA invited the teachers to attend a group meeting at either the Queens or the Brooklyn Technical Assistance Center. A total of eight teachers attended these meetings.

Based on information from these meetings and the questionnaire responses, OREA selected seven teachers to observe. Using an observation protocol developed for this study, evaluators observed each teacher, either teaching the same class or different classes, for two or three class sessions over a period of two months. Observers also met with teachers, usually after each observation, to clarify aspects of the observation, and to obtain information about any related activities that may have preceded the classes observed or follow-up activities planned.

SCOPE OF THIS REPORT

This report consists of four chapters. Chapter I includes the program overview and the evaluation procedures. Background information on collaborative learning is provided in Chapter II. Chapter III presents the findings from questionnaires and observations. Conclusions and recommendations are presented in Chapter IV. An appendix presents profiles of each of the seven class sites (taught by teachers A through G) visited.

II. BACKGROUND

In order to provide a context within which the findings of this study can be interpreted, a discussion of the theoretical framework of cooperative learning and a presentation of the relevant research in this area follows.

Although our nation's schools are being called upon to play an ever-increasing role in preparing students for the responsibilities of work, family life, and civic involvement, those who seek to improve American education often focus on the alteration of course content to increase academic knowledge rather than on the improvement of teaching methods to promote the development of critical social skills. For instance, Schuncke and Bloom (1979) have noted that cooperation is recognized as an essential component of social behavior--one which significantly contributes to societal stability--but our schools do little to promote it and, instead, strongly emphasize competition. However, educational researchers and cognitive psychologists are now renewing the call for the adoption of collaborative learning opportunities within the structures of existing academic courses (Tucker, 1986; Resnick, 1987; Berryman, 1987). Techniques for doing this involve methods of structuring classroom environments to facilitate cooperation among students by encouraging them to work together in pairs or small groups to achieve academically and socially beneficial goals (Sharan, Hare, Webb, & Hertz-Lazarowitz, 1980).

COOPERATIVE LEARNING DEFINED

According to Johnson and Johnson (1975), the ways in which classroom teachers structure their students' learning goals determine how students will interact with one another, and these interaction patterns become the major determinants of the cognitive and affective outcomes of the instruction. Teachers determine whether students are positively interdependent, negatively interdependent, or independent of each other in instructional activities by structuring learning goals cooperatively, competitively, or individualistically. Cooperative learning strategies, according to the Johnsons, tend to emphasize positive interdependence among students.

But what is a "cooperative learning strategy?" Deutsch (1949) defined a cooperative social situation as one in which an individual can obtain his goal if, and only if, the others with whom he is interdependently linked can obtain their goals. Based on this definition, a cooperative task is defined as one that contains a single common goal that all group members aspire to attain. More specifically, Schunke and Bloom (1979) state that an effective cooperative task is one in which the possibility of open interaction exists--interaction that permits the sharing of ideas, the working through of problems, and the synthesis of knowledge.

Cooperative learning techniques, therefore, are methods of structuring classroom environments that facilitate collaborative efforts among students. Students are encouraged to utilize one

another as major resources, with the teacher acting as a "consultant" rather than as an "expert." Evaluation of their efforts is based on specific criteria, and everyone receives the same letter grade for his or her group's effort.

Sharan (1980) divided such team-learning methods into two models: peer tutoring and group investigation. Within the peer tutoring model, the class functions as a group of separate, independent teams that are often in competition with one another, but which work cooperatively among themselves. Academic tasks are divided into segments, with each group member responsible for teaching a segment of the material to the entire group. Group investigation emphasizes the cooperative gathering, interpretation, and synthesis of data by a group, with the goal of creating a single group project. With this model, however, the classroom resembles a "group-of-groups" structure, with between-group coordination of all activities to encourage the sharing of knowledge. Although peer tutoring utilizes many of the features of traditional classroom instruction, and group investigation makes much greater use of coordinated, cooperative processes, according to Sharan, the two models are complementary and may be used by classroom teachers to meet different academic and social goals.

Johnson and Johnson (1984) strongly emphasize the necessity of structure in their explication of these instructional methods. According to the Johnsons, cooperative learning is not merely having students sit together and talk while they work on their

individual assignments; nor is it having students work at individual assignments, with those who finish first helping their slower counterparts. Rather, it should include the following four basic elements to be considered "cooperative learning":

- Positive goal interdependence must be emphasized in all aspects of the group's interactions (goal, task, resource, role, and reward activities).
- Face-to-face interaction must be promoted among group members, in order to foster positive verbal interchanges and interaction patterns.
- Individual accountability must be demanded in order to measure and maximize the achievement of each student.
- Appropriate interpersonal and small group skills must be learned and utilized by each student.

There are several basic assumptions underlying the teaching of cooperative skills: the teacher must carefully structure a cooperative context for instruction; students must be taught cooperative skills prior to the initiation of the academic project; and peer group support and feedback must be balanced with peer pressure in order to achieve group interdependence.

Johnson and Johnson (1984) and Sharan and Lazarowitz (1980) have identified the following strategies for teachers to use in structuring cooperative learning situations:

- Specifying Objectives: Instructional objectives are specified (both academic and collaborative skills objectives).
- Making Decisions: Decisions are made regarding group size and composition, the arrangement of the room, the selection of instructional materials, the assignment of student roles, the explication of the academic task, the structuring of goals, the planning of group interactions, the emphasis on individual accountability, the selection of criteria for evaluation, and the specification of desired behaviors.

- Monitoring and Intervening: Student behavior is observed, task assistance is provided, collaborative skills are taught, and closure is provided for the lesson.

- Evaluation and Processing: Evaluation of the quality and quantity of learning, and an assessment of the groups' functions are conducted.

As teachers make greater use of cooperative learning activities, they will become more proficient in conducting these lessons, and will be able to refine their teaching techniques to achieve the social and academic goals that nave been set for the students.

RATIONALE FOR COOPERATIVE LEARNING

The promotion of collaborative learning as an instructional method is not a new idea. Philosophers such as Plato and Rousseau focused on the positive societal outcomes resulting from such cooperation among societal members. During the late 19th century, Colonel Francis Parker, a leading public school educator and the Superintendent of Schools in Quincy, Massachusetts, advocated collaborative instructional methods in his district, thereby creating a model that the rest of the country emulated well into the early 20th century. John Dewey also promoted the use of collaborative learning groups as part of his project method of instruction and, in the 1940's, Morton Deutsch developed a theory of cooperation and competition that served as the foundation for present-day research on collaborative learning. However, with the demise of the progressive education movement in the 1950s, collaborative learning took a "back seat" to the more structured, individualistic, competitive methods of teaching and evaluation.

Since the 1920s, research on collaborative learning has built on personality, learning, and instructional theories of social and behavioral psychologists (Johnson, Johnson, Holubec & Roy, 1984). Bohlmeyer and Burke, in their 1987 review of the literature, reported that proponents of cooperative educational methods had identified such benefits as: (1) improved interpersonal relationships (Blaney, Stephen, Rosenfield, Aronson & Sikes, 1977; DeVries & Slavin, 1978; Johnson & Johnson, 1974) including improved cross-ethnic relationships (Johnson, Johnson, Tiffany & Zaidman, 1983; Slavin, 1985); improved cross-gender relationships (Slavin, 1985); and improved acceptance of physically disabled students (Johnson & Johnson, 1982; Slavin, 1985); (2) higher self-esteem (Blaney, et al, 1977) (3) improved role-participation (Bridgeman, 1978) (4) improved academic achievement (Johnson, Maruyama, Johnson, Nelson & Skon, 1981; Slavin, 1985). However, Ross (1988) reported that there remains some controversy as to whether cooperative treatments are superior to individualistic or competitive methods in the learning of such higher order skills as solving puzzle-like problems (Bargh & Schul, 1980) or planning complex science experiments (Okebukola & Ogunniyi, 1984). Despite these disagreements, Talmage, Pascarella, and Ford (1984) argued that, overall, the research revealed that collaborative learning techniques could foster positive cognitive and affective outcomes. However, the results of the major studies are acknowledged to be strongly situation specific (Cotton & Cook,

1982; Slavin, 1980), with Johnson, et al. (1981) noting that future research should take into account the effect that the total classroom milieu has on the success of collaborative instructional methods.

A focus of recent research on collaborative instructional practices is on classroom settings that utilize microcomputers. These classes may be devoted to microcomputer literacy (e.g., programming, word processing, database management) or to computer-assisted instruction in specific subject areas. Although Seymour Papert (1981) and other educators have called for school systems to provide a microcomputer for each child and teacher throughout the grade levels, the costliness of hardware and software, the unavailability of adequate security systems to protect the equipment, and the low level of microcomputer literacy among teachers have all militated against the adoption of these recommendations. Therefore, students often work in pairs or in groups of three or four at the microcomputers, creating a natural laboratory setting in which to observe collaboration.

Johnson and Johnson (1986) criticized the lack of attention focused on collaborative learning in microcomputer environments:

> ...how students should interact with each other while working with a computer is relatively ignored. It should not be. How teachers structure student/student interaction patterns has a great deal of influence on how well students learn, their attitudes toward school and subject areas, their attitudes toward each other, their self-esteem, and their attitudes toward the computer and computer related careers (p.12).

Although there is little research in this area and no clear conclusions can yet be drawn from the few studies that exist, some of the findings are intriguing, and point the way for future inquiry.

Daiute (1982) observed that the social organization that developed around a classroom microcomputer altered both what was taught and how it was taught, thereby influencing the effectiveness of the machine as an instructional tool. There is also evidence that pairing students at microcomputers reduced low-level errors and fostered higher-level activities than did individual seat work (Levin & Souviney, 1983; LCHC, 1982). Mehan, et al. (1985) found that cooperative peer interaction naturally emerged in micrcomputer environments, and that teachers in such settings were able to foster the achievement of educational goals that would have been unattainable had the machines been unavailable. Johnson, Johnson, and Stanne (1986) reported that computer-assisted cooperative instruction promoted higher achievement levels, more successful problem solving, a greater amount of task-related student interaction, and a heightened perception of the status of female students. Clements and Nastasi (1988) discovered that the teaching of the computer programming language LOGO by cooperative methods encouraged students to engage in conflict resolution, rule determination, and self-directed activities. These findings supported the proposition by Papert (1980) that the LOGO environment fosters peer interaction in social problem-solving and metacognitive

processing. Finally, Zimmerman, Smith, Bastone, and Friend (1989) found that the paired use of microcomputers for instruction was as effective as the one-student/one-machine approach in the mastery of course content, and more effective in the stimulation of social learning among student partners.

Despite these findings, Johnson and Johnson (1986) have maintained that there is a need for more systematic investigation of the amount, types, and implications of student interactions that are fostered when the microcomputer is combined with collaborative learning techniques to structure a cooperative learning environment. The significance of such future studies, according to the Johnsons, will be to formalize these valuable instructional settings:

> ...The use of computer assisted cooperative learning overcomes many of the instructional limitations of computer assisted individualistic learning. The isolation, the lack of oral explanation and elaboration of the information being learned, the lack of social models, the impersonality of the reinforcement and feedback, the lack of creative and divergent thinking, and the lack of peer accountability existing in computer assisted individualistic learning activities all are reversed in computer assisted cooperative learning activities. The technology of computers and the interpersonal interaction promoted by cooperative learning provide complementary strengths. It is a partnership that maximizes the advantages of each instructional strategy (p.18).

III. FINDINGS

The findings presented here are based on the following data sources: questionnaire responses from the 16 teachers who described their use of computers to promote collaborative learning; information obtained from the subset of eight teachers who attended one of the two group meetings with OREA staff to discuss their approach to collaborative learning in greater detail; observation of two to three computer class sessions of seven of these teachers; and conversations with the teachers whose classes were observed. (See Chapter I for a discussion of selection procedures.)

TEACHER QUESTIONNAIRES

The questionnaire asked teachers how they defined collaborative learning, what benefits or outcomes they thought could result from it, how they used computers to promote it among students, and what roles they assumed in collaborative learning situations.

Teachers defined collaborative learning in terms of several key factors: the kinds of interaction between students; the types of skills learned and taught; and the intellectual and social goals of the activity. The following are sample excerpts from teachers' definitions of collaborative learning:

- "collaborative learning is shared information, experiences, and insights focused on the information to be acquired";
- "students working and interacting together to reach a common goal...encouraging and supporting their peers as they work together to solve problems and projects";
- "...the sharing of individual knowledge to solve a problem....";

- "students working together in small groups to solve a problem or learn something new...students teaching students"; and
- "...sometimes peers can explain to each other easier than a teacher can."

Asked specifically about the educational benefits or outcomes of collaborative learning, teachers most often identified a set of social benefits that facilitated different kinds of learning:

- "Young people often learn more effectively from their peers because of the unique interaction between youngsters."
- "Students will feel more secure tutored by a peer than by a teacher."
- "Students develop self-esteem, they become self-motivated."
- "It fosters social, cultural, ethnic, racial, and academic integration."
- "When students communicate with each other there is a feeling of belonging....encourages listening, speaking, and writing."
- "...learning how to work together as a team player...to participate in discussions and the decision-making process."
- "...trying to solve a common problem...students enjoy interaction."

In summary, teachers identified several purposes, or goals, of collaborative learning: to solve problems, to produce products, and generally to increase learning through students teaching each other. These teachers believed that collaborative learning promotes these goals because students like interacting with and learning from other students, enjoy participating actively in their own learning, and work well when they have

specific goals to accomplish, with team members reinforcing one another in accomplishing these goals.

Teachers identified several examples of collaborative learning, both with and without computers:

- older students helping younger students learn word processing;
- small groups of students using "problem solving" software such as The Factory (Sunburst Communications);
- students testing each other on spelling or multiplication;
- students reading stories together on a computer and answering questions about the stories;
- students conducting interviews and doing role playing activities;
- students collaborating to find the answer to programming problems; and
- students working on computer crossword puzzles together.

The process of collaborative learning, according to these teachers, includes several key elements: student discussion; students teaching and learning from other students; students sharing information, ideas, and knowledge; and students working together to carry out a project or assignment.

Teachers cited various kinds of software that students used in collaborative activities, including word processors, databases, spreadsheets, programming languages, "problem-solving" games, and page layout software.

Asked how collaborative groups were formed, most teachers responded that they let students choose their own partners, but a few teachers selected the groups themselves in an effort to

ensure harmonious working relationships or to achieve heterogeneous ability grouping.

On the topic of preparing students for collaborative work, almost all teachers indicated that collaboration occurred spontaneously rather than through advance planning and preparation on the teachers' part. Some teachers, however, indicated that they did conduct discussions with their classes about how to work together with other students.

Finally, teachers provided a number of descriptions of their own roles during collaborative learning, including troubleshooter, moderator, facilitator, resource person, student rather than teacher, guide, observer, and mentor. A few teachers also identified their roles before collaborative activity began, including preparing students for collaboration by talking about practices and behaviors, and acting as a model for collaborative work, sometimes by teaching the class with another teacher.

COLLABORATIVE LEARNING IN CLASSES

As described in Chapter II, collaborative learning connotes a process consisting of several crucial parts: a careful elaboration of the aims of collaboration, including social and cognitive goals; preparation of students for the activity; structuring of the learning situation by the teacher, including composition of learning groups; regular discussions with the class about group work (often called group processing in the literature); and attention to the roles of students and teacher in collaborative activities.

The findings below indicate that many of the individual elements or collaborative activity were present in the classes observed, but generally lacking was an overall awareness of the complete process described above, including thorough preparation and close attention to how students learn together.

While teachers in this study were generally unfamiliar with recent research on collaborative learning and none reported receiving any staff development directed at supporting them in using this instructional approach, they were striving to implement collaborative learning on their own. Thus, to describe the extent to which these teachers' practices did not conform to an ideal, as we do below, is not to criticize them. On the contrary, their work is exemplary in building toward collaborative activity using computers, and these findings should serve to highlight areas in which they could use assistance in furthering their efforts.

The course content and student populations of the seven teachers observed varied considerably. Classes ranged from a high school business course using spreadsheets, to special education students using simulations, to elementary school children using word processors for creative writing. In spite of these differences, however, the nature of the collaborative learning observed can be discussed along several dimensions described in Chapter II. These dimensions include:

- preparation for collaborative work;
- composition of collaborative groups;

- students' tasks, roles, and goals in the activity;
- the teacher's role; and
- types of collaborative activity involved.

Preparation for Collaborative Work

Prior to having students work together, teachers typically reminded students that they were expected to cooperate with each other in their work, discussed what should be done if disputes arose, and sometimes told their students that working collaboratively was different or special. For instance, one teacher told her students, "You know, often when you work in the classroom you work alone. But when you come to the computer room, you work with each other." However, there was no evidence of direct teaching of those skills needed to work collaboratively, such as explaining one's point of view, asking appropriate questions, considering and integrating the views of others, and resolving conflicts of opinion.

Group Composition

Almost all groups observed were composed of pairs of students, but there were some instances of three students in a group. All of the group work occurred in the context of using computers, which in itself limited the number of students who could work together. Whereas various kinds of collaborative work might conceivably involve larger groups, in the computer lab there is a practical limit to how many students can see or use one computer at a time. Further, many teachers tend to view two as the optimum number of students to share one microcomputer.

The computer lab setting can "force" students to share terminals if there are more students than computers. Some educators have wondered whether, when teachers refer to collaborative work in computer labs, they really mean that the lack of computers makes it necessary for students to share the computer. In fact, of the seven teachers observed in this study, two explained that their original motivation to have students work together was the insufficient number of computers. However, these two reported that as a consequence of such sharing, they had come to see the benefits of cooperative work, and would continue using this approach even if there were enough computers for each student. The other teachers reported that they recognized the value of collaborative learning without the necessity of students sharing computers.

In the majority of student groups observed, students themselves had determined the composition of the group. Many teachers believed that collaborative groups would function better if students selected those with whom they wanted to work. Almost all of the teachers, however, organized some of the groups based on their beliefs regarding which students would work best together, particularly for groups involving students known to be difficult to work with. One teacher, for example, chose some student groups herself to minimize potential conflict, but let the other children choose their own partners. At times she also had certain students work alone, because she felt they were not able to work with someone else. Occasional crowding necessitated

groups of three, but sometimes teachers permitted three students to work together because they wanted to collaborate. In one class, for instance, the teacher thought three boys who were friends and composed poetry (in the form of rap songs) together in the playground would be a good working group.

On the issue of ability level within a group, most of the literature on collaborative learning recommends heterogeneous grouping in order to maximize learning for those with lower ability and to provide opportunities for higher ability students to clarify their own thinking. In this study, ability level was rarely found to be a factor in grouping decisions, either when students grouped themselves or when teachers chose the groups. A few teachers, however, did recognize the desirability of heterogeneous grouping when possible. The three boys mentioned in the preceding paragraph, for example, varied widely in achievement levels, and this was an additional reason why the teacher favored their working together. She also instructed more advanced students to help their less advanced peers and those absent from the previous class.

Student Interdependence in Tasks, Roles, and Goals

Interdependence is a construct used by theorists to describe how people work together, or the degree to which they depend on one another to accomplish a task. Three kinds of interdependence are discussed here. Task interdependence describes the nature of the task itself and how the its parts are divided between members of the group. Role interdependence describes the roles (e.g.,

data collector, observer, recorder, or reporter) assigned to each. Goal interdependence is the degree to which each of the members of the group is working to achieve a common goal. Ideal collaborative learning groups are interdependent in all these three dimensions--their separate jobs and roles blend together to achieve a common goal.

In collaborative learning, the teacher is responsible for structuring activities to achieve positive interdependence. In spite of the differences among the seven learning situations in this study, the ways teachers structured collaborative learning activities with computers were notably similar, as described below.

Task interdependence. Student tasks in collaborative learning groups are often differentiated. In a group research project, for example, different students might be assigned to research parts of the topic. Alternatively, one student might look up information, another might be responsible for organizing it, another for presenting it, and so on. In a peer tutoring activity, students generally study different parts of the lesson and then teach them to each other.

The activities in this study all involved two or three students working together on a specific computer application. The range of tasks was therefore not as great as it might be in other types of collaborative learning activities where, for example, a group of students might engage in a lengthy and complex research project, and either the teacher or the students themselves decide what tasks are necessary to complete the study.

In the classes observed, the possibilities for differentiating tasks were limited by the activity as assigned by the teacher. Whether the computer application was programming in LOGO, preparing a spreadsheet, writing a story on a word processor, or playing a simulation, teachers generally told students to work in pairs and complete some specific task based wholly on the software. Within these parameters, the teacher did not specify different tasks for different students. In almost every case, the teacher's instructions were simply that studnets complete a specified task together--help each other write a story, consult on drawing a square in LOGO, or solve a game puzzle. Task interdependence in such activities can be characterized as positive, in that students worked closely together, and their combined efforts were required to complete the assignment. However, since teachers generally restricted activities to the completion of short assignments on the computer, the degree of differentiation was necessarily limited.

A greater degree of task differentiation was possible with collaborative activities having a broader scope. In one class that studied the history of New York City, for example, students collaborated in making maps, writing reports, compiling bibliographies, and drawing illustrations. This work involved using several pieces of software (as well as non-computer activities) and spanned an entire marking period. Students in this class, then, were engaged in a more complex type of collaborative activity than those in the other classes, one that

integrated several types of activity and involved students in different roles at different times. In terms of task differentiation, the complexity of this project enabled students to perform different tasks (such as researching different areas of the city) and combine them to produce a product.

Role interdependence. Role interdependence refers to the kinds of roles students play in completing a task and how well these work together. Typical kinds of roles can be group leader, mediator in discussions, idea generator, group observer, and reporter. In collaborative learning situations, these roles provide students with the opportunity to learn and practice different skills involved in working together. For this reason the assignment, and the periodic trading of roles, are crucial to the success of collaborative learning.

However, the constrained nature of most of the observed activities negated the possibility of many different roles. In the typical situation, where two students completed a software assignment together, role options were limited to typing, for one student, and either dictating or watching, for the other.

The assignment of roles, like that of tasks, was left to the students. Further, teachers did not generally prepare students to assume various roles. Rather, they generally told the class simply to work together in pairs. Sometimes teachers advised students to trade the role of typist, for example, but most often students were left on their own. While students periodically alternated roles, their repertoire was limited to typist or

non-typist, and the purpose not clearly delineated or necessarily directed at collaborating.

For example, when the task involved typing at the keyboard, often the dominant member of the pair typed while the other watched. This was the case, for example, in Ms. A's class, where the more aggressive of the pair monopolized the keyboard and the decisionmaking, while the less aggressive watched for errors. Sometimes, in writing stories, the student with the most ideas dictated while the other typed; in other cases, the two students traded off roles from time to time. In terms of working together to complete the assignment, the same kind of variety prevailed. Sometimes one member took responsibility for writing or solving problems, and sometimes students assumed this responsibility jointly.

Group roles were strongly interrelated in the sense that students worked together to get the assignment done. As in the case of task interdependence, however, the degree of collaboration was constrained by the limited nature of the tasks and the students' unfamiliarity with the specific components of collaborating--e.g., presenting and elaborating on a point of view, asking and responding to questions, clarifying ideas, persuading others, and resolving differences of opinion.

Goal interdependence. The lack of task differentiation and the simplicity of these activities strong influenced students' goals. Since the tasks were very short (usually completed in one class period), and the two or three students involved worked on all tasks together without dividing them into subtasks, it was

clear that students were working together toward the same goal--to complete the assignment. Goals can be truly interdependent, however, only if students need to coordinate separate individual tasks to complete an assignment.

In summary, the activities observed in this study were structured by teachers so that students worked together. In comparison to collaborative learning activities in general, however, these computer activities were generally simple and limited in scope, and were structured by teachers so that student choices and roles were limited.

The Teacher's Role

Teachers have many potential roles. Whereas in traditional classroom settings the teacher usually acts as lecturer and questioner, previous OREA studies of the MAC/VIP program have found that in computer labs many teachers act as facilitators, in the sense of circulating around the computer lab and working with individual students.* These studies, however, found little evidence of students working together. In cooperative learning situations, teachers take active roles in preparing students for collaborative work, in interacting with learning groups during the activity, in helping students process or reflect on their cooperative experiences, and in modeling aspects of cooperative learning. The following summarizes OREA's findings with respect to each of these possible roles.

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*See final evaluation reports of the Municipal Assistance Corporation/Vocational Improvement Program Computer Education Program for 1986-87 and 1987-88, published by the New York City Public Schools, June 1988 and May 1989, respectively.

Preparation. As discussed above, this study found little evidence of teachers preparing students for collaborative learning in terms of teaching them the specific skills needed for working together effectively.

Interaction. During collaborative work activities, all of the teachers interacted with learning groups, spending all or nearly all of the activity time circulating among groups, engaging in the following kinds of interactions:

- responding to students' questions;
- reviewing completed work;
- asking students questions about their work;
- suggesting extensions or revisions of work;
- helping students use software or print their work; and
- praising groups for their work.

For the most part, teachers did not intervene in group activities. Some teachers generally preferred not to interfere unless necessary, in order to give students the opportunity to solve problems by themselves (both in the content of their work and in their group interactions). Mr. C, for example, let students work out their own problems in making LOGO drawings, intervening only when absolutely necessary.

Most teacher interventions focused on the content of a group's work. Rarely did teachers deal with the way groups worked together, and then usually in response to a problem between two children. Even when they circulated to check the content of a group's work, teachers did not typically intervene to ensure student understanding. The group observed in Ms. A's

class, for example, did not understand the simulation that they were assigned to do, never asked for or received content-related help, and simply started the program over when they ran into trouble.

Processing. Another important aspect in most models of collaborative learning is the opportunity to reflect afterwards on the group experience in order to modify aspects of it and to plan for future experiences. Thus, at the end of a class period in which collaborative activity takes place, teachers should discuss with students how they thought the activity went, whether group members in their various roles and tasks worked together well, and what they could do to improve group functioning in the future. Theorists regard this opportunity for reflection and discussion as essential to the success of group collaboration. This type of group processing was not observed in this study, nor did teachers talk about it in interviews and discussions.

Modeling learning. Several teachers also voiced the opinion that, in collaborative learning situations, they acted at times as students, learning from their own students. This is an important aspect of modeling, since it informs students that they can not only teach each other but at times they can teach adults as well.

Types of Collaboration

As discussed in Chapter II, theorists divide collaborative learning activities into two main groups: peer tutoring and group investigation. In peer tutoring situations, group members learn some specific course content in order to teach others in the

group. Many types of peer tutoring have been developed, with variations on how students tutor each other, whether groups compete with each other or not, and so on. In general, though, any activity in which students are assigned course material to learn and teach others can be called peer tutoring.

In group investigation activities, much more planning and initiative are left to group members. The teacher may assign a topic to be researched, but student groups will usually be responsible for making many of the decisions involved in carrying out the research: what the tasks should be; how to divide the tasks and roles among members of the group; where to look for information; how to combine information gathered by individuals; and how to analyze and present conclusions of the research. Typical group investigation activities are more comprehensive in scope than peer tutoring, usually having several stages (planning, researching, analyzing), and often involving students in more than one kind of task or role.

The two major types of collaborative learning as presented here are ideals, and actual practice may alter them or combine elements of both. They should be viewed as the extremes of a continuum. While both emphasize students learning together, they imply very different roles for teachers and students. Peer tutoring preserves the traditional role of the teacher as the maker of decisions about exactly what assignments students will do and how they will do them; students' roles are to implement assignments and instructions as given by the teacher. In group investigation, much less is specified in advance--students make

decisions about the assignment and how to implement it, while the teachers' role is less to tell students exactly what to do than to help them learn to work together in making decisions and to advise them on how to investigate topics.

Almost all group activities observed in this study were closer in structure to peer tutoring than to group investigation. Students did not take initiatives in making decisions about their learning. Teachers specified the tasks and students implemented them. On the other hand, since teachers did not plan for or instruct students to tutor one another in the content of their activities, these activities do not meet the criteria for peer tutoring as defined in the literature.

Only the class taught by teacher E shared some of the characteristics of group investigation. In this class, group investigations of New York City history took much of a semester, involved many separate activities, and necessitated decisions about what aspects of the topic to investigate, what information was needed, how to make maps, and how to present finished work.

IV. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

This study of New York City teachers who used computers to promote collaborative learning found that without benefit of explicit training or support in the instructional techniques of this approach, the seven teachers observed were successful in implementing aspects of collaborative learning in their computer classes. On the other hand, these teachers, and the larger group that returned questionnaires, were seemingly unaware of other aspects of collaborative learning, which they did not implement.

Researchers and practitioners of collaborative learning have identified several instructional aspects that are vital to its success. Teachers prepare students for collaboration by teaching them necessary social and cognitive skills, including listening to other students, voicing and justifying opinions, making joint decisions, and resolving conflicts of opinion. They also prepare students for taking various roles in group work and for trading roles periodically. In addition, teachers help students divide tasks within their group, interact with groups to help students master both the social skills necessary for collaboration and the content to be learned, and repeatedly discuss with the class successes and failures in the group work process so that the process can be improved in the future.

These aspects of collaborative learning are not separate activities, but rather part of a process. Whether the

collaborative learning involves a peer tutoring activity that lasts one or two class periods, or a group investigation project that continues for an entire marking period, it is the combination of the various aspects of collaborative learning that leads to its success. Preparation of students, composition of groups, repeated discussions about working in groups, teacher interaction and intervention, are all parts of an ongoing process.

Observations of computer classes showed that, while teachers incorporated some of the aspects of collaborative learning, other aspects were missing from their instructional practices. Teachers generally instructed students simply to work together: preparation in the social skills necessary for collaboration was minimal or absent. Discussions between teachers and students about the collaborative process were similarly missing. Almost all of the activities observed consisted of two students working together at a microcomputer, but teachers did not differentiate roles or tasks within the pair. Finally, teacher interaction with groups was most often related to the content of the work rather than to the nature of the collaboration, except when problems between students arose which teachers felt they needed to handle.

On the other hand, these activities were different from individual learning in that students did work together to complete assigned tasks, and this working together was a conscious part of teachers' instructional purposes.

Questionnaires showed that teachers in this study believed that students learn from their peers, enjoy learning in this way, and can sometimes learn more effectively from each other than from adults. The process of collaborative learning, according to these teachers, consisted of students talking to and learning from each other, working together to complete assignments.

With these teacher responses in mind, computer activities observed did support teachers' perceptions of what collaborative learning entailed. In almost every case, students were observed working together on assignments given by their teachers. Whether the activity was creative writing with a word processor, inventory analysis with a spreadsheet, or problem solving with simulation programs or LOGO, teachers explained the assignment to students and told them to work together, most often in pairs. During these group activities, teachers generally circulated to answer questions, handle problems, check students' work, make suggestions, and criticize or praise work.

Previous OREA studies of teachers who used computer labs for instruction showed that many teachers perceived themselves as facilitators in the computer lab. While in these studies teachers were engaged in facilitating the work of individual students, teachers in the current study encouraged students to collaborate, and facilitated group work by circulating around the computer lab and assisting them.

Previous OREA studies of the MAC/VIP computer labs also highlighted the role that computers play in facilitating student

interaction. As in the current study, teachers generally saw the computer as a tool that lends itself easily to student involvement and to spontaneous student discussion about both the content of the work and the operation of the software. Further, teachers believed that this involvement made it possible for them to circulate around the computer lab and interact with students as facilitators.

For both of these--the tendency of students to interact with each other in using computers and the teachers' ability to circulate from group to group because of students' involvement with software--computers can help facilitate collaborative learning situations. Observations confirmed the involvement of student groups in their software assignments, and interaction among group members during computer activities.

Teachers' motivation to use collaborative learning had various origins. Some teachers, forced to have students share computers because of the number of computers available, came to see the value of student interaction. Others, having liked the idea of collaborative learning before they used computers, saw computers as good tools for implementing collaboration. Whatever the source of their motivation, the teachers in this study believed that computers and collaborative learning should accompany each other. To the best of their ability, and without explicit support and guidance, they implemented important aspects of collaboration in their computer labs. It should be noted that, in part, as a result of the findings of this report, DCIS

sponsored an all-day conference on collaborative learning in October 1989 for interested participants of this study.

RECOMMENDATIONS

Based on the findings related here and other information presented in this report, the following recommendations are made:

- In view of many teachers' desire to use computers to promote collaborative learning, they should be provided with assistance in learning about the techniques involved in this instructional approach.
- Since computers are tools that can facilitate the implementation of collaborative learning, teachers should receive instruction on how to use computers effectively to promote collaboration.
- Guidance should be given to teachers in evaluating software in order to decide which programs are best suited for collaborative activity and which are best used in other learning situations.
- In order that teachers interested in using computers for collaborative learning might receive support from their peers, efforts should be made to link educators interested in this approach, through meetings, electronic bulletin boards, or other means.

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APPENDIX: CLASS PROFILES

Since the findings presented in this report are based on a summary of the data for all of the classes visited by OREA, following is a brief description of each of the seven class sites. These profiles provide a context within which the use of collaborative instructional methods in microcomputing environments may be viewed. Each class was visited for an entire class period on at least two separate occasions.

TEACHER A

Ms. A. is a junior high school mathematics teacher and chair of the mathematics department at a Staten Island intermediate school. In the absence of a schoolwide computer coordinator, she is also serving in that capacity, and is the most technologically knowledgeable teacher in the school. According to Ms. A, her definition of collaborative learning is "...the sharing of individual knowledge to solve a problem, thereby spreading that knowledge amongst all individuals who participate in the collaborative effort." She believes that students derive from collaborative activities the skills of group problem solving and tolerance for the thinking and learning styles of others.

Ms. A. was observed late in the academic year, teaching seventh and eighth grade mathematics classes. On the average, these classes were composed of ten students, since many students were on class trips or attending graduation rehearsal. All

classes were held in the computer laboratory, which housed thirty microcomputers, twenty of which were TRS-80s and ten of which were Tandy 1000s. The bulk of the hardware was arranged against three walls of the lab, with the remainder of the machines on a double row of desks down the middle of the room. There were no working printers in the room, nor were the networking capabilities of the lab utilized. Software for each class lesson was booted up prior to the start of class by student lab assistants, so that the machines were ready for use when the class arrived.

Ms. A. advised the observer that her three classes were being permitted time in the computer lab this week as a "reward" for having completed their end-of-term assignments. The concept of a "reward" was reinforced at the beginning of each class by Ms. A., who would remind the students that it was a privelege to be in the lab, and that those failing to respect the equipment, the teacher, or one another would be sent back to sit in their regular classrooms until the end of the period.

All three of her classes were observed using the software package "Hot Dog Stand," an entrepreneurial exercise which promotes basic arithmetic skills while encouraging students to become acquainted with long-range planning, risk management, and marketing strategies for small businesses. The students sat in pairs before their computers, with one student keyboarding and the other student prompting verbally on the use of the software and hardware. At the same time, however, two other classes (of

approximately eight students each) occupied the lab with their own teachers and paraprofessionals, and utilized the remaining equipment for their own instructional purposes. This raised the noise level and temperature of the room, substantially. It also forced Ms. A. into the role of "computer coordinator," making it difficult for her to spend instructional time interacting with her own students, either individually or as a group.

Within the student pairs who were observed during the three sessions, it was usually the more aggressive student who took over the keyboarding activities, thereby monopolizing the decisionmaking for the pair, as well. The second member, relegated to the "back-seat," would then resort to exercising "power" by berating or pummeling the keyboarder when she or he made an error.

Without the teacher close by to provide direction and support, many opportunities for learning were lost. Many of the students appeared to misunderstand or ignore the concepts that the software sought to teach, and thus derived little benefit from the exercise. For example, most students failed to comprehend the concept of unit purchases, and the connection between an accurate calculation of one's inventory and the profits that could be made to increase one's daily bank balance. As a result, their hotdog stands often wound up in the "red," without any understanding on the student owners' part of how that occurred. However, since they also knew how to override

the program, they would simply reboot it after their bankruptcy, and go on to make the same mistakes during the following round. None of them asked Ms. A. for assistance regarding the arithmetic or business-related concepts of the package; they only summoned her when they encountered hardware or software glitches. Unfortunately, Ms. A., who was dividing her attention among all of the competing groups in the lab, did not have the time to work with her own students to insure that they took the software exercise seriously.

TEACHER B

Ms. B. is a speech and language therapist in an intermediate school in Brooklyn. Her students range from sixth through ninth graders, and have a variety of developmental and learning disabilities and degrees of physical impairments. All are functioning well below grade level, but some possess the physical maturity and social interests of nonhandicapped adolescents, while others are less mature physically and emotionally.

When asked how she views collaborative learning for special education populations, Ms. B. answered:

> Collaborative learning is cooperative learning. This is a broad term which can be used in conjunction with peer tutoring, peer interaction, or just communication among students. What is important is how the lessons are used. As a speech and language therapist working with speech handicapped students in a junior high school...my aim is to have the students interact with each other, creating an atmosphere of learning.

She says that her students are often passive and withdrawn, due to their language difficulties, and collaborative learning

activities can foster a sense of belonging--a feeling of being an important and respected member of the group. In this positive atmosphere, she can encourage the development of their listening, speaking, and writing skills, and help them to feel more confident in social situations.

In order to minimize distractions and to allow for individualized attention, Ms. B. meets with her students in her own small room, a former teachers' lounge. It is equipped with three Apple IIE's, one Hewlett Packard microcomputer, and three printers. During most observed periods, four or five students arrived for their lessons and were promptly paired off by the teacher and helped to select the software packages on which they would collaborate. The observed classes utilized "Concentration," "Kidwriter," "Olympics," "Brick by Brick," "Jungle Hunt," "Spelling Bee," and "Apple LOGO."

Ms. B. spent the entire period moving between the pairs of students, observing, tutoring, challenging, exhorting, and mediating. She has worked with several of them for a number of years, and is obviously very fond of these adolescents, whom she calls "my kids."

Overall, Ms. B.'s students are reluctant to speak, due to their speech impediments, and must be encouraged to verbalize their feelings and to ask for help when needed. Due to their behavioral problems, they are also impulsive, and frequently refuse to ask for assistance or to accept it when it is offered. However, when they encounter a hardware or software glitch, or

when they quarrel with one another, they speak up unhesitatingly.

The observer had the opportunity to see several pairs collaborate in different ways during each class. One such grouping was D. and H., two young men who had become very close while working together on the microcomputer. D., a 17-year-old who suffers from seizure disorders and developmental disabilities, had been extremely withdrawn and unwilling to speak until he began to work on the computer. His buddy, H., is thirteen years old, and also developmentally disabled, with congenital deformities and oral apraxia. Over the course of a few years, the two have been paired for each daily class session, and sometimes come in twice a day. They had been spending the bulk of their time playing the game show package "Concentration," which improves their eye-hand coordination and memory, and encourages verbal exchanges about the matches that must be made in order to win.

D. and H. required no assistance from Ms. B. with "Concentration," and in fact, did not want her to "interfere" with them. When they were later asked to demonstrate other software for the observer, they did so reluctantly, however, and had difficulty with the more intellectually challenging, abstract packages such as "Kidwriter" and "Apple LOGO." D., who had been asked by Ms. B. to act as H.'s "teacher" for these demonstrations, became anxious over his own inability to master the unfamiliar programs, and took his frustration out on H. by

bullying and criticizing him. At this point, the demonstration was discontinued, and the two departed.

Another pair, K. and N., are fourteen and thirteen years old, respectively. Both are severely learning disabled and very immature, with low intellectual functioning; N. also suffers from verbal disfluencies. They were observed using the software package "Spelling Bee," over which they quarreled endlessly. These behaviors necessitated the intervention of Ms. B., who sat with them and acted as tutor, referee, and cheerleader in order to keep the peace.

P., an aggressive 12-year-old boy with very low-level literacy skills, was observed working with A., a severely learning disabled, frail 14-year-old boy who is quiet and passive. As they played "Olympics" and "Jungle Hunt," it soon became evident that while they possessed comparable skills, P. was so aggressive and domineering that he did not even permit A. to get into the game. A. allowed P. to dominate him in this manner for much of the period, but finally reached a breaking point, fought back, and beat P. at the game. This enraged P., who immediately turned off the machine to blank out A.'s winning score, as if this would negate his victory. He then called A. a "cheater," and refused to continue playing with him. Ms. B., who was involved with another pair of students while this was going on, did not realize what was occurring. However, when questioned about it later, she revealed that the two frequently interact in this manner, and that it has been very gratifying to

see A. begin to assert himself and P. begin to realize that he can't always win.

TEACHER C

Mr. C. is a computer science teacher in an elementary school on Staten Island. He teaches regular and special education classes, kindergarten through fifth grade. Mr. C.'s classes are all held in the school's computer lab, which houses one printer, a large screen monitor, and twenty microcomputers: eighteen Tandys and two IBMs. The machines are configured in a "U" shape, facing the blackboard, with an extra row of machines across the back of the room.

Mr. C. defined collaborative learning in the following way:

> Students working and interacting together to reach a common goal; helping one another and sharing ideas to finish computer projects...students encouraging and supporting their peers as they work together to solve problems and projects.

He believed that collaborative learning activities could teach students to work together as a team by encouraging them to willingly share ideas, allowing them to participate in the decisionmaking process, and sending them on a "journey" to discover knowledge together.

One of the groups observed at work was composed of 21 fourth graders who worked in pairs on the assigned project. On the day of the site visit, they were asked to make freehand drawings of a simple object on paper. Among their choices were a house, a gun, a robot, a boat, and a tree. Then, they were directed to transform the drawing into LOGO commands and

reproduce it on the screen. For the most part, the student pairs took the assignment in stride and required little assistance from Mr. C. They seemed to understand that this was an artistic endeavor that involved experimentation and sometimes resulted in errors. When one of them did make an error, usually laughed about it, and then jointly decided how to rectify the mistake.

The pairs appeared to enjoy working together on the assignment, and shared the workload quite well. They regularly took turns at keyboarding and shared in the conception of ideas for their command structures, with little bickering. They seemed to genuinely enjoy working on the computer graphics that were created from their own freehand drawings.

Mr. C. took a "hands off" approach with this group, preferring to let them work out their problems on their own, and only rescued them if they were "drowning." Although the noise level in the room was very high, and the assignment complex for such a short class period, most of the students managed to complete it, and were very proud of their creations.

The second observation involved a kindergarten class of 32 youngsters, 24 general education and eight special education students. The special education teacher and a paraprofessional assisted Mr. C. with this very large group of young children, one-quarter of whom were wheelchair-bound and required extensive physical assistance to navigate in the cramped lab. The general education children were assigned to work in same-gender pairs,

while the special education children were permitted to have their own machines. The class was directed to program a LOGO square and, when this was completed, to program several squares into a design. Mr. C. wrote the command structure on the board for the children to copy, and they had to type in each entry accurately and in the proper sequence to successfully construct a square.

The noise level in the room during the entire period was quite high. All of the students required a great deal of support and assistance from the adults in this activity, since most were unaccustomed to copying words and numbers written on a blackboard. Further, many of the paired children refused to work with one another, and resorted to physical expressions of their displeasure if their partners tried to "interfere" with their work. Some also accused their neighbors of "cheating" if they saw one of them looking over at their own screen. The special education students made a bit more progress, and were less disruptive since they each had their own machine. However, all of the children possessed a low tolerance for frustration, and some cried when they could not get LOGO to do what they wanted. Most of the children failed to produce the desired product, even after numerous attempts. However, none of them appeared to view the computers in a negative way, and all were certainly far more microcomputer-literate than the average five-year-old.

TEACHER D

Ms. D. is a teacher of business computer applications at a lower Manhattan specialized high school. Her class meets in the Accounting Department's microcomputer lab, which houses 16 networked Tandy 1000sxs and one printer.

She defines collaborative learning as creating opportunities for students to use their own unique talents and skills in conjunction with those of other students, to enable all to learn from one other. Ms. D. believes that the young adults she teaches often learn from their peers more effectively because of the unique social relationships that already exist among them.

The observed class was composed of 30 twelfth-graders, all of whom were using a Houghton-Mifflin accounting package, "Lakeshore Computer Center," which presented them with a variety of exercises in corporate accounting. They were directed by the teacher to make their accounting entries by hand in their own ledger booklets, and then to enter those figures in their computer files.

The teacher spent the entire period walking around the room observing, chiding, assisting, teasing, and making announcements to the class about end-of-term assignments and examinations. The students usually sat in self-assigned pairs before each computer and assisted one another with their own entries. The more advanced students were directed by Ms. D. to tutor the slower ones and the absentees from the previous class

session. Although she encouraged all of the students to assist one another, she made it clear that each was still responsible for handing in a ledger to be graded, and that anyone discovered cheating would be dealt with severely.

TEACHER E

Ms. E. is the computer coordinator for an elementary school on the upper east side of Manhattan. She teaches in the school's computer lab, which houses five Commodores (arranged along one side of the room), one Apple IIE (at the back of the room, on loan for the school's banking project), one Macintosh (on a desk at the front of the room), and three printers.

Ms. E. defined collaborative learning as, "...working together to achieve something--a final product, learning, storytelling, etc." She maintained that since her school was small enough to allow multilevel grouping, as well as club period and interdisciplinary special projects--all of which lent themselves to collaboration--and since she believed that children learn better from their peers, this method of learning was a favorite of hers.

Ms. E.'s fourth grade students were observed working on their New York City historical projects, for which they chose some historical area within the city limits (such as Fort Tryon, Turtle Bay, or Coney Island) about which to write. This was a group project, and approximately four students worked on each chosen area. They were directed to include in this project a written report, illustrations, maps, banners, a bibliography, a

list of the group members, and a designed cover. Since this was a lengthy assignment, they had until the end of the term to hand it in. The students utilized "Bank Street Writer," "PFS-File," "Printshop," and, occasionally, LOGO, to complete this assignment.

Due to the nature of the assignment, as well as the shortage of microcomputers, students worked in groups of three and four (and occasionally more) before each machine, which made for a very noisy environment. The activity was also rather fluid, since the students were permitted to work in any way, on any part of their project they wished, for as long as they wished. Although it was difficult to overhear any group conversations, it was possible to observe the students at work. In one group, two boys used LOGO to construct a map of Central Park; in another, four girls entered Staten Island historical sites into a database; and in a third, a group of eight girls worked on designing their groups' report covers using a graphics package. The few students who had already completed their assignments were permitted to use the game software, and had chosen "Memory Castle," in which they were totally absorbed.

Throughout the period, Ms. E. was in constant motion around the room, consulting with individuals and groups, checking printouts for accuracy, and keeping on eye on the overall activity in the class. She refused to assist students unless absolutely necessary, and teased anyone who asked her a question that she knew the student could answer without her

help. She did not "look over students' shoulders," or play the role of disciplinarian; rather, she encouraged them to help one another. Ms. E. also made use of any young "hacker" who happened to be in the room at the time to assist the struggling students. However, she quickly assumed control when a hardware or software problem developed, as several of the machines were already on the verge of breakdowns, and she was fearful of any inadvertent damage to the hardware or software.

TEACHER F

Ms. F. is a junior high school English teacher in Queens who was observed teaching writing to eighth graders in a microcomputer lab. The lab housed 16 networked TRS-80s and a printer, with the machines arranged in two long, vertical rows--one double and one single. A school administrator with microcomputer expertise assisted her during class, and she felt that this collaboration served as a useful model for her students.

Ms. F. defined collaborative learning as the process involved when a small group of students work together in the teacher's presence on a single project. She believed that such collaboration fostered positive interactions that promoted not only achievement of academic goals, but social ones as well, including greater cultural, religious, ethnic, and racial tolerance.

The observed classes, each comprised of 30 students, were part of an ongoing writing workshop in which students progressed

through a series of assignments on the computer. The students were divided into groups of two or three for this work, usually of the teacher's choice. Each group collaborated on the project it had selected at its own pace. Ms. F. and her assistant periodically checked on the progress of each group during the class. As each group completed an assignment, the teacher would thoroughly critique it, and sometimes suggest that the group add to what they had already written. In one of the classes, a student also assisted the groups. The students readily called on the girl for help, and she admitted that the students liked to have her read their work, since they knew she'd "tell them the truth about it." She appeared to be well-acquainted with the software, and Ms. F. corroborated this impression by referring to her as the "software expert," affirming that she encouraged the girl to help the others.

During one observation, a group of three boys (all friends) worked on an original poem that they had begun on the playground the previous day. One boy did the keyboarding while the other two observed what he wrote, made suggestions, pointed out errors, and occasionally reached over and entered a change themselves. Initially, the keyboarder recalled a dozen lines of their poem, and typed those in. Then, his two collaborators came up with the next dozen or so lines between them, which the keyboarder also typed in. Finally, all three "brainstormed" an ending, with the keyboarder making entries only after each line was completed and agreed upon by all three.

During another session of the class, two boys were observed collaborating on a written report describing a social studies project that they had recently completed. One boy typed while the other boy dictated what was to be entered. In this case, the typist was more passive than the one who dictated, and whenever an argument arose over an entry, the typist always acceded to his partner's point of view. When their work was completed, they showed it to the teacher, who corrected their spelling, suggested an addition to one sentence, and asked them to write more text. Clearly at a loss for anything more to say, the two decided to append a description of their science project to the social studies one, in order to make it longer, as per her instructions.

TEACHER G

Ms. G. is a fifth grade teacher in an elementary school in the South Bronx. She teaches an introduction to word processing in the microcomputer lab which houses sixteen Apple IIE microcomputers arranged primarily in clusters of two or three around the room.

In the observed class sessions, the students worked cooperatively on stories on the theme of "wishes." They paired off, by choice, and those whom Ms. G. thought would work better alone were assigned to single machines. In the initial session, the class began by reviewing the fundamentals of using the "Bank Street Writer," and also discussed some general rules of grammar. Students then did some some "brainstorming" on the

subject of wishes. Ms. G. reminded them of Jiminy Cricket's song, "When You Wish Upon a Star," and asked them about their own wishes. She wrote their contributions on the board, and noted with pleasure that many of them were altruistic ones. The groups were then directed to agree upon a wish that they would like to write about, and to enter it on their computers. At this point, some children encountered difficulty in working with one another, since they discovered that they could not jointly agree upon a wish. Ms. G. then suggested that they might be happier with new partners, and some looked relieved to be permitted to switch.

During the second session, the class began by having each group read its chosen wish aloud. The teacher then instructed them to imagine that their wishes had been granted, and to write about how that would feel and what might transpire, as a result of this. The students became increasingly excited and involved in their projects at this point, and began to share the keyboarding responsibilities among themselves as they each happily struggled to enter their own "wish come true" thoughts.