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INSTRUCTION BASED ON COOPERATIVE LEARNING

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INTRODUCTION

Cooperative learning refers to instructional methods in which teachers organize students into small groups, which then work together to help one another learn academic content. Cooperative learning methods are extensively researched, and under certain well-specified conditions they are known to substantially improve student achievement in most subjects and grade levels, yet the structured forms of cooperative learning that have proven to be effective are not used as often as more informal forms. Further, there remains considerable debate about the theoretical basis for achievement outcomes of cooperative learning. This chapter reviews and integrates evidence on the theoretical mechanisms relating to learning outcomes of cooperative learning, and presents evidence on the most widely used practical applications of cooperative methods.

Cooperative learning methods vary widely in their details. Group sizes may be from two to several. Group members may have individual roles or tasks, or they may all have the same task. Groups may be evaluated or rewarded based on group performance or the average of individual performances, or they may simply be asked to work together.

In one form or another, cooperative learning has been used and studied in every major subject, with students from preschool to college, and in all types of schools. Cooperative learning is used at some level by hundreds of thousands of teachers. One national survey in the 1990s found that 79% of elementary teachers and 62% of middle school teachers reported regular use of cooperative learning (Puma, Jones, Rock, & Fernandez, 1993). Antil, Jenkins, Wayne, and Vadasy (1998) found that 93% of a sample of US teachers reported using cooperative learning, with 81% reporting daily use.

There have been hundreds of studies of cooperative learning focusing on a wide variety of outcomes, including academic achievement in many subjects, second language learning, attendance, behavior, intergroup relations, social cohesion, acceptance of classmates with handicaps, and attitudes toward subjects (see Gillies, 2014; Johnson & Johnson, 1998; Rohrbeck et al., 2003; Roseth, Johnson, & Johnson, 2008; Slavin, 1995, 2013; Webb, 2008). Reviews of research on a wide variety of innovations in curriculum, technology, and professional development have consistently found certain forms of cooperative learning to be among the most effective of all strategies for elementary and secondary reading (Slavin et al., 2008, 2009a, 2009c) and mathematics (Slavin & Lake, 2008; Slavin et al., 2009b).

THEORETICAL PERSPECTIVES ON COOPERATIVE LEARNING

Although there is a fair consensus among researchers about the positive effects of cooperative learning on student achievement, there remains controversy about why and how cooperative learning methods affect achievement and, most importantly, under what conditions cooperative learning has these effects. Different groups of researchers investigating cooperative learning effects on achievement begin with different assumptions and conclude by explaining the achievement effects of cooperative learning in quite different theoretical terms. In earlier work, Slavin (1995) identified motivationalist, social cohesion, cognitive-developmental, and cognitive-elaboration as the four major theoretical perspectives on the achievement effects of cooperative learning.

The motivationalist perspective presumes that motivation is the single most impactful part of the learning process, asserting that the other processes such as planning and helping are driven by individuals' motivated self interest. Motivationalist-oriented scholars focus more on the reward or goal structure under which students operate (Slavin, 1995). By contrast, the social cohesion perspective (also called social interdependence theory) suggests that the effects of cooperative learning are largely dependent on the cohesiveness of the group. This perspective holds that students help each other learn because they care about the group and its members and come to derive self-identity benefits from group membership (Johnson & Johnson, 1998).

The two cognitive perspectives focus on the interactions among groups of students, holding that, in themselves, these interactions lead to better learning and thus better achievement. Within the general cognitive heading, developmentalists attribute these effects to processes outlined by scholars such as Piaget (1926) and Vygotsky (1978). Work from the cognitive elaboration perspective asserts that learners must engage in some manner of cognitive restructuring (or elaboration) of new materials in order to learn them. Cooperative learning is said to facilitate that process.

This chapter offers a theoretical model of cooperative learning processes that acknowledges the contributions of work from each of the major theoretical perspectives. It places them in a model that suggests the likely role each plays in cooperative learning processes. This work further explores conditions under which each may operate, and suggests research and development needed to advance cooperative learning scholarship so that educational practice may truly benefit from the lessons of thirty years of research.

Integrating Alternative Perspectives

The alternative perspectives on cooperative learning may be seen as complementary, not contradictory. For example, motivational theorists would not argue that the cognitive theories are unnecessary. Instead, they assert that motivation drives cognitive process, which in turn produces learning (Slavin, 1995, 2013). They would argue that it is unlikely over the long haul that students would engage in the kind of elaborated explanations found by Webb (2008) and others to be essential to profiting from cooperative

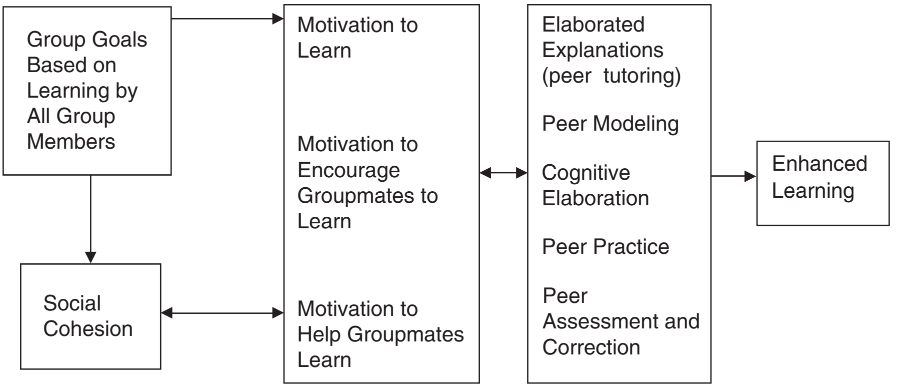

Figure 18.1 Integration of theoretical perspectives on cooperative learning effects on learning.

activity without a goal structure designed to enhance motivation. Similarly, social cohesion theorists might hold that the utility of extrinsic incentives must lie in their contribution to group cohesiveness, caring, and pro-social norms among group members, which could in turn affect cognitive processes.

A simple path model of cooperative learning processes, adapted from Slavin (1995), is diagrammed below. It depicts the main functional relationships among the major theoretical approaches to cooperative learning.

Figure 18.1 begins with a focus on group goals or incentives based on the individual learning of all group members. That is, the model assumes that motivation to learn and to encourage and help others to learn activates cooperative behaviors that will result in learning. This would include both task motivation and motivation to interact in the group. In this model, motivation to succeed leads to learning directly, and also drives the behaviors and attitudes that lead to group cohesion, which in turn facilitates the types of group interactions that yield enhanced learning and academic achievement. The relations are conceived to be reciprocal, such that as task motivation leads to the development of group cohesion, group cohesion may in turn reinforce and enhance task motivation. By the same token, the cognitive processes may become intrinsically rewarding and lead to increased task motivation and group cohesion.

Each aspect of the diagrammed model is well represented in the theoretical and empirical cooperative learning literature. All have well established rationales and some supporting evidence. What follows is a review of the basic theoretical orientation of each perspective, a description of the cooperative learning strategies each prescribes, and a discussion of the empirical evidence supporting each.

Four Major Theoretical Perspectives on Cooperative Learning and Achievement

Motivational Perspectives

Motivational perspectives on cooperative learning posit that task motivation is the most important part of the process, believing that the other processes are driven primarily by motivation. From a motivationalist perspective (e.g., Johnson & Johnson, 1998; Slavin, 1995, 2009, 2013), cooperative incentive structures create a situation in which the only way group members can attain their own personal goals is if the group is successful. Therefore, to meet their personal goals, group members must both help their groupmates to do whatever enables the group to succeed, and, perhaps even more importantly, to encourage their groupmates to exert maximum efforts. In other words, rewarding groups based on group performance (or the sum of individual performances) creates an interpersonal reward structure in which group members will give or withhold social reinforcers (e.g., praise, encouragement) in response to groupmates' task-related efforts.

The motivationalist critique of traditional classroom organization holds that the competitive grading and informal reward system of the traditional classroom creates peer norms opposing academic efforts (see Coleman, 1961). Since one student's success decreases the chances that others will succeed, students are likely to express norms that high achievement is for "nerds" or "teachers' pets." However, by having students work together toward a common goal, they may be motivated to express norms favoring academic achievement, to reinforce one another for academic efforts.

Not surprisingly, motivational theorists build group rewards into their cooperative learning methods. In methods developed at Johns Hopkins University (Slavin, 1994, 1995), students can earn certificates or other recognition if their average team scores on quizzes or other individual assignments exceed a pre-established criterion. Methods developed by David and Roger Johnson (1998) and their colleagues at the University of Minnesota often give students grades based on group performance, which is defined in several different ways. The theoretical rationale for these group rewards is that if students value the success of the group, they will encourage and help one another to achieve.

Considerable empirical evidence from practical applications of cooperative learning in elementary and secondary schools supports the motivationalist position that group rewards are essential to the effectiveness of cooperative learning, with one critical qualification. Use of group goals or group rewards enhances the achievement outcomes of cooperative learning if and only if the group rewards are based on the individual learning of all group members (Slavin, 1995). Most often, this means that team scores are computed based on average scores on quizzes which all teammates take individually, without teammate help. For example, in Student Teams-Achievement Divisions, or STAD (Slavin, 1994), students work in mixed-ability teams to master material initially presented by the teacher. Following this, students take individual quizzes on the material, and the teams may earn certificates based on the degree to which team members have improved over their own past records. The only way the team can succeed is to ensure that all team members have learned, so the team members' activities focus on explaining concepts to one another, helping one another practice, and encouraging one another to achieve. In contrast, if group rewards are given based on a single group product (for example, the team completes one worksheet or solves one problem), there is little incentive for group members to explain concepts to one another, and one or two group members may do all the work (see Slavin, 1995).

In assessing the empirical evidence supporting cooperative learning strategies, the greatest weight must be given to studies of longer duration. Well executed, these are bound to be more realistically generalizable to the day to day functioning of classroom practices. A review of 99 studies of cooperative learning in elementary and secondary schools that involved durations of at least four weeks compared achievement gains in cooperative learning and control groups. Of 64 studies of cooperative learning methods that provided group rewards based on the sum of group members' individual learning, 50 (78%) found significantly positive effects on achievement, and none found negative effects (Slavin, 1995). The median effect size for the studies from which effect sizes could be computed was $d = +.32$ (32% of a standard deviation separated cooperative learning and control treatments).

In contrast, studies of methods that used group goals based on a single group product or provided no group rewards found few positive effects, with a median effect size of only $d = +.07$. Comparisons of alternative treatments within the same studies found similar patterns; group goals based on the sum of individual learning performances were necessary to the instructional effectiveness of the cooperative learning models (e.g., Fantuzzo, Polite, & Grayson, 1990; Fantuzzo, Riggio, Connelly, & Dimeff, 1989).

Why are group goals and individual accountability so important? To understand this, consider the alternatives. In some forms of cooperative learning, students work together to complete a single worksheet or to solve one problem together. In such methods, there is little reason for more able students to take time to explain what is going on to their less able groupmates or to ask their opinions. When the group task is to *do* something, rather than to *learn* something, the participation of less able students may be seen as interference rather than help. It may be easier in this circumstance for students to give each other answers than to explain concepts or skills to one another.

In contrast, when the group's task is to ensure that every group member *learns* something, it is in the interests of every group member to spend time explaining concepts to his or her groupmates. Studies of student behavior within cooperative groups have consistently found that the students who gain most from cooperative work are those who give and receive elaborated explanations (Webb, 1985, 2008). In contrast, giving and receiving answers without explanations were *negatively* related to achievement gain. Group goals and individual accountability motivate students to give elaborated explanations and to take one another's learning seriously, instead of simply giving answers.

Social Cohesion Perspective

A theoretical perspective somewhat related to the motivational viewpoint holds that the effects of cooperative learning on achievement are strongly mediated by the cohesiveness of the group. The quality of the group's interactions is thought to be largely determined by group cohesion. In essence, students will engage in the task and help one another learn because they identify with the group and want one another to succeed. This perspective is similar to the motivational perspective in that it emphasizes primarily motivational rather than cognitive explanations for the instructional effectiveness of cooperative learning. However, motivational theorists hold that students help their groupmates learn primarily because it is in their own interests to do so. Social cohesion theorists, in contrast, emphasize the idea that students help their groupmates learn because they care about the group. A hallmark of the social cohesion perspective is an emphasis on teambuilding activities in preparation for cooperative learning, and processing or group self-evaluation during and after group activities. Social cohesion theorists have historically tended to downplay or reject the group incentives and individual accountability held by motivationalist researchers to be essential. They emphasize, instead, that the effects of cooperative learning on students and on student achievement depend substantially on the quality of the group's interaction (Battisch, Solomon, & Delucchi, 1993).

For example, Cohen (1986, pp. 69–70) stated "if the task is challenging and interesting, and if students are sufficiently prepared for skills in group process, students will experience the process of groupwork itself as highly rewarding . . . never grade or evaluate students on their individual contributions to the group product." Cohen's

(1994) work, as well as that of Shlomo and Yael Sharan (1992) and Elliot Aronson and his colleagues (Aronson, Blaney, Stephan, Sikes, & Snapp, 1978), may be described as social cohesiveness theories. Cohen, Aronson, and the Sharans all prescribe forms of cooperative learning in which students take on individual roles within the group, which Slavin (1983) calls *task specialization methods*.

In Aronson's Jigsaw method, students study material on one of four or five topics distributed among the group members. They meet in *expert groups* to share information on their topics with members of other teams who had the same topic, and then take turns presenting their topics to the team. In the Sharans' Group Investigation method, groups take on topics within a unit studied by the class as a whole, and then further subdivide the topic into tasks within the group. The students investigate the topic together and ultimately present their findings to the class as a whole. Cohen's Finding Out/Descubrimiento program has students play different roles in discovery-oriented science activities.

One main purpose of the task specialization used in Jigsaw, Group Investigation, and Finding Out/Descubrimiento is to create interdependence among group members. In the Johnsons' methods, a somewhat similar form of interdependence is created by having students take on roles as "checker," "recorder," "observer," and so on. The idea is that if students value their groupmates (as a result of teambuilding and other cohesiveness-building activities) and are dependent on one another, they are likely to encourage and help one another to succeed.

There is some empirical evidence that the achievement effects of cooperative learning depend on social cohesion and the quality of group interactions (Battisch et al., 1993). The achievement outcomes of cooperative learning methods that emphasize task specialization are less clear. Research on the original form of Jigsaw has not generally found positive effects of this method on student achievement (Slavin, 1995). One problem with Jigsaw is that students have limited exposure to material other than that which they studied themselves, so learning gains on their own topics may be offset by losses on their groupmates' topics. In contrast, there is evidence that when it is well implemented, Group Investigation can significantly increase student achievement (Sharan & Shachar, 1988). In studies of at least four weeks' duration, the Johnsons' (1998) methods have not been found to increase achievement more than individualistic methods unless they incorporate group rewards (in this case, group grades) based on the average of group members' individual quiz scores (see Slavin, 1995). Studies of forms of Jigsaw that have added group rewards to the original model have found positive achievement outcomes (Mattingly & Van Sickle, 1991).

Research on practical classroom applications of methods based on social cohesion theories provide inconsistent support for the proposition that building cohesiveness among students through teambuilding alone (i.e., without group incentives) will enhance student achievement. In general, methods which emphasize teambuilding and group process but do not provide specific group rewards based on the learning of all group members are no more effective than traditional instruction in increasing achievement (Slavin, 1995), although there is evidence that these methods can be effective if group rewards are added to them.

Cognitive Perspectives

The major alternative to the motivationalist and social cohesiveness perspectives on cooperative learning, both of which focus primarily on group norms and interpersonal influence, is the cognitive perspective. The cognitive perspective holds that interactions among students will in themselves increase student achievement for reasons that have to do with mental processing of information rather than with motivations. Cooperative methods developed by cognitive theorists involve neither the group goals that are the cornerstone of the motivationalist methods nor the emphasis on building group cohesiveness characteristic of the social cohesion methods. However, there are several quite different cognitive perspectives, as well as some which are similar in theoretical perspective, but have developed on largely parallel tracks. The two most notable of these are described in the following sections—developmental perspectives and cognitive elaboration perspectives.

Developmental Perspective

One widely researched set of cognitive theories is the developmental perspective (e.g., Damon, 1984). The fundamental assumption of the developmental perspective on cooperative learning is that interaction among children around appropriate tasks increases their mastery of critical concepts. Vygotsky (1978, p. 86) defines the zone of proximal development as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in *collaboration with more capable peers*" (emphasis added). In his view, collaborative activity among children promotes growth because children of similar ages are likely to be operating within one another's proximal zones of development, modeling in the collaborative group behaviors more advanced than those they could perform as individuals.

Similarly, Piaget (1926) held that social-arbitrary knowledge—language, values, rules, morality, and symbol systems—can only be learned in interactions with others. Peer interaction is also important in logical-mathematical thought in disequilibrating the child's egocentric conceptualizations and in providing feedback to the child about the validity of logical constructions.

There is a great deal of empirical support for the idea that peer interaction can help non-conservers become conservers. Many studies have shown that when conservers and nonconservers of about the same age work collaboratively on tasks requiring conservation, the nonconservers generally develop and maintain conservation concepts (see Bell, Grossen, & Perret-Clermont, 1985). From the developmental perspective, the effects of cooperative learning on student achievement would be largely or entirely due to the use of cooperative tasks. In this view, opportunities for students to discuss, to argue, and to present and hear one another's viewpoints are the critical element of cooperative learning with respect to student achievement.

Despite considerable support from theoretical and laboratory research, there is little empirical evidence from classroom experiments conducted over meaningful time periods that pure cooperative methods, which depend solely on interaction, produce higher achievement. However, it is likely that the cognitive processes described by developmental theorists are important mediating variables that can help explain the positive outcomes of effective cooperative learning methods (Slavin, 1995).

Cognitive Elaboration Perspective

A cognitive perspective on cooperative learning, quite different from the developmental viewpoint, is one that might be called the cognitive elaboration perspective.

Research in cognitive psychology has long held that if information is to be retained in memory and related to information already in memory, the learner must engage in some sort of cognitive restructuring, or elaboration, of the material (Fiorella & Mayer, 2015; Wittrock, 1986). One of the most effective means of elaboration is explaining the material to someone else. Research on peer tutoring has long found achievement benefits for the tutor as well as the tutee (Devin-Sheehan, Feldman, & Allen, 1976). In such methods, students take roles as recaller and listener. They read a section of text, and then the recaller summarizes the information while the listener corrects any errors, fills in any omitted material, and helps think of ways both students can remember the main ideas. The students switch roles on the next section.

In terms of the empirical evidence for this perspective, O'Donnell, Dansereau and their colleagues have found in a series of brief studies that college students working on structured cooperative scripts can learn technical material or procedures better than can students working alone (O'Donnell & Dansereau, 1992). While both the recaller and the listener learned more than did students working alone, the recaller learned more (O'Donnell, 1996; O'Donnell & Dansereau, 1992). This mirrors both the peer tutoring findings and the findings of Webb (2008), who discovered that the students who gained the most from cooperative activities were those who provided elaborated explanations to others. In this research, as well as in O'Donnell and Dansereau's, students who received elaborated explanations learned more than those who worked alone, but not as much as those who served as explainers. Studies of Reciprocal Teaching, in which students learn to formulate questions for each other, have generally supported its positive effects on student achievement (O'Donnell, 2000; Palincsar, Brown, & Martin, 1987; Rosenshine & Meister, 1994).

Structuring Group Interactions

There is some evidence that carefully structuring the interactions among students in cooperative groups can be effective, even in the absence of group rewards (Gillies, 2014). For example, Meloth and Deering (1992) compared students working in two cooperative conditions. In one, students were taught specific reading comprehension strategies and given *think sheets* to remind them to use these strategies (e.g., prediction, summarization, character mapping). In the other group, students earned team scores if their members improved each week on quizzes. A comparison of the two groups on a reading comprehension test found greater gains for the strategy group.

However, there is also evidence to suggest that a combination of group rewards and strategy training produces much better outcomes than either alone. The Fantuzzo et al. (1992) study directly made a comparison between rewards alone, strategy alone, and a combination, and found the combination to be by far the most effective. Further, the outcomes of dyadic learning methods, which use group rewards as well as strategy instruction, produced some of the largest positive effects of any cooperative methods, much larger than those found in studies that provided groups with structure but not rewards. As noted earlier, studies of scripted dyads also find that adding incentives adds to the effects of these strategies (O'Donnell, 1996). The consistent positive findings for Cooperative Integrated Reading and Composition (CIRC) (Stevens et al. 1987), which uses both group rewards and strategy instruction, also argue for this combination.

Reconciling the Four Perspectives

The model shown previously in Figure 18.1 illustrates how group goals might operate to enhance the learning outcomes of cooperative learning. Provision of group goals based on the individual learning of all group members might affect cognitive processes directly, by motivating students to engage in peer modeling, cognitive elaboration, or practice with one another. Group goals may also lead to group cohesiveness, increasing caring and concern among group members and making them feel responsible for one another's achievement, thereby motivating students to engage in cognitive processes that enhance learning.

Finally, group goals may motivate students to take responsibility for one another independently of the teacher, thereby solving important classroom organization problems and providing increased opportunities for cognitively appropriate learning activities. Scholars whose theoretical orientations de-emphasize the utility of extrinsic rewards attempt to intervene directly on mechanisms identified as mediating variables in the model described earlier. For example, social cohesion theorists intervene directly on group cohesiveness by engaging in elaborate teambuilding and group processing training. Cognitive theorists would hold that the cognitive processes that are essential to any theory relating cooperative learning to achievement can be created directly, without the motivational or affective changes discussed by the motivationalist and social cohesion theorists.

From the perspective of the model diagrammed in Figure 18.1, starting with group goals and individual accountability permits students in cooperative learning groups to benefit from the full range of factors that are known to affect cooperative learning outcomes. While group goals and individual accountability may not always be absolutely necessary, to ignore them would be to ignore the tool with the most consistent evidence of positive effects on student achievement.

RESEARCH IN PRAGMATIC APPROACHES TO COOPERATIVE LEARNING

Research and development over the years have led to the creation and evaluation of several practical approaches to cooperative learning. The most widely used and extensively researched of these programs are described in the following sections.

Cooperative learning methods fall into two main categories. One set, *Structured Team Learning*, involves rewards to teams based on the learning progress of their members, and individual accountability, which means that team success depends on individual learning, not group products. A second set, *Informal Group Learning Methods*, includes methods more focused on social dynamics, projects, and discussion than on mastery of well-specified content.

Structured Team Learning Methods

Student Team Learning

Student Team Learning (STL) techniques were developed and researched at Johns Hopkins University (see Slavin, 1994, 1995). More than half of all experimental studies of practical cooperative learning methods involve STL methods.

All cooperative learning methods share the idea that students work together to learn and are responsible for one another's learning as well as their own. STL methods also emphasize the use of team goals and team success, which can only be achieved if all members of the team learn the objectives being taught. That is, in Student Team Learning the students' tasks are not to *do* something as a team but to *learn* something as a team.

Three elements are central to all Student Team Learning methods: *team rewards, individual accountability*, and *equal opportunities for success*. Using STL techniques, teams earn certificates or other team rewards if they achieve above a designated criterion. *Individual accountability* means that the team's success depends on the individual learning of all team members. This focuses the activity of the team members on explaining concepts to one another and making sure that everyone on the team is ready for a quiz or other assessment that they will take without teammate help. *Equal opportunities for success* means that students contribute to their teams by improving over their past performances. This ensures that high, average, and low achievers are equally challenged to do their best and that the contributions of all team members will be valued.

Four principal Student Learning methods have been extensively developed and researched. Two are general cooperative learning methods adaptable to most subjects and grade levels: Student Team-Achievement Divisions (STAD) and Teams-Games-Tournament (TGT). The remaining two are comprehensive curriculums designed for use in particular subjects at particular grade levels: Team Assisted Individualization (TAI) for mathematics in years 3–6 and Cooperative Integrated Reading and Composition (CIRC) for reading and writing instruction in years 3–5.

Student Teams-Achievement Divisions (STAD)

In STAD (Slavin, 1994), students are assigned to four-member learning teams mixed in performance level, sex, and ethnicity. The teacher presents a lesson, and the students work within their teams to make sure that all team members have mastered the lesson. Finally, all students take individual quizzes on the material, at which time they may *not* help one another.

Students' quiz scores are compared to their own past averages, and points are awarded based on the degree to which students can meet or exceed their own earlier performances. These points are then summed to form team scores, and teams that meet certain criteria earn certificates or other rewards. The whole cycle of activities, from teacher presentation to team practice to quiz, usually takes three to five class periods.

STAD has been used in a wide variety of subjects, including mathematics, language arts, and social studies. It has been used from grade 2 through college. STAD is most appropriate for teaching well-defined objectives, such as mathematical computations and applications, language usage and mechanics, geography and map skills, and science facts and concepts. In STAD, students work in four-member heterogeneous teams to help each other master academic content. Teachers follow a schedule of teaching, team work, and individual assessment. The teams receive certificates and other recognition based on the average scores of all team members on weekly quizzes.

Numerous studies of STAD have found positive effects of the program on traditional learning outcomes in math, language arts, science, and other subjects (Barbato, 2000; Mevarech, 1985; Reid, 1992; Slavin, 1995; Slavin & Karweit, 1984). For example, Slavin and Karweit (1984) carried out a large, year-long randomized evaluation of STAD in Math 9 classes in Philadelphia. These were classes for students not felt to be ready for Algebra I, and were therefore the lowest-achieving students. Overall, 76% of students were African American, 19% were White, and 6% were Hispanic. Forty-four classes in 26 junior and senior high schools were randomly assigned within schools to one of four conditions: STAD, STAD plus *Mastery Learning, Mastery Learning*, or control. All classes, including the control group, used the same books, materials, and schedule of instruction, but the control group did not use teams or mastery learning. In the *Mastery Learning* conditions, students took formative tests each week, students who did not achieve at least an 80% score received corrective instruction, and then students took summative tests.

Shortened versions of the standardized Comprehensive Test of Basic Skills (CTBS) in mathematics served as pretest and posttest. The four groups were very similar at pretest. On 2×2 nested analyses of covariance, there was a significant effect of a teams factor ($d = +0.21$). The effect size comparing STAD + *Mastery Learning* to control was $d = +0.24$, and that for STAD without *Mastery Learning* was $d = +0.18$. There was no significant *mastery learning* main effect or teams by mastery interaction either in the random effects analysis or in a student-level fixed effects analysis. Effects were similar for students with high, average, and low pretest scores.

Teams-Games-Tournament (TGT)

Teams-Games-Tournament (Slavin, 1994) uses the same teacher presentations and teamwork as in STAD, but replaces the quizzes with weekly tournaments. In these, students compete with members of other teams to contribute points to their team score. Students compete at three-person tournament tables against others with a similar past record in mathematics. A procedure changes table assignments to keep the competition fair. The winner at each tournament table brings the same number of points to his or her team, regardless of which table it is; this means that low achiever (competing with other low achievers) and high achievers (competing with other high achievers) have equal opportunity for success. As in STAD, high performing teams earn certificates or other forms of team rewards. TGT is appropriate for the same types of objectives as STAD. Several studies of TGT have found positive effects on achievement in math, science, and language arts (Slavin, 1995).

Team Assisted Individualization (TAI)

Team Assisted Individualization (TAI: Slavin et al. 1986) shares with STAD and TGT the use of four-member mixed ability learning teams and certificates for high-performing teams. However, where STAD and TGT use a single pace of instruction for the class, TAI combines cooperative learning with individualized instruction. Also, where STAD and TGT apply to most subjects at grade levels, TAI is specifically designed to teach mathematics to students in grades 3–6 (or older students not ready for a full algebra course).

In TAI, students enter an individualized sequence according to a placement test and then proceed at their own rates. In general, team members work on different units. Teammates check each others' work against answer sheets and help one another with any problems. Final unit tests are taken without teammate help and are scored by student monitors. Each week, teachers total the number of units completed by all team members and give certificates or other team rewards to teams that exceed a criterion score based on the number of final tests passed, with extra points for perfect papers and completed homework.

Because students take responsibility for checking each other's work and managing the flow of materials, the teacher can spend most of the class time presenting lessons to small groups of students drawn from the various teams who are working at the same point in the mathematics sequence. For example, the teacher might call up a decimals group, present a lesson, and then send the students back to their teams to work on problems. Then the teacher might call the fractions group, and so on. Several large evaluations of TAI have shown positive effects on math achievement in the upper-elementary grades (e.g., Slavin & Karweit, 1985; Stevens & Slavin, 1995b).

Cooperative Integrated Reading and Composition (CIRC)

A comprehensive program for teaching reading and writing in the upper elementary grades is called Cooperative Integrated Reading and Composition (CIRC) (Stevens et al., 1987). In CIRC, teachers use reading texts and reading groups, much as in traditional reading programs. However, all students are assigned to teams composed of two pairs from two different reading groups. While the teacher is working with one reading group, the paired students in the other groups are working on a series of cognitively engaging activities, including reading to one another, making predictions about how narrative stories will come out, summarizing stories to one another, writing responses to stores, and practicing spelling, decoding, and vocabulary. Students work as a total team to master main idea and other comprehension skills. During language arts periods, students engage in writing drafts, revising and editing one another's work, and preparing for publications of team books.

In most CIRC activities, students follow a sequence of teacher instruction, team practice, team pre-assessments and quizzes. That is, students do not take the quiz until their teammates have determined that they are ready. Certificates are given to teams based on the average performance of all team members on all reading and writing activities.

Research on CIRC and similar approaches has found positive effects in upper-elementary and middle school reading (Stevens & Durkin, 1992; Stevens, Madden, Slavin, & Farnish, 1987; Stevens & Slavin, 1995a, 1995b). CIRC has been adapted as the upper-elementary and middle school component of the Success for All comprehensive reform model and is currently disseminated under the name *Reading Wings* by the Success for All Foundation (see Slavin & Madden, Chambers, & Haxby, 2009).

Success for All (SFA)

Success for All (Slavin, Madden, Chambers, & Haxby, 2009) is a whole-school reform model for elementary and middle schools focused primarily on reading. It makes extensive use of cooperative learning, including incorporating a form of CIRC in grades 2–8. However, it also incorporates several additional elements, so its effects cannot be ascribed to cooperative learning alone. These effects have been assessed in many large-scale, longitudinal evaluations. For example, Borman et al. (2007) carried out a national three-year randomized evaluation and found strong positive effects on reading measures. Quint et al. (2015) also reported positive effects of SFA on reading in a three-year large-scale randomized evaluation. Rowan et al. (2007) reported on a four-year study of 120 schools using any of four approaches, three of which were whole-school reform models, and Success for All had very positive impacts in comparison to all other approaches (see Cheung & Slavin, in press).

Peer-Assisted Learning Strategies (PALS)

Peer Assisted Learning Strategies (PALS) is a dyadic learning approach in which pairs of children take turns as teacher and learner. The children are taught simple strategies for helping each other, and are rewarded based on the learning of both members of the pair. Research on PALS in elementary and middle school math and reading has found positive effects of this approach on student achievement outcomes, (e.g., Calhoon, 2005; Calhoon et al., 2006; Fuchs, Fuchs, & Karns, 2001; Fuchs, Fuchs, Kazden, & Allen, 1999; Mathes & Babyak, 2001). Positive effects of a similar program called Classwide Peer Tutoring (Greenwood, Delquardi, & Hall, 1989) have also been found, and another similar approach has been found to be effective in two Belgian studies (Van Keer & Verhedge, 2005, 2008).

IMPROVE

IMPROVE (Mevarech, 1985) is an Israeli mathematics program that uses cooperative learning strategies similar to those used in *STAD* but also emphasizes teaching of metacognitive skills and regular assessments of mastery of key concepts and re-teaching of skills missed by many students. Studies of *IMPROVE* have found positive effects on the mathematics achievement of elementary and middle school students in Israel (Mevarech & Kramarski, 1997; Kramarski, Mevarech, & Lieberman, 2001).

For example, Mevarech and Kramarski (1997, Study 1) evaluated *IMPROVE* in four Israeli junior high schools over one semester. Three seventh-grade classes used *IMPROVE* and five served as matched controls, using the same books and objectives. The experimental classes were selected from among those taught by teachers with experience teaching *IMPROVE*, and matched control classes were selected as well. Students were pre- and posttested on tests certified by the Israeli superintendent of mathematics as fair to all groups. Pretest scores were similar across groups. On analyses of covariance with classes nested within treatments, treatment effects significantly favored the *IMPROVE* classes on scales assessing introduction to algebra ($d = +0.54$) as well as mathematical reasoning ($d = +0.68$), for an average effect size of $d = +0.61$. Effects were similar for low, average, and high achievers.

Informal Group Learning Methods

Jigsaw

Jigsaw was originally designed by Elliot Aronson and his colleagues (1978). In Aronson's Jigsaw method, students are assigned to six-member teams to work on academic material that has been broken down into sections. For example, a biography might be divided into early life, first accomplishments, major setbacks, later life, and impact on history. Each team member reads his or her section. Next, members of different teams who have studied the same sections meet in expert groups to discuss their sections. Then, the students return to their teams and take turns teaching their teammates about their sections. Since the only way students can learn sections other than their own is to listen carefully to their teammates, they are motivated to support and show interest in one another's work.

Slavin (1994) developed a modification of Jigsaw at Johns Hopkins University and then incorporated it in the Student Team Learning program. In this method, called Jigsaw II, students work in four- or five-member teams as in TGT and STAD. Instead of each student being assigned a particular section of text, all students read a common narrative, such as a book chapter, a short story, or a biography. However, each student receives a topic (such as "climate" in a unit on France) on which to become an "expert." Students with the same topics meet in expert groups to discuss them, after which they return to their teams to teach what they have learned to their teammates. Then, students take individual quizzes, which result in team scores based on the improvement score system of STAD. Teams that meet preset standards earn certificates. Jigsaw is used primarily in social studies and other subjects where learning from text is important (Mattingly & Van Sickle, 1991).

Learning Together

David Johnson and Roger Johnson at the University of Minnesota developed the Learning Together models of cooperative learning (Johnson & Johnson, 1998). The methods they have researched involve students working on assignment sheets in four- or five-member heterogeneous groups. The groups hand in a single sheet and receive praise and rewards based on the group product. Their methods emphasize team-building activities before students begin working together and regular discussions within groups about how well they are working together. Numerous relatively brief experiments have shown positive effects of these approaches (see Johnson & Johnson, 1998; Roseth et al., 2008).

Group Investigation

Group Investigation, developed by Shlomo Sharan and Yael Sharan (1992) at the University of Tel-Aviv, is a general classroom organization plan in which students work in small groups using cooperative inquiry, group discussion, and cooperative planning and projects. In this method, students form their own two- to six-member groups. After choosing subtopics from a unit being studied by the entire class, the groups further break their subtopics into individual tasks and carry out the activities necessary to prepare group reports. Each group then makes a presentation or display to communicate its findings to the entire class. A study in Israel by Sharan and Shachar (1988) found positive effects of Group Investigation on achievement in language and literature.

CONCLUSIONS AND FUTURE DIRECTIONS

Learning environments for the 21st century must be ones in which students are actively engaged with learning tasks and with each other. Today, teachers are in competition with television, computer games, and all sorts of engaging technology, and the expectation that children will learn in a passive way, which was never very realistic, is becoming even less so. Cooperative learning offers a proven, practical means of creating exciting social and engaging classroom environments that can help students master traditional skills and knowledge as well as develop the creative and interactive skills needed in today's economy and society.

Cooperative learning has been established as a practical alternative to traditional teaching, and specific forms of cooperative learning have been proven effective in hundreds of studies throughout the world. Yet, many observational studies (e.g., Antil, Jenkins, Wayne, & Vadasy, 1998) find that most use of cooperative learning is informal and does not incorporate the group goals and individual accountability that research has found to be essential to producing positive achievement outcomes. Clearly, cooperative learning can be a powerful strategy for increasing student achievement, but fulfilling this potential depends on the provision of professional development for teachers that is focused on the forms of cooperative learning that are most likely to make a difference.

In comparison to schooling practices that are often supported by government, such as tutoring, technology use, and school restructuring, cooperative learning is relatively inexpensive and easily adopted. Yet, 30 years after much of the foundational research was completed, cooperative learning remains at the edge of school policy. This does not have to remain the case, and it may be that as governments begin to support the larger concept of evidence-based reform, the strong evidence base for the forms of cooperative learning that have been found to be effective will lead to a greater focus on this set of approaches to the core of instructional practice.

NOTE

1 Portions of this paper are adapted from Slavin, 1995.

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