35. COOPERATION AND THE USE OF TECHNOLOGY

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35.1 TECHNOLOGY IN THE CLASSROOM

We live in an age that needs people who can work collaboratively designing, using, and maintaining the tools of technology. These tools pervade every aspect of our lives, from automatic teller machines, to bar codes on the things we buy, to copy machines, computers, and fax machines. Our society has moved from manufacturing-based work on which individuals generally competed or were independent from each other to information and technological-rich work on which individuals generally work in teams. Technology and teamwork will continuously play a larger role in our lives. Children, adolescents, and young adults have no choice but to develop and increase their technological and teamwork literacy. There is no better place for them to start than in school. Learning in cooperative groups while utilizing the tools of technology should occur in all grade levels and subject areas.

Because the nature of technology used by a society influences what the society is and becomes, individuals who do not become technologically literate will be left behind. Influences of a technology include the nature of the medium, the way the medium extends human senses, and the type of cognitive processing required by the medium. Harold Adam Innis (1964, 1972) proposed that media biased towards lasting a long time, such as stone hieroglyphics, lead to small, stable societies because stone was difficult to edit and rewrite and was too heavy to distribute over great distances. In contrast, media biased toward traveling easily across distances, such as papyrus, enabled the Romans to build and run a large empire. Marshall McLuhan (1964) believed that the way the media technology balances the senses creates its own form of thinking and communicating and eventually alters the balance of human senses. He believed that oral communication makes hearing dominant and thought simultaneous and circular. Written communication makes sight dominant, and thought may be linear (one thing follows another), rational (cause and effect), and abstract. Electronic technology tends to recreate the village on a global scale through instantaneous and simultaneous communication in which physical distance between people becomes irrelevant. On a more negative note, Neil Postman (1985) expressed fears that our ability to reason with rigor and self-discipline is being eroded as fewer people read systematically and more people watch and listen to electronic media. Their thinking may become more reactive and impressionistic.

Given the pervasive and powerful effects media technologies can have on the nature of society and the thinking and communicating of its members, there can be little doubt that technology will increasingly be utilized in instructional situations. In the past, however, teachers and schools have been very slow in adopting new technologies and very quick in discontinuing its use (Cuban, 1986). Cuban documents a cyclic pattern in which: (a) the potential of a technology leads to fervent claims and promises by advocates, (b) its utility is demonstrated by academic research in a small set of classrooms rich with human and technical support, (c) teachers who have little or no resources adopt the technology and are frustrated by their failure to make it work, and (d) the use of the new technology gradually declines.

The failure of schools to adopt available instructional technologies and to maintain (let alone continuously improve) their use may be at least in part due to two barriers: (a) the individual assumption underlying most hardware and software development and (b) the failure to utilize cooperation learning as an inherent part of using instructional technologies. The purpose of this chapter is to clarify the interdependence between instructional technologies and cooperation among students in using the technologies as an inherent part of classroom life. In order to understand how cooperative learning may be used with instructional technologies, the nature of cooperative learning needs to be defined, the theoretical foundations on which it is based need to be clarified, the research validating its use needs to be reviewed, distinctions between cooperative learning and other types of instructional groups needs to be made, and the basic elements that make cooperation work must be defined. At that point, the interrelationships between cooperative learning and technology-assisted instruction can be noted and their complementary strengths delineated. The future of technology-assisted cooperative learning can then be discussed.

35.2 THE INDIVIDUAL ASSUMPTION

Many hardware and software designers (as well as teachers) automatically assume that all technology-assisted instruction should be structured individualistically. One student to a computer has been the usual assumption, and computer programs have been written accordingly. A strength of the computer and interactive technologies has been perceived to be their apparent ability to deliver individualized instruction. Tailoring instruction to each student's personal learning needs has strong intuitive appeal, as students differ in aptitude, learning style, personality characteristics, and motivation. The ability of designers to adapt instruction sequences to the cognitive and affective needs of each learner, however, is limited by three factors:

1. Substantial variation exists in types of learning styles and personality traits and, although many of them are sometimes correlated with achievement, few have been shown to predict achievement consistently.
2. Little agreement exists on how to translate differences in learning styles and personal traits into instructional prescriptions. The only design rule widely accepted is that students should control the flow of information.
3. Creating algorithms to adapt instruction to individual needs and designing and producing multiple versions of lessons are both time consuming and expensive.

Thus, the potential for individualized instruction may be limited due to the difficulties associated with identifying individual differences and translating them into instructional prescriptions. In addition, individualized instruction has several shortcomings:

1. Individual work isolates students, and working alone for long periods may lower personal motivation by increasing boredom, frustration, anxiety, and the perception that learning is impersonal.
2. Individual instruction limits the resources and the technology available for individual effort. The support and encouragement of peers and the cognitive benefits associated with explaining to peers and developing shared mental models is lost.
3. Individualized instruction greatly increases development and hardware costs. A workstation is required for each learner, which entails considerable hardware expense. Substantial development and software expenses are required when lessons have to be designed to personalize instruction and to adapt the instructional sequence to individual processing requirements.

The difficulties associated with identifying and accommodating individual needs severely limit designers' ability to individualize instruction. The shortcomings of individualized instruction call into question the wisdom of designing individualized programs. Despite these problems, however, virtually all instructional software is designed, developed, and marketed for individual use.

In his description of the implementation of the Apple Classrooms of Tomorrow, Dwyer (1994) notes that the cooperative, task-related interaction among students was spontaneous and more extensive than in traditional classrooms, with students interacting with one another while working at computers, spontaneously helping each other, showing curiosity about each other's activities, wanting to share what they had just learned to do, working together to build multimedia presentations about diverse topics, and combining their group's work into whole-class, interdisciplinary projects. The spontaneous cooperation often reported around technology both casts doubt on the individual assumption made by hardware and software designers and points toward the use of cooperative learning in technology-assisted instruction. To use cooperative learning, however, educators must understand its nature.

35.3 THE NATURE OF COOPERATIVE LEARNING

The best way to conduct technology-assisted instruction is to embed it in cooperative learning. To understand technology-assisted cooperative learning, you must understand the nature of cooperative learning, the theoretical foundations on which it is based, the research validating its use, the distinctions between cooperative learning and other types of instructional groups, and the basic elements that make cooperation work.

Cooperation is working together to accomplish shared goals (Johnson & Johnson, 1989). Within cooperative activities, individuals seek outcomes that are beneficial to themselves and beneficial to all other group members. *Cooperative learning* is the instructional use of small groups so that students work together to maximize their own and each other's learning. In cooperative-learning situations, there is a positive interdependence among students' goal attainments; students perceive that they can reach their learning goals if and only if the other students in the learning group also reach their goals (Deutsch, 1962; Johnson & Johnson, 1989). There are four types of cooperative learning that may be used in combination with instructional technology: formal cooperative learning, informal cooperative learning, cooperative base groups, and academic controversy.

Formal cooperative learning is students working together, for one class period to several weeks, to achieve shared learning goals and complete jointly specific tasks and assignments—such as decision making or problem solving, completing a curriculum unit, writing a report, conducting a survey or experiment, or reading a chapter or reference book, learning vocabulary, or answering questions at the end of the chapter (Johnson, Johnson & Holubec, 1992, 1993). Any course requirement or assignment may be reformulated to be cooperative. In formal cooperative learning groups, teachers:

1. *Specify the objectives for the lesson.* In every lesson there should be an academic objective specifying the concepts and strategies to be learned and a social skills objective specifying the interpersonal or small-group skill to be used and mastered during the lesson.
2. *Make a number of preinstructional decisions.* A teacher has to decide on the size of groups, the method of assigning students to groups, the roles students will be assigned, the materials needed to conduct the lesson, and the way the room will be arranged.
3. *Explain the task and the positive interdependence.* A teacher clearly defines the assignment, teaches the required concepts and strategies, specifies the positive interdependence and individual accountability, gives the criteria for success, and explains the expected social skills to be engaged in.
4. *Monitor students' learning and intervene within the groups to provide task assistance or to increase students' interpersonal and group skills.* A teacher systematically observes and collects data on each group as it works. When assistance is needed, the teacher intervenes to assist students in completing the task accurately and in working together effectively.
5. *Evaluate students' learning and help students process how well their groups functioned.* Students' learning is carefully assessed and student performances are evaluated. Members of the learning groups then process how effectively they have been working together.

Informal cooperative learning consists of having students work together to achieve a joint learning goal in temporary, ad-hoc groups that last from a few minutes to one class period (Johnson, Johnson & Holubec, 1992; Johnson, Johnson & Smith, 1991). During a lecture, demonstration, or film, ad-hoc groups can be used to focus student attention on the material to be learned, set a mood conducive to learning, help set expectations as to what will be covered in a class session, ensure that students cognitively process the material being taught, and provide closure to an instructional session. During direct teaching, the instructional challenge for the teacher is to ensure that students do the intellectual work of organizing material, explaining it, summarizing it, and integrating it into existing conceptual structures. Informal cooperative learning groups are often organized so that students engage in 3- to 5-minute *focused discussions* before and after a lecture, and 2- to 3-minute *turn-to-your-partner* discussions interspersed throughout a lecture.

Cooperative base groups are long-term, heterogeneous cooperative learning groups with stable membership (Johnson, Johnson & Holubec, 1992; Johnson, Johnson & Smith, 1991). *The purposes of the base group are to give the support, help, encouragement, and assistance each member needs to make academic progress (attend class, complete all assignments, learn) and develop cognitively and socially in healthy ways.* Base groups meet daily in elementary school and twice a week in secondary school (or whenever the class meets). They are permanent (lasting from one to several years) and provide the long-term caring peer relationships necessary to influence members consistently to work hard in school. They formally meet to discuss the academic progress of each member, provide help and assistance to each other, and verify that each member is completing assignments and progressing satisfactorily through the academic program. Base groups may also be responsible for letting absent group members know what went on in class when they miss a session. Informally, members interact every day within and between classes, discussing assignments and helping each other with homework. The use of base groups tends to improve attendance, personalizes the work required and the school experience, and improve the quality and quantity of learning. The larger the class or school and the more complex and difficult the subject matter, the more important it is to have base groups. Base groups are also helpful in structuring homerooms and when a teacher meets with a number of advisors.

When students work together in cooperative groups, they will often disagree and argue with each other. Using intellectual conflicts for instructional purposes is one of the most dynamic and involving, yet least-used, teaching strategies. The fourth type of cooperative learning is *academic controversy,* which exists when one student's ideas, information, conclusions, theories, and opinions are incompatible with those of another, and the two seek to reach an agreement (Johnson & Johnson, 1992). Teachers structure academic controversies by choosing an important intellectual issue, assigning students to groups of four, dividing the group into two pairs, and assigning one pair the "pro" position and the other pair a "con" position. Students then follow the five-step controversy procedure of (a) preparing the best case possible for their assigned position, (b) persuasively presenting the best case possible for their position to the opposing pair, (c) having an open discussion in which the two sides argue forcefully and persuasively for their position while subjecting the opposing position to critical analysis, (d) reversing perspectives, and (e) dropping all advocacy coming to a consensus as to their best reasoned judgment about the issue.

In all four types of cooperative learning, repetitive lessons can be scripted so they become classroom routines. *Cooperative learning scripts* are standard cooperative procedures for conducting generic, repetitive lessons and managing classroom routines (Johnson, Johnson & Holubec, 1993). They are used to organize course routines and generic lessons that occur repeatedly. These repetitive cooperative lessons provide a base on which the cooperative classroom may be built. Some examples are checking homework, preparing for and reviewing a test, drill-review of facts and events, reading of textbooks and reference materials, writing reports and essays, giving presentations, learning vocabulary, learning concepts, doing projects such as surveys, and problem solving. Each of these instructional activities may be done cooperatively and, once planned and conducted several times, will become automatic activities in the classroom. They may also be used in combination to form an overall lesson.

Cooperative learning is being used throughout preschools, elementary and secondary schools, colleges, and adult education programs because of its blend of theory, research, and practice. It is not a strictly American educational phenomenon; it is touted from Finland to New Zealand, from Israel to Japan. What underlies cooperative learning's popularity is that it is based on well-formulated theories that have been validated by numerous research studies.

35.4 THEORETICAL FOUNDATIONS OF COOPERATIVE LEARNING

There are at least three general theoretical perspectives that have guided research on cooperative learning: cognitive-developmental, behavioral, and social interdependence. The *cognitive-developmental perspective* is largely based on the theories of Piaget and Vygotsky. The work of Piaget and related theorists is based on the premise that when individuals cooperate on the environment, sociocognitive conflict occurs that creates cognitive disequilibrium, which in turn stimulates perspective-taking ability and cognitive development. The work of Vygotsky and related theorists is based on the premise that knowledge is social, constructed from cooperative efforts to learn, understand, and solve problems. The *behavioral learning theory perspective* focuses on the impact of group reinforcers and rewards on learning. Skinner focused on group contingencies; Bandura focused on imitation; and Homans, as well as Thibaut and Kelley, focused on the balance of rewards and costs in social exchange among interdependent individuals. While the cognitive-developmental and behavioral theoretical orientations have their followings, by far the theory dealing with cooperation that has generated the most research is *social interdependence theory.*

Social interdependence exists when individuals share common goals (see 6.4), and each person's success is affected by the actions of the others (Deutsch, 1962; Johnson & Johnson, 1989). It may be differentiated from *social dependence* (i.e., the outcomes of one person are affected by the actions of a second person, but not vice versa) and *social independence* (i.e., individuals' outcomes are unaffected by each other's actions). There are two types of social interdependence: cooperative and competitive. The absence of social interdependence and dependence results in individualistic efforts. Social interdependence is one of the most fundamental and ubiquitous aspects of being a human being and it affects all aspects of our lives (Deutsch, 1949, 1962).

Theorizing on *social interdependence* began in the early 1900s, when one of the founders of the Gestalt School of Psychology (see 5.2.2), Kurt Koffka, proposed that groups were dynamic wholes in which the interdependence among members could vary. One of his colleagues, Kurt Lewin, refined Koffka's notions in the 1920s and 1930s while stating that: (a) The essence of a group is the interdependence among members (created by common goals), which results in the group's being a "dynamic whole," so that a change in the state of any member or subgroup changes the state of any other member or subgroup; and (b) an intrinsic state of tension within group members motivates movement toward the accomplishment of the desired common goals. For interdependence to exist, there must be more than one person or entity involved, and the persons or entities must have impact on each other in that a change in the state of one causes a change in the state of the others. From the work of Lewin's students and colleagues, such as Ovisankian, Lissner, Mahler, and Lewis, it may be concluded that it is the drive for goal accomplishment that motivates cooperative and competitive behavior.

In the late 1940s, one of Lewin's graduate students, Morton Deutsch, extended Lewin's reasoning about social interdependence and formulated a theory of cooperation and competition (Deutsch, 1949, 1962). Deutsch conceptualized three types of social interdependence: positive, negative, and none. Deutsch's basic premise was that the type of interdependence structured in a situation determines how individuals interact with each other, which, in turn, largely determines outcomes. Positive interdependence tends to result in promotive interaction; negative interdependence tends to result in oppositional or contrient interaction; and no interdependence results in an absence of interaction. Depending on whether individuals promote or obstruct each other's goal accomplishments, there is substitutability, cathexis, and inducibility. The relationships between the type of social interdependence and the interaction pattern it elicits is assumed to be bidirectional. Each may cause the other. Deutsch's theory has served as a major conceptual structure for this area of inquiry for the past 45 years.

35.5 RESEARCH ON SOCIAL INTERDEPENDENCE

The research on social interdependence is notable for the sheer amount of work done, the long history of the work, the wide variety of dependent variables examined, the generalizability and external validity of the work, and the sophistication of the research reviews.

A great deal of research on social interdependence has been conducted over 10 decades. Between 1898 and 1989, over 550 experimental and 100 correlational studies were conducted on social interdependence (see Johnson & Johnson, 1989, for a complete listing of these studies). Hundreds of other studies have used social interdependence as the dependent rather than the independent variable. In our own research program at the Cooperative Learning

Center at the University of Minnesota over the past 25 years, we have conducted over 85 studies to refine our understanding of how cooperation works. In terms of sheer quantity of research, social interdependence theory is one of the most examined aspects of human nature.

A wide variety of dependent variables has been examined in the research on social interdependence. Social interdependence is a generic human phenomenon that affects many different outcomes simultaneously. Over the past 95 years, researchers have focused on such diverse dependent variables as individual achievement and retention, group and organizational productivity, higher-level reasoning, moral reasoning, achievement motivation, intrinsic motivation, transfer of training and learning, job satisfaction, interpersonal attraction, social support, interpersonal affection and love, attitudes toward diversity, prejudice, self-esteem, personal causation and locus of control, attributions concerning success and failure, psychological health, social competencies, and many others. These numerous outcomes may be subsumed within three broad categories (Johnson & Johnson, 1989): effort to achieve, positive interpersonal relationships, and psychological health.

The research on social interdependence has an external validity and a generalizability rarely found in the social sciences. The more variations in places, people, and procedures the research can withstand and still yield the same findings, the more externally valid the conclusions. The research has been conducted in 10 different historical decades. Research subjects have varied as to age, sex, economic class, nationality, and cultural background. A wide variety of research tasks, ways of structuring the types of social interdependence, and measures of the dependent variables have been used. The research has been conducted by many different researchers with markedly different theoretical and practical orientations working in different settings and even in different countries. The diversity of subjects, settings, age levels, and operationalizations of social interdependence and the dependent variables give this work wide generalizability and considerable external validity.

If research is to have impact on theory and practice, it must be summarized and communicated in a complete, objective, impartial, and unbiased way. In an age of information explosion, there is considerable danger that theories will be formulated on small and nonrepresentative samples of available knowledge, thereby resulting in fallacious conclusions that in turn lead to mistaken practices. A quantitative reviewing procedure allows for more definitive and robust conclusions. To establish the current state of knowledge about social interdependence, therefore, the meta-analysis process was applied. *Meta-analysis* is a method of statistically combining the results of a set of independent studies that test the same hypothesis and using inferential statistics to draw conclusions about the overall result of the studies. The essential purpose of meta-analysis is to summarize a set of related research studies so that the size of the effect of the independent variable on the dependent variable is known.

The basic premise of social interdependence theory is that the way interdependence among goals is structured determines how individuals interact, which in turn largely determines outcomes. Research, therefore, has focused on both the interaction patterns found among interdependent individuals and the outcomes resulting from their efforts.

35.5.1 Interaction Patterns

Two heads are better than one.—Heywood

Positive interdependence (see Fig. 35-1) creates *promotive interaction,* which occurs as individuals encourage and facilitate each other's efforts to reach the group's goals (such as maximizing each member's learning). Group members promote each other's success (Johnson & Johnson, 1989) by:

1. Giving and receiving help and assistance. In cooperative groups, members both give and receive work-related and personal help and support. Hooper (1991) found a positive and significant correlation between achievement and helping behaviors.
2. Exchanging resources and information. Group members seek information and other resources from each other, comprehend information accurately and without bias, and make optimal use of the information provided (e.g., Cosen & English, 1987; Hawkins et al., 1982; Webb, Ender & Lewis, 1986). There are a number of beneficial results from (a) orally explaining, elaborating, and summarizing information and (b) teaching one's knowledge to others. Yueh and Alessi (1988) found that a combination of group and individual rewards resulted in increased peer teaching. Explaining and teaching increase the degree to which group members cognitively process and organize information, engage in higher-level reasoning, attain insights, and become personally committed to achieving. Listening critically to the explanations of groupmates provides the opportunity to utilize other's resources.
3. Giving and receiving feedback (see 32.2) on taskwork and teamwork behaviors. In cooperative groups, members monitor each other's efforts, give immediate feedback on performance, and, when needed, give each other help and assistance. Carrier and Sales (1987) found that students working in pairs chose elaborative feedback more frequently than did those working alone.
4. Challenging each other's reasoning. Intellectual controversy promotes curiosity, motivation to learn, reconceptualization of what one knows, higher-quality decision making, greater insight into the problem being considered, higher-level reasoning, and cognitive development (Johnson & Johnson, 1992). Logo environments (see 12.3.2.1, 24.5.1.3) may especially engender conflicts among ideas and subsequent negotiation and resolution of that

conflict (Clements & Nastasi, 1985, 1988; Lehrer & Smith, 1986).

5. Advocating increased efforts to achieve. Encouraging others to achieve increases one's own commitment to do so.
6. Mutually influencing each other's reasoning and behavior. Group members actively seek to influence and be influenced by each other. If a member has a better way to complete the task, groupmates usually adopt it quickly.
7. Engaging in the interpersonal and small-group skills needed for effective teamwork.
8. Processing how effectively group members are working together and how the group's effectiveness can be continuously improved.

Negative interdependence typically results in *oppositional interaction,* which occurs as individuals discourage and obstruct each other's efforts to achieve. Individuals focus both on increasing their own success and on preventing anyone else from being more successful than they are. *No interaction* exists when individuals work independently without any interaction or interchange with each other. Individuals focus only on increasing their own success and ignore as irrelevant the efforts of others.

Each of these interaction patterns affects outcomes differently. The outcomes of social interdependence may be organized into three major areas.

35.5.2 Effort to Achieve

In *Look Homeward Angel,* Thomas Wolfe records how in grammar school Eugene learned to write from a classmate, learning from a peer what *"all instruction failed"* to teach him. Is Eugene an isolated case? No. Between 1898 and 1989, researchers conducted over 375 experimental studies on social interdependence and achievement (Johnson & Johnson, 1989). A meta-analysis of all studies indicates that cooperative learning results in significantly higher achievement and retention than does competitive and individualistic learning (see Table 35-1). The more conceptual and complex the task, the more problem solving required; and the more creative the answers need to be, the greater the superiority of cooperative over competitive and individualistic learning. When we examined only the methodological high-quality studies, the superiority of cooperative over competitive or individualistic efforts was still pronounced.

Some cooperative procedures contained a mixture of cooperative, competitive, and individualistic efforts, while others contained pure cooperation. The original jigsaw procedure (Aronson, 1978), for example, is a combination of resource interdependence and an individualistic reward structure. Teams-games-tournaments (see 17.3; DeVries & Edwards, 1974) and student-teams-achievement-divisions (Slavin, 1986) are mixtures of cooperation and intergroup competition. Team-assisted instruction (Slavin, Leavey & Madden, 1982) is a mixture of individualistic and coopera-

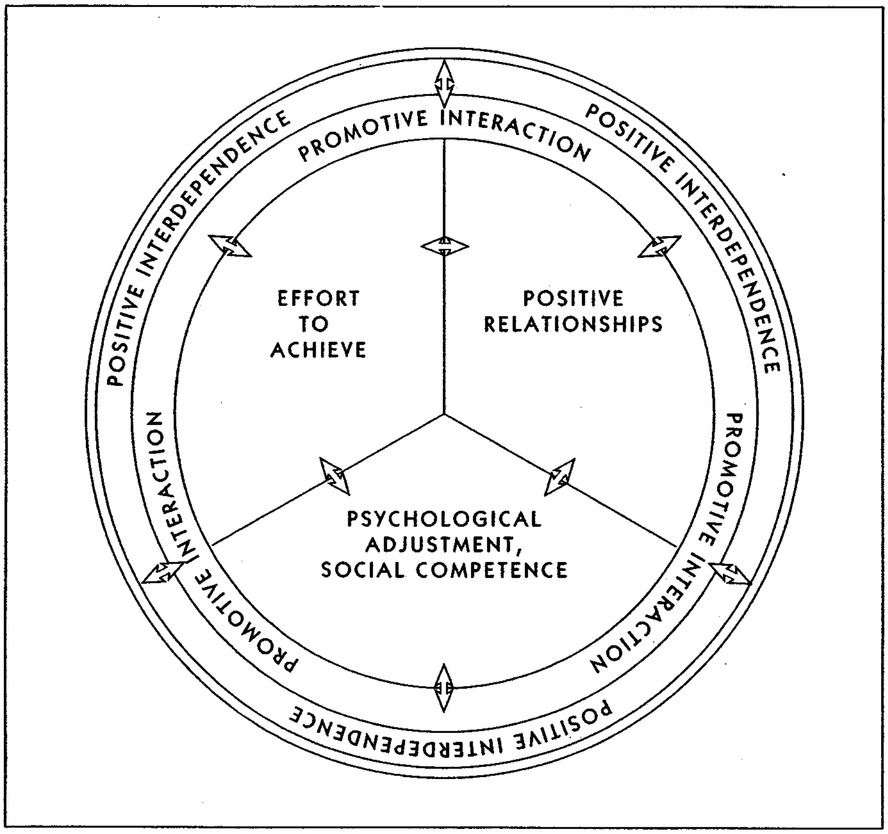

Figure 35-1. Outcomes of cooperation. Reprinted by permission from Johnson, D. W., Johnson, R. & Holubec, E. (1993). *Circles of Learning,* 4th ed. Edina, MN: Interaction Book Company.

TABLE 35-1. MEAN WEIGHTED EFFECT SIZES OF SOCIAL INTERDEPENDENCE ON DEPENDENT VARIABLES

	Mean	s.d.	*n*
Achievement			
Cooperative vs. competitive	0.67	0.93	129
Cooperative vs. individualistic	0.64	0.79	184
Competitive vs. individualistic	0.30	0.77	38
Interpersonal attraction			
Cooperative vs. competitive	0.67	0.49	93
Cooperative vs. individualistic	0.60	0.58	60
Competitive vs. individualistic	0.08	0.70	15
Social support			
Cooperative vs. competitive	0.62	0.44	84
Cooperative vs. individualistic	0.70	0.45	72
Competitive vs. individualistic	-0.13	0.36	19
Self-esteem			
Cooperative vs. competitive	0.58	0.56	56
Cooperative vs. individualistic	0.44	0.40	38
Competitive vs. individualistic	-0.23	0.42	19

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tive learning. When the results of "pure" and "mixed" operationalizations of cooperative learning were compared, the pure operationalizations produced higher achievement.

Besides higher achievement and greater retention, cooperation, compared with competitive or individualistic efforts, tends to result (Johnson & Johnson, 1989) in more:

1. Willingness to take on difficult tasks and persist, despite difficulties, in working toward goal accomplishment.
2. Long-term retention of what is learned.
3. Higher-level reasoning (critical thinking) and metacognitive thought. Cooperative efforts promote a greater use of higher-level reasoning strategies and critical thinking than do competitive or individualistic efforts (effect sizes = 0.93 and 0.97, respectively). Even on writing assignments, students working cooperatively show more higher-level thought.
4. Creative thinking (process gain). In cooperative groups, members more frequently generate new ideas, strategies, and solutions that they would think of on their own.
5. Transfer of learning from one situation to another (group to individual transfer). What individuals learn in a group today, they are able to do alone tomorrow.
6. Positive attitudes toward the tasks being completed (job satisfaction). Cooperative efforts result in more positive attitudes toward the tasks being completed and greater continuing motivation to complete them. The positive attitudes extend to the work experience and the organization as a whole.
7. Time on task. Cooperators spend more time on task than do competitors (effect size = 0.76) or students working individualistically (effect size = 1.17).

Kurt Lewin often stated, *"I always found myself unable to think as a single person."* Most efforts to achieve are a personal but social process that require individuals to cooperate and to construct shared understandings and knowledge. Both competitive and individualistic structures, by isolating individuals from each other, tend to depress achievement.

35.5.3 Positive Interpersonal Relationships

Heartpower is the strength of your corporation.—Vince Lombardi, famous coach of the Green Bay Packers

Since 1940, over 180 studies have compared the impact of cooperative, competitive, and individualistic efforts on interpersonal attraction (Johnson & Johnson, 1989). Cooperative efforts, compared with competitive and individualistic experiences, promoted considerably more liking among individuals (see Table 35-1). The effects sizes were higher for (a) high-quality studies and (b) the studies using pure operationalizations of cooperative learning than for studies using mixed operationalizations. These positive feelings were found to extend to superiors in the organizational structure. Thus, *individuals tend to care more about each other and to be more committed to each other's success and well-being when they work together cooperatively than when they compete to see who is best or work independently from each other.*

A major extension of social interdependence theory is social judgment theory that focuses on relationships among diverse individuals (Johnson & Johnson, 1989). Cooperators tend to like each other, not only when they are homogeneous but also when they differ in intellectual ability, handicapping conditions, ethnic membership, social class, culture, and gender (see 6.4). Individuals working cooperatively tend to value heterogeneity and diversity more than do individuals working competitively or individualistically. The positive impact of heterogeneity results from a process of acceptance that includes frequent and accurate communication, accurate perspective taking, mutual inducibility (openness to influence), multidimensional views of each other, feelings of psychological acceptance and self-esteem, psychological success, and expectations of rewarding and productive future interaction.

Closely related to the research on the impact of social interdependence on interpersonal relationships is the study of group cohesion (Johnson & F. Johnson, 1994). Generally, the more positive the relationships among group members, the lower the absenteeism, the fewer the members who drop out of the group, and the more likely students will commit effort to achieve educational goals, feel personal responsibility for learning, take on difficult tasks, be motivated to learn, persist in working toward goal achievement, have high morale, be willing to endure pain and frustration on behalf of learning, listen to and be influenced by classmates and teachers, commit to each other's learning and success, and achieve and produce.

In addition, positive peer relationships influence the social and cognitive development of students and such attitudes and behaviors as educational aspirations and staying in school (Johnson & Johnson, 1989). Relationships with peers influence what attitudes and values students adopt, whether students become prosocial or antisocial oriented, whether students learn to see situations from a variety of perspectives, the development of autonomy, aspirations for postsecondary education, and whether students learn how to cope with adversity and stress. Mevarech et al. (1987), for example, found that altruism increased among students learning in cooperative pairs.

Besides liking each other, cooperators give and receive considerable social support, both personally and academically (Johnson & Johnson, 1989). Since the 1940s, over 106 studies comparing the relative impact of cooperative, competitive, and individualistic efforts on social support have been conducted. Social support may be aimed at enhancing another person's success (task-related social support) or at providing support on a more personal level (personal social support). Cooperative experience promoted greater task-oriented and personal social support than did competitive (effect size = 0.62) or individualistic (effect size = 0.70) experiences. Social support tends to promote achievement and productivity, physical health, psychological health, and successful coping with stress and adversity.

Interpersonal relationships are at the heart of communities of practice. Learning communities are based as much on relationships as they are on intellectual discourse. The more positive the relationships among students and the more committed students are to each other's success, the harder students will work and the more productive they will be.

35.5.4 Psychological Health

Ashley Montagu was fond of saying, *"With few exceptions, the solitary animal is, in any species, an abnormal creature."* Karen Horney said, *"The neurotic individual is someone who is inappropriately competitive and, therefore, unable to cooperate with others."* Montagu and Horney recognized that the essence of psychological health is the ability to develop and maintain cooperative relationships. *Psychological health* may be defined, therefore, as the ability to develop, maintain, and appropriately modify interdependent relationships with others to succeed in achieving goals. To manage social interdependence, individuals must correctly perceive whether interdependence exists and whether it is positive or negative, be motivated accordingly, and act in ways consistent with normative expectations for appropriate behavior within the situation. The major variables related to psychological health studied by researchers interested in social interdependence are psychological adjustment, self-esteem, perspective-taking ability, social skills, and a variety of related attitudes and values.

A number of studies have been conducted on the relationship between social interdependence and psychological health (Johnson & Johnson, 1989). Working cooperatively with peers and valuing cooperation results in greater psychological health than does competing with peers or working independently. *Cooperativeness* is positively related to a number of indices of psychological health, such as emotional maturity, well-adjusted social relations, strong personal identity, ability to cope with adversity, social competencies, and basic trust in and optimism about people. Personal ego strength, self-confidence, independence, and autonomy are all promoted when cooperative efforts are involved. *Individualistic attitudes* tend to be related to a number of indices of psychological pathology such as emotional immaturity, social maladjustment, delinquency, self-alienation, and self-rejection. *Competitiveness* is related to a mixture of healthy and unhealthy characteristics. Cooperative experiences are not a luxury; they are an absolute necessity for healthy psychological development.

The relationship between social interdependence and self-esteem has been examined by interested researchers. A process of self-acceptance is posited to be based on (a) internalizing perceptions that one is known, accepted, and liked as one is, (b) internalizing mutual success, and (c) evaluating oneself favorably in comparison with peers. A process of self-rejection may occur from (a) not wanting to be known, (b) low performance, (c) overgeneralization of self-evaluations, and (d) the disapproval of others. Since the 1950s there have been over 80 studies comparing the relative impact of cooperative, competitive, and individualistic experiences on self-esteem (Johnson & Johnson, 1989). Cooperative experiences promoted higher self-esteem than did competitive (effect size = 0.58) or individualistic (effect size = 0.44) experiences. Our research demonstrated that cooperative experiences tend to be related to these beliefs: One is intrinsically worthwhile; others see one in positive ways; one's attributes compare favorably with those of one's peers; and one is a capable, competent, and successful person. In cooperative efforts, students (a) realize that they are accurately known, accepted, and liked by one's peers, (b) know that they have contributed to their own, others, and group success, and (c) perceive themselves and others in a differentiated and realistic way that allows for multidimensional comparisons based on complementarity of their own and others' abilities. Competitive experiences tend to be related to conditional self-esteem based on whether one wins or loses. Individualistic experiences tend to be related to basic self-rejection.

A number of studies have related cooperative, competitive, and individualistic experiences to perspective-taking ability (the ability to understand how a situation appears to other people) (Johnson & Johnson, 1989). Cooperative experiences tend to increase perspective-taking ability, while competitive and individualistic experiences tend to promote egocentrism (being unaware of other perspectives other than your own) (effect sizes of 0.61 and 0.44, respectively). Individuals, furthermore, who are part of a cooperative effort learn more social skills and become more socially competent than do persons competing or working individualistically. Finally, it is through cooperative efforts that many of the attitudes and values essential to psychological health (such as self-efficacy) are learned and adopted.

35.5.5 Everything Affects Everything Else

Deutsch's (1985) crude law of social relations states that the characteristic processes and effects elicited by a given type of social interdependence also tend to elicit that type of social interdependence. Thus, positive interdependence elicits promotive interaction, and promotive interaction tends to elicit positive interdependence. Deutsch's law may also be applied to the three types of outcomes resulting from cooperative experiences.

Each of the outcomes of cooperative efforts (effort to achieve, quality of relationships, and psychological health) influences the others, and, therefore, they are likely to be found together (Johnson & Johnson, 1989). *First,* caring and committed friendships come from a sense of mutual accomplishment, mutual pride in joint work, and the bonding that results from joint efforts. The more individuals care about each other, on the other hand, the harder they will work to achieve mutual goals. *Second,* joint efforts to achieve mutual goals promote higher self-esteem, self-efficacy, personal control, and confidence in one's competencies. The healthier psychologically individuals are, on the other hand, the better able to they are to work with others to achieve mutual goals. *Third,* psychological health is built on the internalization of the caring and respect received from loved ones. Friendships are developmental advantages that promote self-esteem, self-efficacy, and general psychological adjustment. The healthier people are psychologically (i.e., free of psychological pathology such as depression, paranoia, anxiety, fear of failure, repressed anger, hopelessness, and meaninglessness), on the other hand, the more caring and committed their relationships. Since each outcome can induce the others, you are likely to find them together. They are a package, with each outcome a door into all three. Together they induce positive interdependence and promotive interaction.

35.6 WHAT IS AND IS NOT A COOPERATIVE GROUP

It is the potential for such outcomes that make cooperative groups the key to successful education. *The truly committed cooperative learning group is probably the most productive instructional tool educators have.* Creating and maintaining truly committed cooperative learning groups, however, require an understanding of the differences between cooperative learning groups and other forms of classroom grouping, the forces hindering group performance, and the basic elements that make cooperative work.

35.6.1 Making Potential Group Performance a Reality

Not all groups are cooperative groups. Placing people in the same room and calling them a cooperative group does not make them one. Having a number of people work together does not make them a cooperative group. Study groups, project groups, lab groups, committees, task forces, departments, and councils are groups, but they are not necessarily cooperative. Groups do not become cooperative groups simply because that is what someone labels them.

The authors have studied cooperative learning groups for 30 years. We have interviewed thousands of students and teachers in a wide variety of school districts in a number of different countries over three different decades to discover how groups are used in the classroom and where and how cooperative groups work best. On the basis of our findings and the findings of other researchers such as Katzenbach and Smith (1993), a learning group performance curve has been developed to clarify the difference between various types of learning groups (Fig. 35-2).

The *learning group performance curve* illustrates that how well any small group performs depends on how it is structured. On the performance curve, four types of learning groups are described. It begins with the individual members of the group and illustrates the relative performance of these students to pseudo groups, traditional classroom groups, cooperative learning groups, and high-performance cooperative learning groups.

A *pseudo-learning group* is a group whose members have been assigned to work together, but they have no interest in doing so. They meet but do not want to work together or help each other succeed. Members often block or interfere with each other's learning, communicate and coordinate poorly, mislead and confuse each other, loaf, and seek a "free ride." The interaction among group members detracts from individual learning without delivering any benefit. The result is that the sum of the whole is less than the potential of the individual members. The group does not mature, because members have no interest in or commitment to each other or the group's future.

A *traditional classroom learning group* is a group whose members have accepted that they are to work together but see little benefit from doing so. Interdependence is low. The assignments are structured so that very little if any joint work is required. Members do not take responsibility for anyone's learning other than their own. Members interact primarily to share information and clarify how the assignments are to be done. Then they each do the work on their own. And their achievements are individually recognized and rewarded. Students are accountable as separate individuals, not as members of a team. Students do not receive training in social skills, and a group leader is appointed who is in charge of directing members' participation. There is no processing of the quality of the group's efforts.

A *cooperative learning group* is more than a sum of its parts. It is a group whose members are committed to the common purpose of maximizing each other's learning. A *high-performance cooperative learning group* is a group that meets all the criteria for being a cooperative learning group and outperforms all reasonable expectations, given its membership. What differentiates the high-performance group from the cooperative learning group is the level of commitment members have to each other and the group's success. Jennifer Futernick, who is part of a high-performing, rapid-response team at McKinsey & Company, calls the emotion binding her teammates together a form of love (Katzenbach & Smith, 1993). Ken Hoepner of the Burlington Northern Intermodal Team (also described by Katzenbach & Smith, 1993) stated: *"Not only did we trust each other, not only did we respect each other, but we gave a damn about the rest of the people on this team. If we saw somebody vulnerable, we were there to help."* Members' mutual concern for each other's personal growth enables high-performance cooperative groups to perform far above expectations, and also to have lots of fun. The bad news about high-performance cooperative groups is that they are rare. Most groups never achieve this level of development.

35.6.2 Forces Hindering Group Performance

Performance and small groups go hand in hand. Although cooperative groups outperform individuals working alone, there is nothing magical about groups. There are conditions

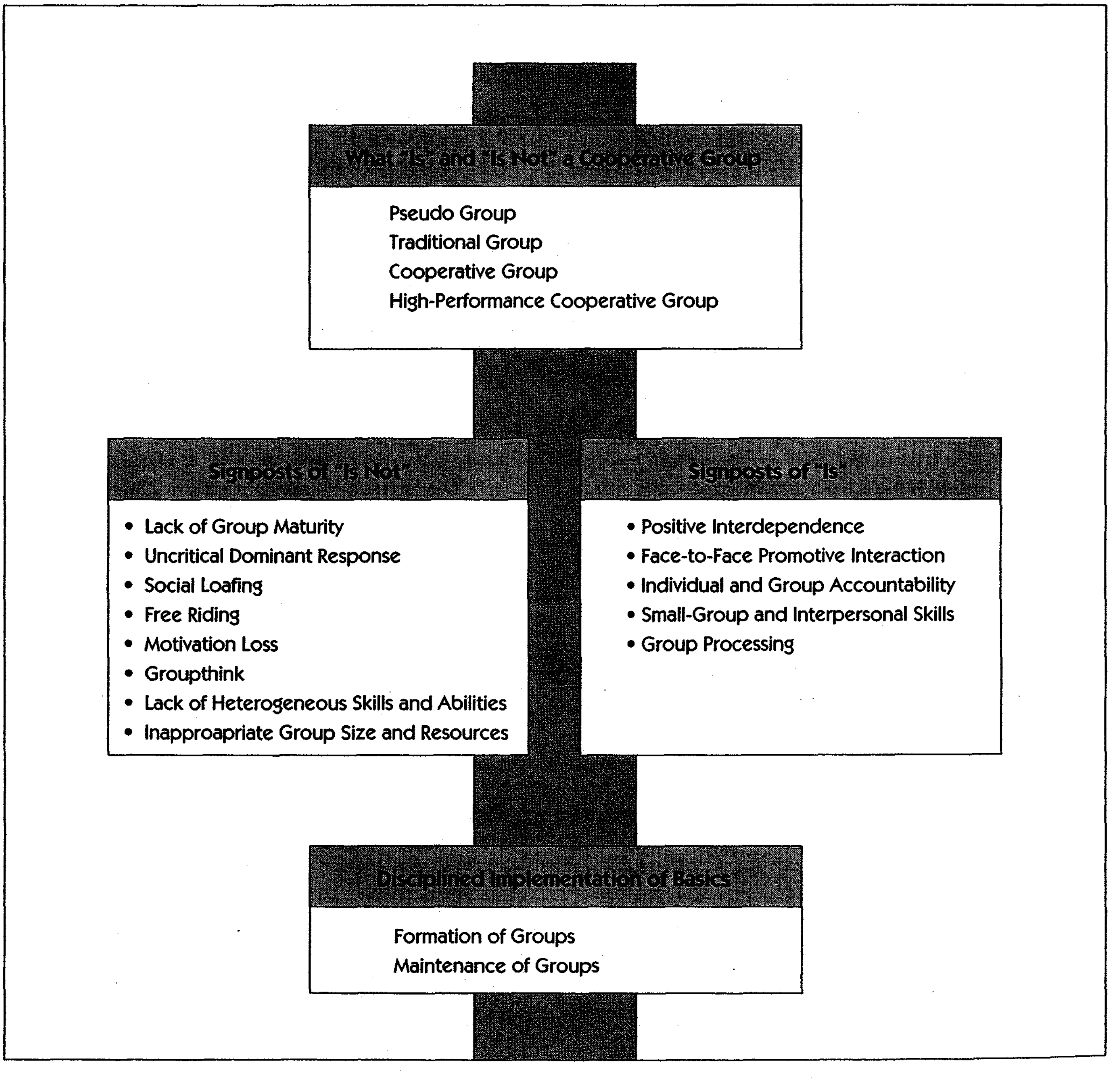

Figure 35-2. Making cooperative groups work. Reprinted by permission from Johnson, D. W., Johnson, R. & Holubec, E. (1993). *Circles of Learning*, 4th ed. Edina, MN: Interaction Book Company.

under which groups function effectively, and conditions under which groups function ineffectively. *Potential barriers to group effectiveness* (Johnson & F. Johnson, 1994) are:

1. *Lack of group maturity.* Group members need time and experience working together to develop into an effective group. Temporary, ad-hoc groups usually do not develop enough maturity to function with full effectiveness.
2. *Uncritically giving one's dominant response.* A central barrier to higher-level reasoning and deeper-level understanding is the uncritical giving of members' dominant response to academic problems and assignments. Instead, members should generate a number of potential answers and choose the best one.
3. *Social loafing—hiding in the crowd.* When a group is working on an additive task (group product is determined by summing together individual group members' efforts), and individual members can reduce their effort without other members realizing that they are doing so, many people tend to work less hard. Such social loafing has been demonstrated on a variety of additive tasks such as rope pulling, shouting, and clapping.
4. *Free riding—getting something for nothing.* On disjunctive tasks (if one member does it, all members receive the benefit), there is the possibility of a free ride. When group members realize that their efforts are dispensable (group success or failure depends very little on whether or not they exert effort), and when their efforts are costly, group members are less likely to exert themselves on the group's behalf.
5. *Motivation losses due to perceived inequity—not being a sucker.* When other group members are free riding, there is a tendency for the members who are working to reduce their efforts to avoid being a "sucker."
6. *Groupthink.* Groups can be overconfident in their ability and resist any challenge or threat to their sense of invulnerability by avoiding any disagreements and seeking concurrence among members.
7. *Lack of sufficient heterogeneity.* The more homogeneous the group members, the less each member adds to the group's resources. Groups must develop the right mix of taskwork and teamwork skills necessary to do their work. Heterogeneity ensures that a wide variety of resources are available for the group's work.
8. *Lack of teamwork skills.* Groups with members who lack the small-group and interpersonal skills required to work effectively with others often underperform their most academically able members.
9. *Inappropriate group size.* The larger the group, the fewer the members who can participate, the less essential each member views his or her personal contribution, the more teamwork skills required, and the more complex the group structure.

Not every group is effective. Most everyone has been part of a group that wasted time, was inefficient, and generally produced poor work. But there are groups that accomplish wondrous things. Educators must be able to spot the above characteristics of ineffective groups and take action to eliminate them. The hindering factors are eliminated by the basics of cooperation.

35.7 APPLYING THE BASICS OF COOPERATION

Educators fool themselves if they think well-meaning directives to "work together," "cooperate," and "be a team" will be enough to create cooperative efforts among students. *There is a discipline to creating cooperation.* The "basics" of structuring cooperation are not a series of elements that characterize good groups. They are a regimen that, if followed rigorously, will produce the conditions for effective cooperation. Cooperative learning groups are rare because educators (and students) seek shortcuts to quality groupwork and assume that "traditional classroom groups will do." Like persons who wish to lose weight without dieting, they seek easy alternatives to the disciplined application of the basics of effective groups, which are positive interdependence, face-to-face promotive interaction, individual and group accountability, appropriate use of social skills, and group processing.

35.7.1 Positive Interdependence: We Instead of Me

All for one and one for all.—Alexandre Dumas

In a football game, the quarterback who throws the pass and the receiver who catches the pass are positively interdependent. The success of one depends on the success of the other. It takes two to complete a pass. One player cannot succeed without the other. Both have to perform competently if their mutual success is to be assured. If one fails, they both fail.

The discipline of using cooperative groups begins with structuring positive interdependence (see Johnson & Johnson, 1989, 1992b, 1992c). The heart of cooperation is positive interdependence. Group members must believe that they sink or swim together and know that they cannot succeed unless all other members of their group succeed. It is positive interdependence that requires group members to work together to accomplish something beyond individual success. Positive interdependence creates the realization that members have two responsibilities: to learn the assigned material and to ensure that all members of their group learn the assigned material. When positive interdependence exists in a group, all group members realize they (a) *share a common fate* where they all gain or lose on the basis of the overall performance of group members, (b) *are striving for mutual benefit* so that all members of the group will gain, (c) *have a long-term time perspective* so that long-term joint productivity is perceived to be of greater value than short-term personal advantage, and (d) *have a* *shared identity based on group membership* (besides being a separate individual, one is a member of a team). When positive interdependence is clearly understood, it highlights that (a) each group member's efforts are required and indispensable for group success (i.e., there can be no "free riders"), and (b) each group member has a unique contribution to make to the joint effort because of his or her resources and/or role and task responsibilities (i.e., there can be no social loafing).

To structure positive interdependence, the teacher *first* assigns the group a clear, measurable task (members have to know what they are supposed to do) and, *second,* explains the positive goal interdependence (mutual goals) so that members believe that they can attain their goals if and only if their groupmates attain their goals. Positive goal interdependence ensures that the group is united around a common goal, a concrete reason for being, such as *"learn the assigned material and make sure that all members of your group learn the assigned material."* *Third,* the teacher supplements positive goal interdependence with other types of positive interdependence, such as joint rewards, divided resources, complementary roles, and a team identity. The more types of interdependence used in a group, the greater the impact on outcomes.

The authors have conducted a series of studies investigating the nature of positive interdependence and the relative power of the different types of positive interdependence (Frank, 1984; Hwong, Caswell, Johnson & Johnson, 1993; Johnson, Johnson, Stanne & Garibaldi, 1990; Johnson, Johnson, Ortiz & Stanne, 1991; Lew, Mesch, Johnson & Johnson, 1986a, 1986b; Mesch, Johnson & Johnson, 1988; Mesch, Lew, Johnson & Johnson, 1986). Our research indicates that positive interdependence provides the context within which promotive interaction takes place, group membership and interpersonal interaction among students do not produce higher achievement unless positive interdependence is clearly structured, the combination of goal and reward interdependence increases achievement over goal interdependence alone, and resource interdependence does not increase achievement unless goal interdependence is present also.

35.7.2 Individual Accountability/ Personal Responsibility

> *What children can do together today, they can do alone tomorrow.*—Vygotsky

Among the early settlers of Massachusetts, there was a saying: *"If you do not work, you do not eat."* Everyone had to do his or her fair share of the work. *The discipline of using cooperative groups includes structuring group and individual accountability. Group accountability* exists when the overall performance of the group is assessed, and the results are given back to all group members to compare against a standard of performance. *Individual accountability* exists when the performance of each individual member is assessed, the results given back to the individual and the group to compare against a standard of performance, and the member is held responsible by groupmates for contributing his or her fair share to the group's success. On the basis of the feedback received, (a) efforts to learn and contribute to groupmates' learning can be recognized and celebrated, (b) immediate remediation can take place by providing any needed assistance or encouragement, and (c) groups can reassign responsibilities to avoid any redundant efforts by members.

The purpose of cooperative groups is to make each member a stronger individual in his or her own right. Individual accountability is the key to ensuring that all group members are in fact strengthened by learning cooperatively. After participating in a cooperative lesson, group members should be better prepared to complete similar tasks by themselves. There is a pattern to classroom learning. *First,* students learn knowledge, skills, strategies, or procedures in a cooperative group. *Second,* students apply the knowledge or perform the skill, strategy, or procedure alone to demonstrate their personal mastery of the material. Students learn it together and then perform it alone. Hooper, Ward, Hannafin, and Clark (1989) found that cooperative technology-assisted instruction resulted in higher achievement when individual accountability was structured than when it was not.

35.7.3 Positive Interdependence and Accountability

In cooperative situations, group members share responsibility for the joint outcome. Each group member takes personal responsibility for (a) contributing his or her efforts to accomplish the group's goals and (b) helping other group members do likewise. The greater the positive interdependence structured within a cooperative learning group, the more students will feel *personally responsible* for contributing their efforts to accomplish the group's goals. The shared responsibility adds the concept of "ought" to members' motivation: One *ought* to do one's share, contribute, and pull one's weight. The shared responsibility also makes each group member personally accountable to the other group members. Students will realize that if they fail to do their fair share of the work, other members will be disappointed, hurt, and upset.

35.7.4 Face-to-Face Promotive Interaction

> *In an industrial organization, it's the group effort that counts. There's really no room for stars in an industrial organization. You need talented people, but they can't do it alone. They have to have help.*—John F. Donnelly, President, Donnelly Mirrors

The discipline of using cooperative groups includes ensuring that group members meet face to face to work together to complete assignments and promote each other's success. Group members need to do real work together *Promotive interaction* exists when individuals encourag and facilitate each other's efforts to complete tasks in order to reach the group's goals. Through promoting each other's success, group members build both an academic and a personal support system for each member. Promotive interaction is characterized by individuals providing each other with efficient and effective help and assistance, exchanging needed resources such as information and materials and processing information more efficiently and effectively, providing each other with feedback in order to improve subsequent performance, challenging each other's conclusions and reasoning in order to promote higher-quality decision making and greater insight into the problems being considered, advocating the exertion of effort to achieve mutual goals, influencing each other's efforts to achieve the group's goals, acting in trusting and trustworthy ways, being motivated to strive for mutual benefit, and a moderate level of arousal characterized by low anxiety and stress. Promoting each other's success results in group members' getting to know each other on a personal as well as a professional level.

While electronic communication has many positive features, face-to-face communication has a richness that electronic communication may never match. There is evidence that up to 93% of people's intent was conveyed by facial expression and tone of voice, with the most important channel being facial expression (Druckman, Rozelle & Baxter, 1982; Meherabian, 1971). Harold Geneen, the former head of ITT, believed that his response to requests was different face to face than through teletype: *"In New York, I might read a request and say No. But in Europe, I could see that an answer to the same question might be Yes. . . . It became our policy to deal with problems on the spot, face to face"* (cited in Trevino, Lengel & Draft, 1987). For this and other reasons (such as lack of effective groupware), instructional programs may be most effective when they use face-to-face rather than electronic teams. Learning teams, however, may be electronically linked with other training teams in other sites.

35.7.5 Interpersonal and Small-Group Skills

I will pay more for the ability to deal with people than for any other ability under the sun.—John D. Rockefeller

The fourth arena in the disciplined use of cooperative groups is teaching group members the small-group and interpersonal skills they need to work effectively with each other. In cooperative learning groups, students are required to learn academic subject matter (*taskwork*) and also to learn the interpersonal and small-group skills required to function as part of a group (*teamwork*). If the teamwork skills are not learned, then the taskwork cannot be completed. If group members are inept at teamwork, their taskwork will tend to be substandard. On the other hand, the greater the members' teamwork skills, the higher will be the quality and quantity of their learning. Cooperative learning is inherently more complex than competitive or individualistic learning because students have to engage simultaneously in taskwork and teamwork. In order to coordinate efforts to achieve mutual goals, students must (a) get to know and trust each other, (b) communicate accurately and unambiguously, (c) accept and support each other, and (c) resolve conflicts constructively (Johnson, 1991, 1993; Johnson & F. Johnson, 1994).

The more socially skillful students are, and the more attention teachers pay to teaching and rewarding the use of social skills, the higher the achievement that can be expected within cooperative learning groups. In their studies on the long-term implementation of cooperative learning, Marvin Lew and Debra Mesch (Lew, Mesch, Johnson & Johnson, 1986a, 1986b; Mesch, Johnson & Johnson, 1988; Mesch, Lew, Johnson & Johnson, 1986) investigated the impact of a reward contingency for using social skills as well as positive interdependence and a contingency for academic achievement on performance within cooperative learning groups. In the cooperative skills conditions, students were trained weekly in four social skills, and each member of a cooperative group was given two bonus points toward the quiz grade if all group members were observed by the teacher to demonstrate three out of four cooperative skills. The results indicated that the combination of positive interdependence, an academic contingency for high performance by all group members, and a social skills contingency promoted the highest achievement.

35.7.6 Group Processing

Take care of each other. Share your energies with the group. No one must feel alone, cut off, for that is when you do not make it.—Willi Unsoeld, Renowned Mountain Climber

The final phase of the discipline of using cooperative groups is structuring group processing. Effective group work is influenced by whether or not groups reflect on (process) how well they are functioning. A process is an identifiable sequence of events taking place over time, and process goals refer to the sequence of events instrumental in achieving outcome goals (Johnson & F. Johnson, 1994). *Group processing* occurs when members discuss how well they are achieving their goals and maintaining effective working relationships among members. Cooperative groups need to describe what member actions are helpful and unhelpful and make decisions about what behaviors to continue or change. The *purposes* of group processing are to clarify and improve the effectiveness of members in contributing to the collaborative efforts to achieve the group's goals by (a) enabling groups to improve continuously the quality of member's work, (b) facilitating the learning of teamwork skills, (c) ensuring that members receive feedback on their participation, and (d) enabling groups to focus on group maintenance (Johnson, Johnson & Holubec, 1993). Groups that process how effectively members are working together tend to higher achievements than do groups that do not process or than individuals working alone. The combination of teacher and student processing resulted in greater problem-solving success than did the other cooperative conditions. And the combination of group and individual feedback resulted in higher achievement (Archer-Kath, Johnson & Johnson, 1994; Johnson, Johnson, Stanne & Garibaldi, 1990; Yager, Johnson & Johnson, 1985).

Group processing and self-monitoring are interrelated. Discussing the observations of members' actions results in (a) a heightened self-awareness of the effective and ineffective actions taken during the group meetings, (b) public commitment to increase the frequency of effective actions and decrease the frequency of ineffective actions, and (c) an increased sense of having the ability to be more effective if appropriate effort is exerted (i.e., self-efficacy). Participating in group processing inherently increases the self-monitoring by group members. There is evidence, however, that high- and low-ability students may differ in their self-monitoring capacity. Ames and Lau (1982) found that ability and effort, among other things, played a significant role in determining students' help-seeking and self-monitoring behaviors. Zimmerman (1986) found that high school students' effective use of self-monitoring skills was related to their achievement level. Thus, because low-ability students are often lacking in self-monitoring skills, it seems reasonable to expect that they would benefit by working with students who typically exhibit more effective monitoring during the learning process.

Group processing leads not only to self-monitoring, it also leads to *self-efficacy,* which is the expectation of successfully obtaining valued outcomes through personal effort. The opposite of self-efficacy is helplessness. Sarason and Potter (1983) examined the impact of individual self-monitoring of thoughts on self-efficacy and successful performance and found that having individuals focus their attention on self-efficacious thoughts is related to greater task persistence and less cognitive interference. They concluded that the more that people are aware of what they are experiencing, the more aware they will be of their own role in determining their success. The greater the sense of self- and joint-efficacy promoted by group processing, the more productive and effective group members and the group as a whole become.

Effective processing focuses group members on positive rather than negative behaviors. Monitoring one's own and one's collaborators' actions begins with deciding which behaviors to direct one's attention toward. Individuals can focus either on positive and effective behaviors, or on negative and ineffective behaviors. Sarason and Potter (1983) found that when individuals monitored their stressful experiences, they were more likely to perceive a program as having been more stressful than did those who did not. But when individuals monitored their positive experiences, they were more likely to perceive the group experience as involving less psychological demands, were more attracted to the group and had greater motivation to remain members, and felt less strained during the experience and more prepared for future group experiences. When individuals are anxious about being successful, and are then told they have failed, their performance tends to decrease significantly, but when individuals anxious about being successful are told they have succeeded, their performance tends to increase significantly (Turk & Sarason, 1983).

35.8 THE COOPERATIVE SCHOOL

The new electronic tools are radically changing the way people access and use information and, therefore, have profound implications for the educational process. Education, on the other hand, is stuck with organizational patterns and professional traditions that negate many of the advantages of the new technologies. For technology to be fully utilized in schools, the organizational structure of the school has to change as well as the organizational structure of the classroom. To utilize the new technologies most effectively, schools need to change from a mass-manufacturing organizational structure to a team-based, high-performance organizational structure. This new organizational structure is created when cooperative learning is used the majority of the time in the classroom, and cooperation is used to structure faculty and staff work in (a) colleagial teaching teams, (b) school-based decision making, and (c) faculty meetings (Johnson & Johnson, 1994a).

Just as the heart of the classroom is cooperative learning, the heart of the school is *colleagial teaching teams*: small cooperative groups in which members work to improve continuously each other's (a) instructional expertise and success in general and (b) expertise in using cooperative learning in particular. Administrators may also be organized into colleagial support groups to increase their administrative expertise and success.

School-based decision making may be structured through the use of two types of cooperative teams. A *task force* considers a school problem and proposes a solution to the faculty as a whole. The faculty is then divided into *ad-hoc decision-making groups* and considers whether to accept or modify the proposal. The decisions made by the ad-hoc groups are summarized, and the entire faculty then decides on the action to be taken to solve the problem.

Faculty meetings represent a microcosm of what administrators think the school should be. The clearest modeling of cooperative procedures in the school may be in faculty meetings and other meetings structured by the school administration. All four types of cooperative learning (formal, informal, base groups, and controversy) may be used at faculty meetings to increase their productivity, build faculty cohesion, and improve the faculty's social competence.

Technological innovation lags in schools. A key obstacle to the use of technology in schools is the limited support teachers have for integrating unfamiliar technologies into instruction. Just as students group together to learn cooperatively how to use new software or hardware, teachers need to group together to learn how to use the new technologies and then how to integrate them into the instruction. As long as each teacher works in isolation from his or her peers, the implementation of technology represents a personal decision on the part of each teacher, rather than an organizational change at the school and district levels. Many teachers are unfamiliar with the new technologies and feel unable to master them. In order to implement technology fully, the organizational structure of the school has to change from the old mass-manufacturing organizational structure to a team-based, high-performance organizational structure where teams of teachers can explore the new technologies, learn how to use them, and implement them together.

35.9 COOPERATIVE LEARNING AND TECHNOLOGY-BASED INSTRUCTION

In order to enhance learning, technology must promote cooperation among students and create a shared experience. *Technology-assisted cooperative learning* exists when the instructional use of technology is combined with the use of cooperative learning groups. Students, for example, may be assigned to cooperative groups of two or three members and given a cooperative assignment to complete a task for which a technology is to be utilized. Positive interdependence is typically established at the terminal so that students are aware of their dependence on other group members in accomplishing their learning goals.

Adding technology to a lesson inherently increases the lesson's complexity. When students participate in technology-assisted instruction, they have the dual tasks of (a) learning how to use the technology (i.e., the hardware and software required by the lesson) and (b) mastering the information, skills, procedures, and processes being presented within the technology. When cooperative learning groups are used, students have the additional task of learning teamwork procedures and skills. The complexity may be worth it. Technology-assisted cooperative learning tends to be a cost-effective way of teaching students how to use technology, increasing academic achievement, giving learners control over their learning, creating positive attitudes toward technology-based instruction and cooperative learning, promoting cognitive development, and increasing social skills. Computers themselves promote cooperative interaction among learners. The composition of the group and the gender of the learners are factors that have been hypothesized to affect the success of technology-assisted cooperative learning. Through technology, individuals in different settings can be networked into electronic cooperative learning groups.

35.9.1 Cost Effectiveness

The use of cooperative learning increases the cost effectiveness of technology. Although the range of technology that could be used in schools is increasing yearly (Hancock & Betts, 1994), the cost of adopting new technologies is an inhibiting factor to its use. Ensuring that every student is provided with the latest technology is beyond the financial resources of most school districts. Giving each cooperative learning group access to the latest technology is much more cost effective. An historical example is the adoption of computers by schools. By having groups work at computers (instead of individuals), schools were able to reduce significantly the cost of obtaining and maintaining computers (Johnson & Johnson, 1985; Wizer, 1987).

35.9.2 Learning How to Use Technology

Cooperative learning may reduce hardware and software problems that decrease achievement when students work alone (Hativa, 1988). Students naturally form groups when learning how to use a new technology or software program (Becker, 1984). When technology-assisted lessons require complex procedures (such as learner-controlled lessons), cooperative learning promotes greater mastery of the procedures than does individualistic learning. Trowbridge and Durnin (1984) found that students working in groups of two or three seemed more likely to interpret program questions as the authors of the materials intended. Discussions of multiple interpretations tended to converge on the correct interpretation. Hooper (1992) reported that students were frustrated and could not master the computer-assisted lesson when they worked alone with a learner-controlled lesson. Dyer (1993) compared structured cooperative pairs, unstructured cooperative pairs, and individuals completing a computer-assisted series of math problem-solving lessons. Structured cooperative pairs communicated more frequently and used the computer more efficiently and skillfully than did the unstructured cooperative pairs or students in the individualistic condition. McDonald (1993) found that students in the learner-controlled/cooperative learning condition selected more options during the lesson and spent more time interacting with the tutorial than did the learner-controlled/individual learning condition. When teachers wish to introduce new technology and new software programs of some complexity, they will be well advised to use cooperative learning. Hooper, Temiyakarn, and Williams (1995) found that cooperative learning established a mutually supportive learning environment among group members in which both cognitive difficulties and navigational disorientation were overcome in using the computer to complete a symbolic-reasoning task. Students studying alone had greater difficulty reading and understanding lesson directions, used the help option more often, and required more attempts to master embedded quizzes than did students in cooperative learning groups. Generally, this evidence indicates that students will learn how to use hardware and software more quickly and effectively when they learn in cooperative groups rather than alone.

In learning how to use computers, Webb (1984a) and Webb, Ender, and Lewis (1986) found that, in cooperative groups, explaining how to do computer programming was not related to skill in doing so (see also 24.5.3), and receiving explanations only influenced the learning of basic commands (not the interpretation of programs or the ability to generate programs). Fletcher (1985), on the other hand, investigating cognitive facilitation, found on a computer task calling for solving equations in an Earth spaceship game that individuals who were told to verbalize their decisions did as well in problem-solving performance on the game as groups told to come to consensus (both of which had superior results to individuals working silently). King (1989) asked groups of fourth-graders to reproduce a stimulus design using LOGO computer graphics (see 24.5.1.3) after they had watched a videotape modeling of "think-aloud problem solving." The groups were instructed to think aloud as they performed their task. More successful groups asked more task-related questions, spent more time on strategy, and reached higher levels of strategy elaboration than did groups who were less successful on the task.

35.9.3 Academic Achievement

We conducted several studies examining the use of cooperative, competitive, and individualistic learning activities at the computer (D. Johnson, Johnson, Stanne & Garibaldi, 1989, 1990; R. Johnson, Johnson & Stanne, 1985, 1986; R. Johnson, Johnson, Stanne, Smizak & Avon, 1987; Richards, Johnson & Johnson, 1986). The studies included students from the eighth grade through college freshmen and lasted from 3 to 30 instructional hours. The tasks were a computerized navigational and map-reading problem-solving task and word-processing assignments. Computer-assisted cooperative learning, compared with competitive and individualistic efforts at the computer, promoted (a) higher quantity of daily achievement, (b) higher quality of daily achievement, (c) greater mastery of factual information, (d) greater ability to apply one's factual knowledge in test questions requiring application of facts, (e) greater ability to use factual information to answer problem-solving questions, and (f) greater success in problem solving. Cooperation at the computer promoted greater motivation to persist on problem-solving tasks. Students in the cooperative condition were more successful in operating computer programs. In terms of oral participation, students in the cooperative condition, compared with students in the competitive and individualistic conditions, made fewer statements to the teacher and more to each other, made more task-oriented statements and fewer social statements, and generally engaged in more positive, task-oriented interaction with each other (especially when the social skill responsibilities were specified and group processing was conducted). Finally, the studies provided evidence that females were perceived to be of higher status in the cooperative than in the competitive or individualistic conditions.

In addition to our work, there are a number of studies that have found that students using a combination of cooperative learning and computer-based instruction learn better than do students using computer-based instruction while working individually (Cox & Berger, 1985; Dalton, 1990; Dalton, Hannafin & Hooper, 1987; Hooper, 1992; Hooper, Temiyakarn & Williams, 1995; Hythecker, Rocklin, Dansereau, Lambiotte, Larson & O'Donnell, 1985; Love, 1969; Mevarech, Stern & Levita, 1987; Okey & Majer, 1976; Repman, 1993; Rocklin, O'Donnell, Dansereau, Lambiotte, Hythecker & Larson, 1985; Shlecter, 1990; Stephenson, 1992; Webb, 1984; Yueh & Alessi, 1988). There are also a number of studies that found no statistically significant differences in achievement between subjects who worked in groups and subjects who worked alone (Carrier & Sales, 1987; Cosden & English, 1987; Hooper & Hannafin, 1988; Trowbridge & Durnin, 1984). No study has reported significantly greater learning when students work alone.

Simon Hooper and his colleagues have conducted a series of studies on technology-assisted cooperative learning involving fifth- to eighth-graders and college students (Dyer, 1993; Hooper, 1991; Hooper & Hannafin, 1988a, 1988b, 1991; Hooper, Ward, Hannafin & Clark, 1989; Huang, 1993; McDonald, 1993). They found that: (a) Cooperative group members achieved significantly higher than did students working under individualistic conditions; (b) cooperative learning groups in which individual accountability was carefully structured achieved higher than did cooperative learning groups in which no individual accountability was structured; (c) the achievement of low-ability students in heterogeneous cooperative groups was consistently higher than the achievement of low-ability students in homogeneous groups; (d) a positive and significant correlation was found between achievement and helping behaviors, and increases in achievement and cooperation to be significantly related within heterogeneous groups; and (e) cooperative (compared with individualistic) learning resulted in greater willingness to learn the material, options selection, time on task, perceived interdependence, and supportiveness for partners. Carlson and Falk (1989) and Noell and Carnine (1989) found that students in cooperative groups perform higher than students working alone on learning tasks involving interactive videodiscs. Adams, Carson, and Hamm (1990) suggest that cooperative learning can influence attention, motivation, and achievement when students use the medium of television.

35.9.4 Learner Control

Combining cooperative learning and technology-assisted instruction results in students having more control over their learning (see 33.1 to 33.3). Simon Hooper and his associates (Hooper, 1992; Hooper, Temiyakarn & Williams, 1993) note that three forms of lesson control are used in the design of technology-based instruction: learner, program, and adaptive control. *Learner control* involves delegating instructional decisions to learners so that they can determine what help they need (see 33.2), what difficulty level or content density of material they wish to study, in what sequence they wish to learn material, and how much they want to learn. *Program or linear control* prescribes an identical instructional sequence for all students regardless of interest or need. *Adaptive control* modifies lesson features according to student aptitude (see 22.1; Snow, 1980), prior performance (see 22.3.4.4; Tobias, 1987), or ongoing lesson needs (e.g., Tennyson, Christensen & Park, 1984).

Of the three, learner control may be the most important, as Hooper (1992) notes that the field of technology-assisted instruction seems to be moving toward learner-controlled environments, such as simulations, hypermedia (see Chapter 21), and on-line databases. He suggests that as learner control increases so does instructional effectiveness and efficiency (Reigeluth & Stein, 1983) and learner independence, efficiency, mental effort, and motivation (Federico, 1980; Salomon, 1983, 1985; Steinberg, 1984). On the other hand, linear or program control may impose an inappropriate lesson sequence on learners and thereby lower their motivation, and adaptive instruction may foster learner dependence (Hannafin & Rieber, 1989).

Technology-assisted cooperative learning tends to increase the effectiveness of learner control. When students work alone, in isolation from their peers, they tend not to control the learning situation productively, making ineffective instructional decisions and leaving instruction prematurely (Carrier, 1984; Hannafin, 1984; Milheim & Martin, 1991; Steinberg, 1977, 1989). Students working cooperatively tend to motivate each other to seek elaborative feedback to their responses to practice items during learning control and to seek a greater variety of feedback types more frequently than did those working alone (Carrier & Sales, 1987). Additionally, the cooperative pairs spent longer times inspecting information on the computer screen as they discussed which level of feedback they needed and what the answers were to practice items. McDonald (1993) found that students in the learner-controlled/cooperative learning condition selected more options during the lesson, and spent more time interacting with the tutorial, than did students in the learner-controlled/individual learning condition. Hooper, Temiyakarn, and Williams (1995) found that students in the program-control conditions attempted more than 4 times as many examples and nearly twice as many practice questions as did the students in the learner-control conditions. The LOGO computer environment (see 12.3.2.1, 24.5.1.3) tends to promote more actual learner control over the task structure and the making of rules to govern it than does the CAI computer environment (Battista & Clements, 1986; Clements & Nastasi, 1985, 1988; Nastasi, Clements & Battista, 1990). Learner control seems to be most effective when prior knowledge is high or when students possess well-developed metacognitive abilities (Garhart & Hannafin, 1986). What these studies imply is that cooperative learning is an important variable in improving the effectiveness of learner-controlled environments.

35.9.5 Attitudes Toward Technology-Based Instruction

Cooperative learning tends to promote positive attitudes toward technology-based instruction. A key aspect of technology-assisted instruction is the student attitudes generated by the experience. Students are more likely to learn from and to use technology-based instruction in the future when their self-efficacy toward technology and attitudes about technology-based instruction are positive (Sutton, 1991). Hooper, Temiyakarn, and Williams (1995) found that students developed more positive attitudes toward the computer-based instructional lesson when they worked in cooperative learning groups than when they worked individually. McDonald (1993) found that students developed more positive attitudes toward learning with a computer in the cooperative conditions than in the individualistic conditions. Huang (1993) found that students working cooperatively had more positive attitudes toward the computer-based lesson than did students working individually. Students appear to enjoy using the computer to engage in cooperative activities (Bonk, Southerly, Brantmayer & Smith, 1991).

35.9.6 Attitudes Toward Cooperative Learning

Closely related to the attitudes toward technology (see 34.6) are students' attitudes toward cooperative learning. Students with negative attitudes about cooperative learning may be less likely to invest effort in the group process and to engage in actions that mediate achievement. Mevarech et al. (1985) found that students who learned in pairs were more positive in their attitudes toward cooperative learning than were students who worked individually with the computer. Evaluations obtained by Rocklin et al. (1985) from students involved in computer-based cooperative learning were more positive towards cooperative learning and how it affected them personally than were subjects who worked individually. Hooper, Temiyakarn, and Williams (1995) found that students working in cooperative pairs developed more positive attitudes toward cooperative learning than did students working alone. Hooper et al. (1993) found that students rated cooperative learning in a computer-assisted lesson almost a point higher on a five-point scale than did students who worked alone. Dyer (1993) found that students in the structured cooperative learning conditions developed more positive attitudes toward working cooperatively than did students in the unstructured cooperative learning or the individualistic learning condition. McDonald (1993) and Huang (1993) both found that students in the cooperative conditions developed more positive attitudes toward working cooperatively than students working alone. Thus, when technology-assisted instruction is used, students' attitudes toward the instructional experience will be more positive when cooperative learning is an inherent part of the lesson.

35.9.7 Cognitive Development: Cooperation and Controversy

Social-cognitive theory posits that cognitive development is facilitated by individuals (Bearison, 1982; Johnson & Johnson, 1979, 1992; Perret-Clermont, 1980): (a) working cooperatively with peers on tasks that require coordination of actions or thoughts, (b) collaborators contradicting and challenging each other's intuitively derived concepts and points of view (i.e., engaging in *academic controversy*), thereby creating cognitive conflict within and among group members, and (c) the successful and equitable (members contributing approximately equally) resolution of those conflicts (learners have to go beyond mere disagreement to benefit from cognitive conflict [Bearison, Magzament & Filardi, 1986; Damon & Killen, 1982]). In order to create the conditions under which cognitive development takes place, students must work cooperatively, challenge each other's points of view, and resolve the resulting cognitive conflicts. Douglas Clements and Bonnie Nastasi have conducted a series of studies on the occurrence of cooperation and controversy in technology-assisted instruction (Battista & Clements, 1986; Clements & Nastasi, 1985, 1988; Nastasi & Clements, 1992; Nastasi, Clements & Battista, 1990). They have found that both LOGO (see 12.3.2.1, 24.5.1.3) and CAI/CBI-W computer environments promoted considerable cooperative work and conflict (both social and cognitive). The LOGO environment (compared to CAI/CBI-W computer and traditional classroom tasks environments) promoted (a) more peer interaction focused on learning and problem solving, (b) self-directed problem solving (i.e., learners solve problems they themselves have posed) in which there is mutual "ownership" of the problem, (c) more frequent occurrence and resolution of cognitive conflicts, (d) greater development of executive level problem-solving skills (planning, monitoring, decision making), higher-level reasoning, and cognitive development. The development of higher-level cognitive processes seemed to be facilitated by the resolution of cognitive conflict that arises out of cooperating. They also found that the LOGO (compared with the CAI) computer environment resulted in more learner satisfaction and expressions of pleasure at the discovery of new information and their work, variables reflective of intrinsic and competence motivation. Clements and Nastasi conclude that the LOGO environment generally promotes the development of motivated, self-directed learners who seek to validate their ideas not only through their own reasoning but also through meaningful communication with others.

35.9.8 Increasing Social Competencies

If students are to work effectively in cooperative groups, they must have the teamwork skills to do so. In order to examine the importance of social skills training on the productiveness of cooperative groups, it is possible to compare studies that have included cooperative skills training and those that have not. A number of studies have found that when teamwork procedures and skills are present, cooperative learning results in higher achievement in technology-assisted instructional lessons than individualistic learning (Hooper & Hannafin, 1991; Hooper & Hannafin, 1988a; Hooper, 1991; Johnson R., Johnson & Stanne, 1985, 1986). In studies where teamwork procedures and skills were not emphasized, reliable differences in achievement in cooperative and individualistic technology-assisted instruction were not found (Meuarech, Stern & Leuita, 1987; Underwood & McCaffrey, 1990; Hooper, Ward, Hannafin & Clark, 1989).

Software designers may be able to facilitate the development use of the interpersonal and small-group skills required for teamwork in several ways:

1. Before students engage in the actual instruction, they might first be required to complete a tutorial activity designed to introduce or refresh their understanding of cooperative skills. This could include a discussion of each member's role and its value in determining the overall group success.
2. Teachers' guides can suggest roles to assign to each group member to perform in the group (keyboarder, recorder, checker for understanding, encourager of participation).
3. Allow time for group processing to analyze and discuss how effectively they are working together and how they may work more effectively together in the future. Software could be designed to include pauses during which group members are directed to focus on their progress, discuss the records they are keeping, or reflect on improvements or changes they might make to increase performance.
4. The software could periodically remind students to monitor their own performance and to assist in optimizing group performance.
5. Yueh and Alessi (1988) suggest that group reward is crucial to provide a group goal motivating everyone to work well together, and individual accountability is needed to create a feeling of fairness among group members. Tangible prizes are recognition for individual successes, and group achievement offers motivation to succeed on both levels. One computer-generated reward would be a printout of collective characters, coupons, or certificates that are assigned points or a relative value, or are valued based on the number accumulated. These items could be displayed by students where they would be acknowledged by the teacher and other classmates.

35.9.9 Preference for Using Technnology Cooperatively

There is a natural partnership between technology and cooperation. There is evidence that individuals prefer to work cooperatively at the computer (Hawkins, Sheingold, Gearhart & Berger, 1982; Levin & Kareev, 1980; Muller & Perlmutter, 1985). The introduction of computers into classrooms increases cooperative behavior and task-oriented verbal interaction (Chernick & White, 1981, 1983; Hawkins, Sheingold, Gearhart & Berger, 1982; Levin & Kareev, 1980; Rubin, 1983; Webb, 1984). Working at a computer collaboratively with classmates seems to be more fun and enjoyable, as well as more effective, to most students. Students are more likely to seek each other out at the computer than they normally would for other school work. Even when students play electronic games, they prefer to have partners and associates. The computer may not only be a good place to cooperate but may also be a good place to introduce cooperative learning groups in schools.

35.9.10 Group Composition

A factor hypothesized to effect the success of technology-assisted cooperative learning is whether cooperative learning groups are composed homogeneously or heterogeneously. There is considerable disagreement. Advocates of heterogeneous grouping point out that students are more likely to gain sophistication and preparation for life in a heterogeneous society by working cooperatively with classmates from diverse cultures, attitudes, and perspectives rather than by learning in homogeneous groups or studying alone. Proponents of heterogeneous ability grouping point out that (a) high-achieving students benefit by the cognitive restructuring that occurs when providing in-depth explanations to peers, and (b) less academically successful students benefit from the extra attention, alternative knowledge representations, and modeling that more academically successful students provide (Johnson & Johnson, 1989; Webb, 1989). Students in heterogeneous-ability groups learned more than did students in homogeneous-ability groups (Yager, Johnson & Johnson, 1985; Yager, Johnson, Johnson & Snider, 1986). Beane and Lemke (1971) found that high-ability students benefited more from heterogeneous than homogeneous grouping. The academic discussion and peer interaction in heterogeneous groups promotes the discovery of more effective reasoning strategies than would occur in homogeneous groups (Johnson & Johnson, 1979; Berndt, Perry & Miller, 1988).

Proponents of homogeneous-ability grouping, however, state that heterogeneous-ability grouping may fail to challenge high-ability students (Willis, 1990) and that less academically successful students benefit at the expense of their more successful partners (Mills & Durden, 1992; Robinson, 1990). Many of the most carefully conducted studies aimed at resolving this controversy have been focused on ability grouping in technologically-assisted instruction. Webb (1982) and Swing and Peterson (1982) reported that heterogeneous grouping hinders the performance of average-performing students when groups include a wide range of student performance levels.

In a week-long study on the learning of LOGO, Webb (1984) investigated whether the higher-ability students in cooperative groups of three would try to monopolize the computer. She found that (a) student ability did not relate to contact time with the computer, and (b) student success in programming was predicted by different profiles of abilities and by group process variables such as verbal interaction. Yueh and Alessi (1988) used group ability composition as one of their treatments for students utilizing the computer to learn three topics in algebra. They formed groups of medium-ability students and groups of mixed-ability students, and found that group composition had no significant effect on achievement.

In a study with 40 eighth-grade students, Hooper and Hannafin (1988a) had students work in cooperative groups of three or four which were classified as homogeneous low, homogeneous high, or heterogeneous. Students worked on a computer task. Low-ability students working with high-ability partners achieved higher than did low-ability students studying in homogeneous groups or alone, and the achievement of high-ability students was basically the same whether they worked with a low-achieving partner, a high-achieving partner, or studied alone.

Hooper and Hannafin (1991) conducted a study involving 125 sixth- and seventh-grade students. Subjects were randomly assigned to homogeneous or heterogeneous pairs, and the pairs were randomly assigned to cooperative or individualistic conditions. The high-ability students interacted equally across treatments, but low-ability students interacted 30% more when placed in heterogeneous pairs. Increases in achievement and cooperation were significantly related within heterogeneous groups.

Simsek and Hooper (1992) compared the effects of cooperative and individual learning on student performance and attitudes during interactive videodisc instruction. Thirty fifth- and sixth-grade students were classified as high or low ability and randomly assigned to cooperative or individual treatments. Students completed a level II interactive videodisc science lesson. The achievement, attitudes, and time-on-task of high- and low-ability students working alone or in cooperative groups were compared. Results indicated that both high- and low-ability students performed better on the posttest when they learned in cooperative groups than did their counterparts who learned alone. Students who worked individually spent less time-on-task. Members of cooperative groups developed more positive attitudes toward instruction, teamwork, and peers than did students studying alone.

Simsek and Tsai (1992) compared the effects of homogeneous- versus heterogeneous-ability grouping on performance and attitudes of students working cooperatively during interactive videodisc instruction. After two cooperative training sessions, 80 fourth- through sixth-grade students, classified as high and low ability, were randomly assigned to treatments. Students completed a level II interactive videodisc science lesson. The amount of instructional time for each group was also recorded. Homogeneous low-ability groups scored significantly lower than the other three groups, while the difference between achievement of high-ability students in homogeneous and heterogeneous groups was not statistically significant. Homogeneous low-ability groups consistently used the least amount of time. Low-ability students in heterogeneous groups had significantly more positive attitudes than did their high-ability groupmates.

Hooper (1992) compared individual and cooperative learning in an investigation of the effects of ability grouping on achievement, instructional efficacy, and discourse during computer-based mathematics instruction. A total of 115 fifth- and sixth-grade students were classified as having high or average ability and were randomly assigned to group or individual treatments. Students in the cooperative condition were assigned to either heterogeneous or homogeneous dyads, according to ability. Results indicated that students completed the instruction more effectively in groups than alone. In groups, achievement and efficiency were highest for high-ability homogeneously grouped students and lowest for average-ability homogeneously grouped students. Generating and receiving help were significant predictors of achievement, and average-ability students generated and received significantly more help in heterogeneous groups than in homogeneous ones.

Hooper, Temiyakarn, and Williams (1995) compared cooperative and individualistic learning on academically high- and average/low–performing students. They classified 175 fourth-grade students as high or average/low performing academically and randomly assigned them to paired or individual conditions strategies by performance level. Performance level was determined by scores on the mathematics subscale of the California Achievement Test. High-performing students scored at or above the median, and average/low–ability students scored below the median score of all fourth-grade students in the school. All cooperative pairs consisted of one high and one average/low–performing student. They found that the students in the cooperative conditions performed higher on a computer-assisted symbolic reasoning task than did the students in the individualistic conditions. The greatest benefactors from the group learning experience appeared to be the highest-performing students. Overall achievement increased by almost 20% for high-academic-ability students, but only 4% for average-ability students. High-ability students may have benefited from generating explanations for their less-able partners. Less-able partners might have adopted more passive roles. Mulryan (1992) found that the highest-achieving students adopted the more active roles in cooperative learning groups and the least-able students demonstrated high levels of passive behavior, a pattern that according to Webb (1989) further decreases the achievement of the passive students.

Siann and Macleod (1986) found that mixed-gender pairs working on a LOGO programming exercise were dominated by the males (females were less motivated and successful). Underwood and McCaffrey (1990) studied pairs of students (10 and 11 years of age) on a computer task filling in missing letters from words. They were not told how to work together. Single-sex pairs were more productive than mixed-sex pairs, who did not improve in performance over the individual performance of group members. Single-sex pairs worked by discussion and agreement, with each member of the pair contributing and both sharing keyboard control. In contrast, the mixed-gender pairs tended simply to divide the labor, with one taking over the keyboard and the other instructing the typist, with little discussion of or negotiation about alternative solutions.

The results of these studies indicate that cooperative learning may be used effectively with both homogeneous and heterogeneous groups, but that the greatest educational benefits may be derived when heterogeneous groups work with technology-assisted instruction. In heterogeneous cooperative learning groups, low-ability students increased their achievement considerably, and high-ability students generally either increased their achievement or achieved at the same levels as did their counterparts in homogeneously high groups.

35.9.11 Gender

The gender of group members has been hypothesized to be an important factor in determining the success of technology-assisted cooperative learning. Johnson, Johnson, Richards, and Buckman (1986) found that computer-assisted cooperative learning, compared with competitive and individualistic computer-assisted learning, increased the positiveness of female students' attitudes toward computers, equalized the status and respect among group members regardless of gender, and resulted in a more equal participation pattern between male and female members. While females in cooperative groups liked working with the computer more than males did, there was no significant difference in oral interactions between males and females. Dalton et al. (1987) examined interactions between instructional method and gender and found that cooperative learning was rated more favorably by low-ability females than by low-ability males. Other studies noted no significant differences in performance between males and females in computer-based instruction cooperative learning settings (Mevarech, Stern & Levita, 1987; Webb, 1984). Carrier and Sales (1987) compared female pairs, male pairs, and mixed pairs among college juniors and noted that female pairs verbalized the most while male pairs verbalized the least, and that male-female pairs demonstrated the most off-task behavior. Lee (1993) found that males tended to become more verbally active and females tended to become less verbally active in equal-ratio, mixed-gender groups.

A study that looked at mixed-gender groups versus single-gender groups was done by Underwood and McCaffrey (1990) in England. Two classes of students between the ages of 10.5 years and 11.4 years from a single school were the subjects in this study. Forty girls and 40 boys were randomly assigned to three types of pairs: male/male, female/female, and male/female. The study was divided into three sessions. The first session had the subjects working individually. In the second session, subjects worked in pairs. The third session also involved pairs, but subjects who were in mixed pairs were shifted to single-gender pairs, and single-gender pairs were assigned to mixed pairs. The subjects worked with a computer program in language tasks that required them to place missing letters into text. The results showed that single-gender pairs completed more stories and had more correct responses than did mixed-gender pairs. When subjects were shifted from single-gender pairs to mixed-gender pairs, their level of activity decreased, but there was no change in their overall performance. The study found no overall differences for gender on any of the measures. No cooperative training of subjects was undertaken for this study, and it was found that mixed pairs rarely discussed their answers. Rather, one subject operated the keyboard and the other gave directions.

Overall, there is mixed evidence concerning the impact of technology-assisted instruction on males and females. A conservative interpretation of the existing research is that there will be no performance differences between males and females on technology-assisted cooperative learning, but females will have more positive attitudes toward using technology when they learn in cooperative groups.

35.9.12 Networking into Teams

Technology such as electronic mail, bulletin boards, and conferences can be used to create teams made up of individuals who are widely separated geographically. In an electronically networked team, interaction no longer has to be face to face; team members can be anywhere in the world. In electronically networked teams, members may depend on one another differently than they do in face-to-face teams. Meetings only require that members be at their terminals. Communication between meetings can be asynchronous and extremely fast in comparison with telephone conversations and interoffice mail. Participation may be more equalized and less affected by prestige and status (McGuire, Kiesler & Siegel, 1987; Siegel, Dubrovsky, Kiesler & McGuire, 1986). Electronic communication, however, relies almost entirely on plain text for conveying messages, text that is often ephemeral, appearing on and disappearing from a screen without any necessary tangible artifacts. It becomes easy for a sender to be out of touch with his or her audience. And it is easy for the sender to be less constrained by conventional norms and rules for behavior in composing messages. Communicators can feel a greater sense of anonymity, detect less individuality in others, feel less empathy, feel less guilt, be less concerned over how they compare with others, and be less influenced by social conventions (Kiesler, Siegel & McGuire, 1984; Short, Williams & Christie, 1976). Such influences can lead both to more honesty and more "flaming" (name calling and epithets).

35.9.13 The Need for Groupware

For cooperation to take place, students must have a joint workspace. One of the promises of the computer is to allow students all over the world to create powerful shared spaces: super blackboards and super models. Instead of sharing a blackboard or a worktable, people from a wide variety of locations can share a computer screen. The future of technology-assisted cooperative learning will be greatly enhanced by developing both appropriate software and hardware to create workspaces that may be shared by all members of a group, all groups within the same classroom (or school), and all groups in a network that stretches throughout the world. Increasingly, work is being done in self-managing teams, networked electronically with other teams throughout the company and the world. The ability of the hardware to allow or even require people to work cooperatively is an important design issue. Developers of hardware need to think seriously about how technology can increase human cooperation within education and within the workplace. In addition, a challenge facing software programmers is to write *groupware* to support group rather than individual work. The availability of groupware will increase the productivity of joint efforts. In order to write such software, programmers need to understand the nature of cooperation and the five basic elements that mediate its effectiveness.

35.10 QUESTIONS ABOUT TECHNOLOGY-ASSISTED COOPERATIVE LEARNING

Given the powerful effects of cooperation on achievement, relationships, and psychological adjustment, and given the numerous advantages of using technology-assisted cooperative learning, there are a number of questions about the use of technology that may tentatively be answered. The first question is: *Does technology effect achievement or is it merely a means of delivering instruction?* In a review of research, Clark (1983) concluded that technology is merely a means of delivering instruction. Our results support his conclusion. There are cognitive consequences of discussing what one is learning with classmates that technology cannot duplicate. Social interaction is essential for effective learning, the transformation of the mind, and the development of expertise.

The second question is: *Is a "dialogue" with a computer as effective in promoting achievement, higher-level reasoning, and ability to apply learning as a "dialogue" with a peer?* It takes more than the presentation of information to have a dialogue. There needs to be an exchange of knowledge that leads to epistemic conflict and intellectual challenge and curiosity. Such an exchange is personal as well as informational. It involves respect for and belief in each other's abilities and commitment to each other's learning. Our results and the results of other researchers indicate that a dialogue with a peer is far more powerful than one with a computer. The third question is: *Can a computer pass as a person?* Our research leads to the tentative conclusion that a person interacts quite differently with a computer than he or she does with another person. Machines and people are not equally interesting or persuasive. With another person, there is a commitment to his or her learning and well-being. It is rare to feel the same emotions toward a machine. Fourth: *Is the effectiveness of a message separate from the medium?* Generally, the research on cognitive development indicates that the same information, presented in other formats (especially nonsocial formats), is only marginally effective in promoting genuine cognitive development (Murray, 1983; Johnson & Johnson, 1989).

Fifth: *Is technology an amplifier or a transformer of the mind?* An *amplifier* serves tool function like note taking or measuring. A *transformer* leads to the discovery and invention of principles. If technological learning devices are transformers, the habitual technology users eventually will be in a new stage of mental functioning. Neil Postman (1985) believes that the introduction into a culture of a technique such as writing or a clock is not merely an extension of the power of human beings to record information or bind time but a transformation of their way of thinking and the content of human culture. Generally, therefore, it may be concluded that technology such as the computer is a tool to amplify the minds of students. As a tool, the computer (as well as the calculator) can free students from the rote memorization of methods of mathematical formulation and formula-driven science, allowing more time for underlying concepts to be integrated with physical examples. A danger of the computer is that a student will know what button to push to get the right answer without understanding the underlying process or developing the ability to solve the problem on his or her own without the computer. There is far more to expertise than knowing how to run hardware and software.

Finally, the sixth question is: *Can technology such as computers prepare a student for the "real world"?* Technological expertise is helpful in finding and holding a job. Working in a modern organization, however, requires team skills such as leadership and conflict management and the ability to engage in interpersonal problem solving. While it is clear that cooperative learning is an analog to modern organizational life, experience in using technology in and of itself may only marginally improve employability and job success. A person has to have interpersonal competence as well as technical competence.

35.11 THE FUTURE OF TECHNOLOGY-ASSISTED COOPERATIVE LEARNING

Technology-assisted cooperative learning has yet to realize its great promise. It currently rests on the strengths of cooperative learning. Cooperative learning has a well-formulated theory validated by hundreds of research studies, translated into a set of practical procedures that teachers and administrators may use, and actually implemented in tens-of-thousands of classrooms throughout the world. Despite the success of cooperative learning, there are three great shortcomings of technology-assisted cooperative learning.

First, there is a lack of theorizing. Conceptual models of how technology and teamwork may be productively integrated are practically nonexistent. The variables unique to the combination of technology and cooperation have not been identified and defined. *Second*, relatively little research has been done. Overall, the quality of the existing research is quite high. Only a few of the potential outcomes, however, have been studied. The unique strengths of technology-assisted cooperative learning have not been assessed and documented. Rather, investigators have examined more general variables such as the composition of cooperative groups and the gender of members. *Third*, the lack of conceptual models and the scarcity of research has created a corresponding lack of guidelines for practice. Teachers can be trained to implement cooperative learning, but training is underdeveloped in the specific procedures for implementing technology-assisted cooperative learning. Operational procedures are needed for designing and implementing instructional procedures that optimize the impact of technology-assisted cooperative learning on student achievement and other important outcomes. Equivalent procedures need to be designed for work environments where technology and teamwork are used together.

What is needed is theory to stimulate research, which, in turn, will validate and modify the theory. The results need to be used to design specific procedures for operationalizing technology-assisted cooperative learning in every grade level and subject area. Without systematic research, proponents of technology-assisted cooperative learning cannot present a persuasive case for the adoption of an effective training program for teachers. On the positive side, there has been so little research on technology-assisted cooperative learning that the future is wide open to interested social scientists.

There are, however, several areas for researchers to focus on. *First*, there is a need to look at outcomes other than achievement. The impact of technology-assisted cooperative learning on relationships among students and aspects of psychological health need to be examined. *Second*, there is a need for long-term studies that track the use of technology across at least one school year and ideally for several years. Short-term studies of initial use are not enough. The real question is whether the use of the technology will be maintained over several years. *Third*, the implementation process by which technology-assisted cooperative learning is institutionalized within schools needs to be documented and studied. While advocates of technology see a revolution coming in instruction, historians point to the virtual absence of lasting or profound changes in classroom practice over the past 100 years. Despite brief periods of popularity, new instructional technologies such as education television, language labs, and programmed learning were tried and dropped. Life in classrooms remains largely unchanged. Lepper and Gurtner (1989) argue that the last "technology" to have had a major impact on the way schools are run is the blackboard. Most often new technologies are used in ways that do not disrupt regular classroom practices, which means that they can be dropped with no disruption to ongoing classroom life. Similarly, software selection is often conducted with the intention of supporting existing classroom practices rather than transforming them. Considerably more research is needed on the implementation process by which the combination of cooperative learning and learning technologies become integrated and institutionalized in classroom and schools.

Fourth, studies need to focus on the role of teachers and administrators in the implementation process. No matter how good technology is, unless teachers decide to use it and gain some expertise in how to implement it, the technology will not be adopted by schools. *Fifth,* there need to be studies examining the support services required for technology to be used in the classroom. Who repairs the technology and how often are repairs needed are important questions. Teachers, for example, cannot be expected to be computer technicians.

Sixth, cognitive growth and the development of problem-solving skills depend on epistemic conflict, that is, the collision of adverse opinion (Bearison, 1982; Johnson & Johnson, 1992; Piaget, 1950). Students need the opportunity to experience and resolve academic controversies. Computers and multimedia presentations rarely engage students in intellectual conflict the same way other students can. The role of technology in promoting and facilitating intellectual conflicts among students has not been investigated.

Seventh, there is a question whether technology-assisted instruction will increase inequality in educational outcomes (Becker & Sterling, 1987). Students who have access to the new technologies in their homes will be more skilled and sophisticated in their uses than will students who have no access. Equality in the classroom may require heterogeneous grouping where students who are skilled in the use of instructional technologies work with students who are not. Cooperative learning is an essential aspect of such equalization. New studies need to be conducted on group composition focusing on the ability of students to use instructional technologies.

Schools eventually may have to make greater use of appropriate technologies and cooperative learning. Multiple ongoing revolutions in technology and classroom organization require schools to prepare students to make wise choices in situations where there is an overabundance of information and they are part of a team. It may be technology-assisted cooperative learning that best prepares students to live in the modern world.

35.12 SUMMARY

Media technologies can have pervasive and powerful effects on the nature of society and the thinking and communicating of its members. There can be little doubt that technology will increasingly be utilized in instructional situations. In the past, however, teachers and schools have been very slow in adopting new technologies and very quick in discontinuing its use. The failure of schools to adopt available instructional technologies and to maintain (let alone continuously improve) their use may be at least in part due to two barriers: (a) the individual assumption underlying most hardware and software development and (b) the failure to utilize cooperation learning as an inherent part of using instructional technologies.

A recurrent problem is that most technologies traditionally have carried an individualistic bias. Individualized instruction is difficult, as meaningful individual differences are hard to identify, let alone translate into instructional practice. As long as hardware and software designers are fixated on individuals, the potential for technology in education is limited.

The alternative to individual use of technologies is their use by cooperative learning groups. *Cooperative learning* is the instructional use of small groups so that students work together to maximize their own and each other's learning. There are four basic types of cooperative learning: formal cooperative learning, informal cooperative learning, base groups, and academic controversies. *Technology-assisted cooperative learning* exists when the instructional use of technology is combined with the use of cooperative learning groups. What underlies cooperative learning's popularity is that it is based on a well-formulated theory that has been validated by numerous research studies and translated into practical procedures that can be used at any level of education. The three theoretical perspectives that have contributed to cooperative learning are cognitive-developmental theory, behavioral learning theory, and social interdependence theory. It is the latter perspective that has had the most profound influences on the development of cooperative learning. Between 1898 and 1989, over 550 experimental and 100 correlational studies were conducted comparing the relative effectiveness of cooperative, competitive, and individualistic efforts. Their findings verify that positive interdependence results in promotive interaction among students; negative interdependence results in oppositional interaction; and no interdependence results in the absence of interaction. The multiple outcomes resulting from promotive interaction (compared with oppositional and no interaction) may be classified into three categories: effort to achieve, positive interpersonal relationships, and psychological health. Generally, cooperative efforts result in higher achievement, more positive relationships, and greater psychological health than do competitive or individualistic efforts.

Not all groups, however, are cooperative groups. Teachers may assign students to pseudo-learning groups, traditional-learning groups, or cooperative-learning groups. Pseudo- and traditional-learning groups are characterized by lack of group maturity, uncritically giving one's dominant response, social loafing, free riding, motivational losses, and group think. To be a cooperative learning group, five basic elements must be structured within the learning situation: positive interdependence, face-to-face promotive interaction, individual accountability, social skills, and group processing. It is these five elements that give cooperation its power. In order for schools to adopt technology and maintain its use over time, the school organizational structure must change from a mass-manufacturing structure to a team-based, high-performance structure (known as the *cooperative school*).

From the research on technology-assisted cooperative learning, a number of conclusions may be made:

1. Cooperative learning is more cost effective in using technology-assisted instruction than is competitive or individualistic learning.
2. When students are taught to use technology, cooperative-learning groups produce higher achievement than do competitive or individualistic learning.
3. There is a great deal of evidence that when technology-assisted learning is to be used, cooperative learning (compared with competitive and individualistic learning) will result in higher achievement, higher-level reasoning, and long-term retention. There can be little doubt that when technology is involved, individuals should work in teams rather than individualistically or competitively.
4. Cooperative-learning groups provide more productive use of learner control during technology-assisted instruction than do competitive or individualistic learning.
5. Learners will have more positive attitudes toward technology-based instruction and cooperative learning when they participate in cooperative rather than competitive or individualistic learning.
6. Cooperative-learning experiences promote greater cognitive development during technology-assisted instruction than do competitive or individualistic learning.
7. Cooperative-learning experiences promote higher achievement on technology-assisted learning tasks when social skills are taught and emphasized.
8. Learners tend to prefer to work cooperatively at the computer.
9. While technology-assisted cooperative learning may be used with either homogeneous or heterogeneous groups, learners will often achieve more in heterogeneous groups.
10. Females will achieve equally to males and have more positive attitudes toward technology and technology-assisted instruction when they learn in cooperative groups than when they learn competitively or individualistically.
11. Technology creates the possibility of cooperative groups in which members from widely different locations are electronically networked to achieve common goals.

What this research illuminates is that cooperative learning and technology-assisted instruction have complementary strengths. The more technology is used to teach, the more necessary cooperative learning is. The computer, for example, can control the flow of work, monitor accuracy, give electronic feedback, and do calculations. Cooperative learning provides a sense of belonging, the opportunity to explain and summarize what is being learned, social models, respect and approval for efforts to achieve, encouragement of divergent thinking, and interpersonal feedback on academic learning and the use of the technology.

There are a number of questions that must be asked about technology-assisted instruction. Does technology affect achievement or is it only a means for delivering instruction? Current evidence indicates that computers deliver instruction, but they do not affect achievement in and of themselves. Is a dialogue with the computer as effective as a dialogue with another person in promoting achievement and higher-level reasoning? The answer seems to be No. Can the computer pass as a person? The answer seems to be No. Cooperators are people, not machines. Is the effectiveness of a message separate from the medium? The answer seems to be Yes; messages from other people are more powerful and influential than are messages from machines. Is technology an amplifier or a transformer of the mind? The answer seems to be an amplifier. Technology amplifies communication, but it takes other people to transform each other's minds.

The dearth of research on technology-assisted instruction and the absence of theoretically relevant, well-controlled studies on technology-assisted cooperative learning are major barriers for implementation. The interdependence between the use of technology-assisted instruction and cooperative learning is relatively unexplored. Technologies can either facilitate or obstruct cooperation. The future of technology-assisted cooperative learning depends on the development of software written for cooperative groups and the development of hardware that both requires and facilitates cooperative efforts within the group, among groups in the classroom, and among groups throughout the world.

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