Synthesis of Research on Cooperative Learning

Summary

It is unusual in educational research to have such unanimity of findings—in both individualistic settings and randomized experiments. The fact that these results are consistent for a wide span of ages and a wide set of topics indicates that a fundamental learning principle must be involved: ***social interaction increases the ability to learn ideas*** and to integrate them well into their existing cognitive structures. T he techniques for using collaborative learning groups can undoubtedly be improved, but their efficacy is not in doubt.

Introduction

In the 1970's and 1980's studies began on the effects of peer tutoring—that is, having older or more able students tutor within classrooms. As was to be expected, students receiving the tutoring gained significantly. What was less expected was that ***students doing the tutoring gained even more***. See Dineen et. al. (1977), and Cohen et. al. (1982) for summaries of this research and also see Semb et. al. (1993) for evidence that tutoring fosters longer-term retention.

At the same time that peer tutoring was being studied, teachers and researchers began experimenting with universal classroom tutoring by conceiving of the classroom as consisting of smaller cooperative learning groups where every student would have a chance both to tutor and to be tutored. The teacher would introduce the topic as needed and provide on-the-spot assistance where necessary, but much of the learning could reasonably be expected to take place between students as they grappled with ideas and tried to explain to each other or listen to explanations.

The effects of various forms of classroom cooperative learning groups (or small-group learning or learning teams) have now been studied extensively for over 30 years. For thorough overviews of the research, the reader is directed to Sharan (1980), Davidson (1985), Qin et. al (1995), Slavin (1996) and Springer et. al (1999). More in-depth information is provided by Johnson & Johnson (1989) and Slavin (1990). Other articles of general interest are Webb (1982) and (1991), Yager et. al. (1986), Palincsar & Brown (1988), Dees (1991) and Davidson & Kroll (1991).

The main result of all of these tens of thousands of hours of research is that cooperative learning is a more effective way than direct instruction for students of all ages to learn most concepts—and is especially effective for students learning non-linguistic concepts (Qin, op. cit.).

Span of effect—age

We mentioned above that cooperative learning has been found to have a positive effect in a broad variety of learning situations. Fuchs et. al. (2002) did an experimental study of 20 first-grade classrooms randomly assigning half of the rooms to peer tutoring in pairs for mathematics and found that that students "at all points along the achievement continuum benefited." Skon et. al. (1981) had earlier discovered much the same thing for first graders learning mathematics in a smaller study.

A small sample of eighth graders learning science were studied by Chi et. al. (1994) who found that simply explaining to yourself prompted greater learning. For the same age group Shachar and Sharan (1994) found in a study of nine junior-high history and geography classes that "students' achievement scores were higher in classes taught with Group Investigation as compared with those taught with the [traditional Whole Class] method."

In another investigation of high-school students, Nichols (1996) randomly divided 80 geometry students into three classes: one taught by traditional methods and two taught in cooperative learning groups. At the end of the year he found that "students in the cooperative treatment groups exhibited significantly greater gains than the control group in geometry achievement" and also were superior for several affective goals. Two classes of pre-calculus students were compared by Whicker et. al. (1997) who found students in the cooperative learning groups had "higher tests scores than students in the comparison group" who studied alone.

Span of effect—ability

A commonly voiced concern by parents of high-ability students is that cooperative learning groups will interfere with their own child's learning. Stevens & Slavin (1995) addressed this concern directly and concluded after a two-year study in elementary school that "gifted students in heterogeneous cooperative learning classes had significantly higher achievement than their peers in enrichment programs without cooperative learning." More recently, Carter et. al. (2003) investigated achievement gains of highability fifth-grade students in a science unit and found no significant differences in the achievement of high-achieving students regardless of who they were partnered with. - 5 - At the high-school level, Saleh et. al. (2005) looked at students randomly assigned to homogeneous or heterogeneous ability groups in a plant biology course and the researchers concluded that "low-ability students achieve more … in heterogeneous groups … whereas high-ability students show equally strong learning outcomes in homogeneous and heterogeneous groups."

Thus it appears that the achievement and learning of high-ability students is not hindered by being members of cooperative learning groups and may, in fact, be increased by the fact that they have the chance to act as tutors within the group.

Additional benefits of collaborative group work

Gillies has done a series of studies investigating the long-range impact on students who work in cooperative groups. She has found (Gillies, 2000) that first-grade "children who have been trained to cooperate … are able to demonstrate these behaviors in reconstituted groups without additional training a year later." She followed up these results in Gillies (2002) by showing that fifth-graders who had been trained in cooperative groups two years earlier were "more cooperative and helpful than their untrained peers." So the impact of the ability to cooperate in a group lasts well beyond the end of the year or the situation in which that learning occurred.

Promising initial results that need further verification

An interesting interpretation of the positive effect of group work on students in college physics courses comes from Gautreau & Novemsky (1997) whose interviews with students suggest "that 'second teaching' takes place in small groups following 'first teaching' by the instructor." This interpretation would be consistent with the tutoring literature and with the oft-stated dictum that you cannot really understand a topic until you teach it. In addition, if this interpretation holds, it would also support the work of Gillies (2004) who concludes that structured groups (where every student is assigned a role within the group for that class day) are more effective in promoting learning than unstructured groups.

Kramarski (2004) looked at a modified collaborative learning environment for 196 eighth-grade mathematics students and concluded that students who were exposed to metacognitive instruction within cooperative learning groups did better than students who had only metacognitive instruction or who only worked in cooperative learning groups.

In a study of elementary school children, Webb (1991) and in a later study in four seventh-grade classes, Webb & Mastergeorge (2003) categorized the different helpseeking behaviors that are useful for students working in cooperative groups. Specifically they list: asking for specific explanations; persistence; modification of helpseeking strategies; and application to the problem under consideration. They also listed important help-giving behaviors as "providing explanations with verbally-labeled numbers and continued explaining instead of resorting to descriptions of numerical procedures."

References

Carter, G., Jones, M. G., Rua, M. (2003). Effects of partner's ability on the achievement and conceptual organization of high-achieving fifth-grade students. *Science Education* 87(1): 94-111.

Cavalier, J. C., Klein, J. D., Cavalier, F. J. (1995). Effects of cooperative learning on performance, attitude, and group behaviors in a technical team environment. *ETR&DEducational technology research and development*. 43 (3): 61-71.

Chi, M. T. H., DeLeeuw, N., Chiu, M. H., Lanancher, C. (1994). Eliciting selfexplanations improves understanding. *Cognitive Science* 18 (3): 439-477.

Cohen, P. A., Kulik, J. A., Kulik, C. L. C. (1982). Educational outcomes of tutoring – a meta-analysis of findings. *American Educational Research Journal* 19 (2): 237-248.

Crouch, C. H., Mazur, E. (2001). Peer Instruction: Ten years of experience and results. *American Journal of Physics* 69 (9): 970-977.

Davidson, N. (1985). Small group learning and teaching in mathematics: A selective review of the research. In *Learning to Cooperate, Cooperating to Learn*, edited by R. Slavin et al. Plenum Press, New York.

Davidson, N., Kroll, D. L. (1991). An overview of research on cooperative learning related to mathematics. *Journal for Research in Mathematics Education* 22 (5): 362-365.

Dees, R. L. (1991). The role of cooperative learning in increasing problem-solving ability in a college remedial course. *Journal for Research in Mathematics Education* 22 (5): 409-421.

Dineen, J. P., Clark, H. B., Risley, T. R. (1977). Peer tutoring among elementary students – educational benefits to tutor. *Journal of Applied Behavior Analysis* 10 (2): 231-238.

Fuchs, L. S., Fuchs, D., Yazdian, L, Powell, S. R. (2002). Enhancing first-grade children's mathematical development with Peer-Assisted Learning Strategies. *School Psychology Review* 31 (4): 569-583.

Gautreau R., Novemsky, L. (1997). Concepts first - a small group approach to physics learning. *American Journal of Physics* 65 (5): 418-428.

Gillies, R. M. (2000). The maintenance of cooperative and helping behaviours in cooperative groups. *British Journal of Educational Psychology* 70 (1): 97-111.

Gillies, R. M. (2002). The residual effects of cooperative-learning experiences: A twoyear follow-up. *Journal of Educational Research* 96 (1): 15-20.

Gillies, R. M. (2004). The effects of cooperative learning on junior high school students during small group learning. *Learning and Instruction* 14 (2): 197-213.

Johnson, D., and Johnson, R. (1989). *Cooperation and competition: Theory and research*. Interaction Book Company, Edina, MN.

Kramarski B. (2004). Making sense of graphs: does metacognitive instruction make a difference on students' mathematical conceptions and alternative conceptions? *Learning and Instruction* 14 (6): 593-619.

Nichols, J. D. (1996). The effects of cooperative learning on student achievement and motivation in a high school geometry class. *Contemporary Educational Psychology* 21 (4): 467-476.

Palincsar, A. S., and Brown, A. L. (1988). Teaching and practicing teaching skills to promote comprehension in the context of group problem solving. *Remedial and Special Education* 9 (1): 53-59.

Qin, Z. N., Johnson, D. W., Johnson, R. T. (1995). Cooperative versus competitive efforts and problem-solving. *Review of Educational Research* 65 (2): 129-143.

Saleh, M., Lazonder, A. W., De Jong, T. (2005). Effects of within-class ability grouping on social interaction, achievement, and motivation. *Instructional Science* 33 (2): 105-119.

Semb, G. B., Ellis, J. A., Araujo, J. (1993). Long-term memory for knowledge learned in school. *Journal of Educational Psychology* 85 (2): 305-316.

Shachar, H., Sharan, S. (1994). Talking, relating, and achieving – effects of cooperative learning and whole-class instruction. *Cognition and Instruction* 12 (4): 313-353.

Sharan, S. (1980). Cooperative learning in small groups: Recent methods and effects on achievement, attitudes, and ethnic relations. *Review of Educational Research*, 50: 241-271.

Skon, L., Johnson, D. W., and Johnson, R. (1981). Cooperative peer interaction versus individual competition and individualizstic efforts: Effects on the acquisition of cognitive reasoning strategies. *Journal of Educational Psychology* 73: 83-92.

Slavin, R. (1990). *Cooperative learning: Theory, research, and practice*. Prentice Hall, Englewood Cliffs, NJ.

Slavin, R. E. (1996). Research on cooperative learning and achievement: What we know, what we need to know. *Contemporary Educational Psychology* 21 (1): 43-69.

Springer, L., Stanne, M. E., Donovan, S. S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of Educational Research* 69 (1): 21-51.

Treisman, U. (1985) A study of the mathematical performance of Black students at the University of California, Berkeley. Thesis, University of California, Berkeley.

Vigotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press. Webb, N. M. (1982). Interaction and learning in small groups. *Review of Educational Research*, 52 (3): 421-445.

Webb, N. M. (1991) Task-related verbal interaction and mathematics learning in small groups. *Journal for Research in Mathematics Education*, 22 (5): 366-389.

Webb, N. M., Mastergeorge, A. M. (2003). The development of students' helping behavior and learning in peer-directed small groups. *Cognition and Instruction* 21 (4): 361-428.

Whicker, K. M., Bol, L., Nunnery, J. A. (1997). Cooperative learning in the secondary mathematics classroom. *Journal of Educational Research* 91 (1): 42-48.

Yager, S., Johnson, R., Johnson, D., and Snider, B. (1986). The impact of group processing on achievement in cooperative learning groups. *The Journal of Social Psychology*, 126 (3): 389-397.