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ABSTRACT

This paper synthesizes what is known from previous research about the effects of children teaching other children in different K-12 contexts, emphasizing the academic and affective impact of such activity on the child doing the teaching. The study reviews peer teaching, integrating research findings about different types of peer teaching into one analysis. It assesses the extent to which the development of teaching abilities is good general education for students and identifies areas related to the topic that are insufficiently researched. Data are presented on (1) the effectiveness of standard peer teaching approaches: cross-age and same-age peer tutoring, cooperative learning, reciprocal peer tutoring, and reciprocal teaching; (2) conditions affecting peer teaching outcomes: contextual features (e.g., group rewards, individual accountability, and the composition of the cooperative learning group or peer tutoring dyad); student characteristics and behaviors (e.g., children who provide detailed and complex explanations to other children learn the most in peer tutoring and cooperative learning contexts); and (3) what it is about teaching others that leads to learning (e.g., the cognitive effects of explaining to others and arguing with others). (Contains 56 references.) (SM)

Children Teaching for Learning: What happens when children teach others in the classroom?[1]

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Introduction

With the exception of some high school teaching academies, our society does not systematically develop effective teaching skills in people until they are adults. This is surprising since effective teaching is essential to the success of any school community, and our society is also dependent on the existence of good teachers. Although our society doesn't generally attempt to teach effective teaching skills in children, there are several instructional strategies used in K-12 settings that involve children playing the role of a "teacher." Such strategies include peer tutoring of all kinds (i.e., cross-age and same-age, reciprocal and non-reciprocal), cooperative learning, reciprocal teaching, and some other lesser-known strategies. The effectiveness and processes involved in many of these types of peer teaching activities have been examined and discussed in the literature, such that, for example, there exist substantial bodies of research on areas such as cooperative learning and reciprocal peer tutoring.

Although there exists much research on teaching methods that involve peer teaching, including many reviews of research in these areas (Cohen, 1994; Cohen, Kulik, & Kulik, 1982; Qin, Johnson, & Johnson, 1995; Rosenshine & Meister, 1994; Slavin, 1991), there is a lack of literature focusing specifically on children teaching others across contexts and methodologies. Also, most research on peer teaching approaches has emphasized achievement of children as a whole, as opposed to the effects of teaching others on the teacher her/himself. The exception to this is the area of non-reciprocal peer tutoring, wherein the benefits to the tutor have been known and described for at least two decades.

The object of this paper is to compile and synthesize what is known from previous research about the effects of children "teaching" other children in different contexts in the K-12 setting, with an emphasis on the academic and affective impact of such activity on the child doing the teaching. This study is not a meta-analysis, but rather a review of peer teaching which takes research findings about different types of peer teaching and integrates it into one analysis. The paper assesses the extent to which the development of teaching abilities is good general education for students, and identifies areas related to the topic that are insufficiently researched.

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For this review, peer teaching is defined as any activity carried out by a student or students that involves students taking on a teaching role in the school setting. Taking on a teaching role can mean being placed in a situation where one is supposed to carry out activities that are associated with what teachers do to facilitate, guide, or cause learning by students. It can also mean being placed in a situation in which one does teaching-like behaviors, even if that is not the explicit intent. Teaching-like behaviors include demonstrating, telling or explaining material to others, as well as asking questions of others in order to assess or bring about understanding. It also includes organizing information into a teachable form, as in lesson planning.

To find research on students in teaching roles, I used relevant terms, such as 'peer teaching', 'reciprocal teaching', 'peer tutoring', 'collaborative learning', and 'cooperative learning', to search the ERIC database. I also used references in the articles located to find other studies. I concentrated on recent research (articles published since 1990), but I also obtained and examined some studies published prior to that date. For the most part I limited the studies reviewed to empirical research or reviews of research, and did not use articles aimed at practitioners. The most commonly researched classroom activities that fit into my definition of peer teaching are same-age and cross-age non-reciprocal peer tutoring, reciprocal peer tutoring, cooperative learning, and reciprocal teaching.

Effectiveness of Standard Peer Teaching Approaches

Cross-age and Same-age Peer Tutoring

Tutoring of children by other children is beneficial for both the tutor and the tutee. Much research showing benefits of peer tutoring was carried out in the 1970s and 1980s. A 1982 meta-analysis examined 65 studies that compared peer tutoring to conventional classroom teaching in both elementary and secondary schools (Cohen et al., 1982). Dependent variables examined included achievement, attitudes, and self-concept. The analysis found clear benefits in terms of tutor achievement, as 33 of 38 studies found a significant effect. Four of five studies that measured tutor attitudes found that attitudes were more positive for children serving as tutors than for children in conventional instruction. Effect sizes were small, but the results were consistent enough for authors to conclude that peer tutoring has a positive effect on the attitudes toward subject matter taught. Achievement and attitude effects for tutees were similar to those found for tutors, with 45 of 52 studies finding a significant effect for achievement, and all eight studies that measured attitudes of tutees finding positive effects. In terms of self-concept, the analysis concluded that although several studies found positive effects of peer tutoring on self-concept for both tutors and tutees, the effect sizes were too small to be considered statistically reliable (Cohen et al., 1982).

Because the benefits of peer tutoring appear to have been well-established for regular populations prior to the 1990s, many of the studies of peer tutoring since then have been on particular populations. Some studies, for example, have examined effects of low-ability students in the role of tutor in reading (Giesecke & Cartledge, 1993; Jacobson, Thrope, & Fisher, 2001; Taylor, Hanson, Justice-Swanson, & Watts, 1997). These studies found at least some achievement benefits for tutors, and most of them found benefits for tutees as well.

Another set of studies in the 1990s focused on students with disabilities in the role of tutor. One study, for example, found that behaviorally disordered 13 to 19 year old boys made gains in a math tutoring condition, as did their same-ability tutees (Franca, Kerr, Reitz, & Lambert, 1990). Another study found that middle school students with severe emotional disturbances made gains in social skills when they tutored peers in social skills (Blake, Wang, Cartledge, & Gardner, 2000). Their tutees' social skills also improved. A best evidence synthesis of 11 studies of peer tutoring in reading for students with disabilities indicated that peer tutoring was effective for these students (Mathes & Fuchs, 1994). The analysis also found that students with disabilities made greater gains in reading when they were in the role of tutor than when they were tutees or switched roles (and were both). A later meta-analysis of peer tutoring in reading with students with a variety of disabilities examined 20 studies (Elbaum, Vaughn, & Hughes, 1999). The studies used tutor pairing, small groups, or both. In the case of same-age peer tutoring, effects were the same for students with disabilities serving as tutors or tutees. With cross-age peer tutoring, tutees with disabilities did not benefit, but tutors did have achievement benefits. In summary, tutoring other children appears to have benefits for tutors of all ability levels, and holds promise for enhancing achievement of children with various types of disabilities.

Cooperative Learning

By 1990 there was a strong research base on cooperative learning. Studies comparing cooperative learning to conventional instruction demonstrated that cooperative learning was effective, and benefits to cooperative learning had been found at grade levels two to twelve, in all major subjects, with higher and lower order tasks, and in urban and rural populations. Areas of benefit included self-esteem, intergroup relations, achievement, attitudes towards school, and acceptance of children with disabilities (Cohen, 1994; Slavin, 1991, 1996). Although the effectiveness of cooperative learning was generally well established, there was a wide range in terms of effectiveness, with some studies finding much stronger effects than others. This fact spurred E. Cohen and Slavin to publish reviews synthesizing what is known about conditions for effective cooperative learning groups (Cohen, 1994; Slavin, 1991, 1996), the results of which will be discussed later in this paper.

Other recent cooperative learning reviews have focused on effectiveness with specific populations or specific types of tasks. For example, one review examined the effectiveness of cooperative learning with students who have emotional and behavioral disorders (Sutherland, Wehby, & Gunter, 2000). Although some of the eight studies examined found benefits, the effect sizes were generally small, making potential benefits of cooperative learning on students in this population unclear. Another meta-analysis specifically examined whether cooperative efforts or competitive efforts led to greater learning in problem-solving tasks (Qin et al., 1995). This review included 45 studies, with 63 findings, and found that cooperation resulted in higher-quality problem solving than competition in 55 findings, while the reverse was true with only eight findings.

Reciprocal Peer Tutoring

Reciprocal peer tutoring programs, which involve students being paired and in a structured manner taking turns acting as tutor and tutee, have been found to be effective

in terms of academic achievement in subject areas of math, reading, spelling, and science. They have been researched most at the elementary level, but appear to be effective at both elementary and secondary levels. There are studies of the effects of these programs on a variety of student populations, including high-, average-, and low-achievers, students with disabilities, low-income students, and minority students, generally with positive results (DuPaul, Ervin, & Hook, 1998; Fantuzzo, Polite, & Grayson, 1990; Fuchs, Fuchs, Mathes, & Simmons, 1997; Fuchs, Fuchs, & Thompson, 2001; Greenwood, Arreaga-Mayer, & Utley, 2001; Mathes & Fuchs, 1994; Mortweet, Utley, & Walker, 1999; Utley, Mortweet, & Greenwood, 1997). Studies of these programs generally do not separate effects on tutor from effects on tutee because all students play both roles.

There are a few different models of reciprocal peer tutoring. One example is Classwide Peer Tutoring (CWPT), which involves all students in a class being paired randomly and tutoring each other in 30 minute blocks. Each pair is a member of one of two class teams. During the 30 minutes, each member of the dyad is tutored by the other for about 10 minutes; the remaining 10 minutes is used to calculate team points. The tutoring follows introduction of material by teachers, and is used to reinforce or practice material. When tutoring, students follows a precise method that they have been trained in, involving correct answers by tutees leading to points and incorrect answers to a specific practicing strategy. Tutoring sessions usually occur four to five days during the week, followed by a test on the material covered during the week (Arreaga-Mayer, 1998). A more recent version of reciprocal peer tutoring, Peer-Assisted Learning Strategies, is a reading peer tutoring model based on CWPT but which adds specific reading comprehension strategies, such as summarization and prediction (Fuchs, Fuchs, & Thompson, 2001).

Reciprocal Teaching

Reciprocal teaching is an approach to improving reading comprehension which involves instruction and practice of the following four instructional support strategies: generating questions, summarizing, attempting to clarify confusing words or text meaning, and predicting what might happen next. The strategies are taught and modeled by the teacher as they read a passage, paragraph by paragraph. The students gradually take over the role of facilitator and provide instructional support to each other. Students are encouraged to initiate discussion and comment on each other's contributions, with the goal of achieving a dialogue about the meaning of the text (Rosenshine & Meister, 1994).

Rosenshine and Meister (1994) carried out a meta-analysis of studies on reciprocal teaching, using only studies with comparable experimental and control groups and in which the dependent variable involved testing students on new material. Of the nine studies that used standardized tests to measure outcomes, only two had significant results in favor of reciprocal teaching. However, statistically significant differences were found in six of seven studies that used experimenter-developed tests. The number of strategies taught varied in the studies from two to ten, but this did not make a difference in terms of outcome. In examining the difference between the standardized tests and the experimenter-developed tests, researchers found that the former were more difficult, with more complex vocabulary and longer paragraphs.

Some research carried out since the 1994 review has supported the effectiveness of reciprocal teaching (King & Johnson, 1999; Lederer, 2000). An interesting question, however, is to what extent it is the strategy instruction in reciprocal teaching that brings about benefits as opposed to the teaching role of the students per se. One study compared strategy instruction for poor readers in 3rd grade in three different contexts: direct instruction, reciprocal teaching, and collaborative problem-solving. The only measure that showed a difference was comprehension, which was better in the collaborative condition (Palincsar, David, Winn, & Stevens, 1991). Another study used meta-analytic techniques to examine the effectiveness of generating questions for enhancing reading comprehension. The study also compared the instruction and use of this strategy in the context of reciprocal teaching versus teacher-led instruction. Question generation was effective, but no differences were found between question generation implemented as part of reciprocal teaching or in the context of teacher-led instruction (Rosenshine & Meister, 1996).

Conditions Affecting Peer Teaching Outcomes

Contextual Features

In a 1991 review, Slavin concluded that two features that clearly enhance effectiveness of cooperative learning were group rewards and individual accountability (Slavin, 1991). Group rewards refers to positive reinforcement for groups which perform well as a whole, and individual accountability refers to students' individual performance having an impact on their own grades or test scores (Slavin, 1991). Group rewards have also been found effective in reciprocal peer tutoring, especially when combined with a structured peer tutoring format (Fantuzzo, King, & Heller, 1992). Cohen (1994) agrees that group rewards and individual accountability enhance achievement with certain group tasks, but posits that they are most important for lower-level tasks. Such tasks, she believes, necessitate external motivation in order for children to be interested in other children's progress. She argues that with higher level, interesting tasks children do not need external rewards, and that in fact use of them may lead to the negative effects often associated with use of external reinforcement (Cohen, 1994). Her conclusions concerning structure are similar: structuring the interaction in cooperative learning through roles and scripts is helpful for lower-level tasks; however, while some structuring may be useful in higher level, complex tasks, too much structure can constrain the interaction (Cohen, 1994).

Another contextual feature that impacts learning is the composition of the cooperative learning group or the peer tutoring dyad. In her review of cooperative learning, Cohen (1994) concludes that it is hard to predict whether heterogeneous or homogeneous grouping in terms of ability will lead to the most learning. However, one relatively certain finding is that low-achievers learn more in heterogeneous groups than in homogeneous low-achieving groups (Cohen, 1994). Other research has found that children do more explaining in groups which have only high and medium ability or medium and low ability children as opposed to high/medium/low ability groups, probably because medium ability children lose the opportunity to explain when high ability children are there (Webb & Kenderski, 1984). In reciprocal peer tutoring, a study found that high ability children provide better explanations than medium ability children (Fuchs

et al., 1996). The question of how much explaining children do and who does it is important because, as will be discussed in more detail below, children who provide good explanations tend to learn more. It is difficult to tell from this research what impact the grouping has on students learning from a teaching role versus students as recipients of knowledge. However, it does appear that two-tier (medium/high or medium/low ability) as opposed to three-tier groups make it more likely that medium ability children will act as teachers.

Training children in skills of working together and tutoring increases the effectiveness of peer teaching. Children placed in collaborative contexts do not spontaneously use higher order thinking and ask good questions, nor do they spontaneously use appropriate social skills (Cohen, 1994). They also tend to use strategies such as lecture and demonstration to teach each other. Without training, explanations in collaborative groups or dyads are often confused, and low status children are not included in the discussion (Fuchs, Fuchs, Bentz, Phillips, & Hamlett, 1994; Fuchs, Fuchs, Kazdan, & Allen, 1999). Effectiveness of training in quality helping skills has been shown for reciprocal peer tutoring (Bentz & Fuchs, 1996; Fuchs et al., 1994; L. S. Fuchs et al., 1997; King, 1994; King, Staffieri, & Adelgais, 1998), and non-reciprocal peer tutoring (Staub & Hunt, 1993). Positive effects have also been found for training in cooperative learning (Cohen, 1994), although two recent studies that examined effectiveness of a training program for cooperative learning found inconsistent results (Gillies & Ashman, 2000; Nath & Ross, 2001). The type of training necessary may depend on the nature of the task. If the context has built in motivational devices that make students want other students to understand, such as group rewards, and the tasks are low-level, then less training is necessary. If it is desirable that students operate at high levels of thinking, and motivation to help other students understand the material is not built-in, then training in both discourse and interpersonal skills may be necessary (Cohen, 1994).

Student Characteristics and Behaviors

In terms of individual student behaviors that influence learning, research indicates that children who learn most in peer tutoring and cooperative learning contexts are children who provide detailed and complex explanations to other children (Cohen, 1994; Fuchs et al., 1996; Webb, 1992). In addition, the children who provide these explanations are more likely to be high achieving children (Cohen, 1994; Fuchs et al., 1996). Incidentally, explainees only appear to learn when the explanation is of high quality, and tutees do learn more when tutored by a high ability as opposed to a medium ability tutor (Fuchs et al., 1996; Webb, 1992).

The finding that explainers learn most in collaborative settings and that high ability children do more explaining is interesting in light of the criticism received from some educators who worry about the exploitation of high ability children when using cooperative learning and peer tutoring approaches (Hansen, 1992; Randall, 1999). Several studies have examined differential effects of peer tutoring on children of low, medium, and high ability, finding no differences (Fuchs, Fuchs, & Yen, 2001; L. S. Fuchs et al., 1997; Sharpley, Irvine, & Sharpley, 1983). A 1996 review of cooperative learning specifically addressed the issue of high ability children, concluding that there is no basis for an argument that cooperative learning is less effective for high ability

children. In that review Slavin claims most studies have found equal effects for high and low ability children, a few have found more effectiveness for high ability children and a few have found more effectiveness for low ability children (Slavin, 1996). A study that used a case study combined with jigsaw technique for cooperative learning (whereby students become expert on a specific topic and teach others in their group) found that while students of all ability levels increased in knowledge from pretest to posttest, the improvement was higher in the high ability children than the low or medium ability children. Further, posttests revealed that only high ability children had the same level of knowledge in others' expert topics as they did in their own topic (Dori & Herscovitz, 1999).

The research on gifted children and collaborative settings is less clear. Claims have been made that cooperative learning and peer tutoring have a negative impact on the education of gifted children, and that these teaching methods are exploitative (Colangelo & Davis, 1997; Hansen, 1992; Randall, 1999; Robinson, 1990). There is some evidence that gifted children may not enjoy cooperative formats as much as competitive formats. One study examined the hypotheses that children who are not gifted would like cooperative learning better than gifted children, and that gifted children would dislike subjects in which cooperative learning was used more than would non-gifted students. The sample was 851 middle school children in four schools. Schools were classified as either not using cooperative learning at all (two schools), using it a lot (one school), and using it some (one school). Researchers found no difference in attitudes of gifted children and non-gifted children toward subject matter. They did find that in the two schools that used cooperative learning gifted children liked cooperative learning less than non-gifted children (Ramsay & Richards, 1997). Another study compared gifted boys and girls in cooperative learning in mixed-gender groups, cooperative learning in segregated gender groups, and an individual, competitive control condition. Researchers found no differences among the groups on math achievement, self-efficacy, or attitudes towards math (Hernandez Garduno, 2001). Another study involving interviews with gifted middle schoolers found that the students preferred working in groups with other gifted children than with heterogeneous groups (Matthews, 1992).

While some of the above studies provide some support for the possibility that gifted children do not have favorable attitudes towards cooperative learning, this support is not strong. There also does not appear to be evidence that collaborative methods of learning are less effective in terms of achievement for gifted children than for other children. Indeed, a study of the implementation of a two year cooperative learning program in two schools showed benefits for gifted children (Stevens & Slavin, 1995). The cooperative learning program included widespread use of cooperative learning in academic classes, mainstreaming of students with learning disabilities, and teacher, administrator, and parent collaboration. After two years of implementation, gifted children in the cooperative learning schools had significantly higher achievement in reading vocabulary, reading comprehension, language expression and math computation than did gifted children in comparison schools. They also had more positive attitudes towards language arts and reported having more friends than comparison children. This treatment program included many changes in the school in addition to implementation of cooperative learning, so it does not provide solid evidence of benefits of cooperative

learning for gifted children. However, the study does not lend support to opponents of cooperative learning for gifted students.

One fact to keep in mind is that the issue of learning through collaborative methods such as cooperative learning and peer teaching and the issue of whom one collaborates with are separate. This means that even if research found that gifted children learn more when they are working with other gifted children than when working with nongifted children, it would not mean that peer teaching itself was not beneficial to this population. However, a lack of research in this area precludes us from making any firm conclusions.

What Is It about Teaching Others that Leads to Learning?

Several causal explanations have been suggested to explain why cooperative learning and peer tutoring are effective for learning. One category of reasons could be called motivational or attitudinal reasons. A "motivational perspective" put forth by Slavin posits that children work hard to teach each other in cooperative learning because the only way for them to obtain their personal goal is if the whole group succeeds. This only works, he argues, if students are also held individually accountable for the material, because otherwise only a few children will do all the work (Slavin, 1996). Other motivational perspectives suggested to explain effects of cooperative learning are the idea that the change from the normal routine leads children to pay more attention; cooperative learning provides more autonomy, which increases self-determination and hence intrinsic motivation; and that peer support and peer norms lead to increased participation in the learning process, and better development of help-seeking skills (Elbaum et al., 1999; Hertz-Lazarowitz, Kirkus, & Miller, 1992).

A motivational or attitudinal explanation for peer tutoring effects (as opposed to cooperative learning) is "role theory", whereby one becomes what one does. Hence if one acts like a teacher, then one takes on the teacher's characteristics, including status, authority, self-perceptions and attitudes, which then affects achievement (Nevi, 1983). Another possibility raised is that the flexible, friendly environment in peer tutoring reduces anxiety and facilitates learning (Cohen, 1986; Nevi, 1983). Peer tutoring might also work by raising the self-esteem of tutors, which is associated with academic success (Elbaum et al., 1999; Nevi, 1983).

Slavin claims that support for his motivational perspective comes from studies indicating that group rewards combined with individual accountability enhance achievement benefits of cooperative learning (Slavin, 1996). However, Cohen describes research indicating that these external motivators are not necessary in complex, open-ended tasks (Cohen, 1994). With interesting, high level tasks it may be that the task itself, combined with social forces, are enough to drive children to provide explanations and ask each other questions. This is consistent with cognitive theories of motivation, which predict that intrinsic motivation is likely to be present when tasks are interesting and challenging but doable. Basically, if the task is interesting enough that children want to complete it, and they need each others' input to complete it, then children may not need external rewards in order to provide explanations and ask each other questions (Cohen, 1994).

Support for the possibility that enhanced self-esteem causes benefits of peer teaching is inconsistent. Some peer tutoring research has found positive effects on self-

esteem of tutors (Franca et al., 1990; Giesecke & Cartledge, 1993), as has some research on cooperative learning (Slavin, 1991). However, other research in peer tutoring has found no effect for self-esteem (Sharpley et al., 1983). A meta-analysis of research on peer tutoring described earlier in this article found no significant finding for self-esteem, although some individual studies had found effects (Cohen et al., 1982). Findings concerning attitudes toward subject matter are also inconsistent, with some studies finding positive effects (Cohen et al., 1982; Franca et al., 1990; Slavin, 1991), and others reporting no significant effect (Peklaj & Vodopivec, 1999). Even if peer tutoring and cooperative learning enhance self-esteem and attitudes toward the subject matter, it is unclear whether self-esteem and attitudes influence learning or vice versa.

A second category of explanations for benefits of peer teaching are cognitive reasons, although it is generally assumed that cognitive and motivational factors mediate each other, and there is often overlap among explanations (Slavin, 1996). One of two cognitive perspectives for learning in cooperative groups put forth by Slavin is a developmental one, whereby children learn from each other through interaction. Under this perspective it is assumed that in a Vygotskian sense children are working within each other's zones of proximal development, providing feedback to each other, and developing argument skills (Slavin, 1996). This perspective is probably more useful in explaining why children learn from being taught by others in groups, as opposed to why they would learn from teaching. However, insofar as children receive feedback from each other on their explanations, and discover and fill in inconsistencies in their logic, it also explains learning from "teaching" in collaborative contexts.

Qin et al (1995) put forth a perspective similar to Slavin's, suggesting that the reason cooperative problem-solving methods lead to better achievement than competitive methods is due to an exchange of information and insights, the development of shared understandings of solutions to problems, and the generation of strategies that occur (Qin et al., 1995). Also consistent with the developmental perspective, others have suggested that learning occurs in cooperative learning when one needs to integrate new information into one's existing mental structures. Further, experience with multiple sources of information enhances one's capacity to organize information (Hertz-Lazarowitz et al., 1992).

The second of the cognitive perspectives put forth by Slavin is the "cognitive elaboration" perspective, which suggests that when children explain things to each other, they must relate the material and concepts in their minds to other ideas that they know, which makes new cognitive connections, and hence enhances memory and learning (Slavin, 1996). This perspective seems to hold much promise for explaining the benefits of teaching, as it is supported by the consistent finding in both cooperative learning and peer tutoring, cited earlier, that providing detailed and complex explanations predicts learning (Cohen, 1994; Fuchs et al., 1996; Webb, 1992).

The "cognitive elaboration" perspective is also supported by research indicating that generating high quality questions for others, which is a strategy specifically taught in reciprocal teaching and some reciprocal peer tutoring contexts, enhances learning (King & Rosenshine, 1993; King et al., 1998). When question generation is studied as part of reciprocal teaching and reciprocal peer tutoring, it enhances the explanations given and the quality of the dialogue in general. Therefore it is sometimes hard to separate effects of question generation from effects of high quality interaction more generally. However,

there is evidence that question generation as a strategy in and of itself enhances learning, probably because it makes students examine the ideas and the concepts, and make connections(Dori & Herscovitz, 1999; Ezell, Hunsicker, & Quinque, 1997; Rosenshine & Meister, 1996).

Both cognitive perspectives are supported by the finding that in high level tasks, amount of verbal interaction in cooperative learning groups predicts learning (Cohen, 1994). Also, studies comparing cooperative learning involving argumentation to cooperative learning without argumentation have found that when students take opposing points of view learning is enhanced (Cohen, 1994). In one study, researchers divided cooperative learning groups working with electrical circuits into two groups. Half of the cooperative learning groups discussed which of three conclusions were best and worst, while the other half of the groups discussed whether each conclusion was good. The researchers' prediction that the students in the best/worst condition would provide more complex arguments and hence learn more was supported (Chinn, O'Donnell, & Jinks, 2000), indicating that generating ideas through practice in argumentation is effective.

In summary, then, as has been suggested by others, the cognitive effects of explaining concepts to others and arguing with others likely plays a large role in the enhanced learning that occurs when one is placed in a teaching role. When question generation occurs as part of the role, it probably enhances learning as well. The motivational features of working with others likely increases the behaviors that lead to cognitive effects. However, if a student does not really need others to accomplish the task, and if the task is neither interesting nor complex, external rewards for helping others learn may be necessary for the explaining and questioning behaviors to occur. It is less clear to what extent teaching others raises students' self-esteem and improves attitudes towards schooling, but there is some evidence that this may be a factor. Since actual teaching is more clearly a part of peer tutoring than cooperative learning, it would be interesting to compare student attitudes towards teaching in each of those contexts.

Areas for Further Research

The effectiveness of peer teaching in standard formats with many different types of children in a variety of school settings is generally well-established. However, there are areas that need more research. Given the controversy concerning gifted education and peer teaching methodologies, for example, it would certainly be helpful to carry out research examining more closely the effects of peer teaching on gifted students, and on whether this effect is mediated by the ability levels of the students they are working with. Another question is whether the nature of the task could have an impact on whether and how gifted children learn from heterogeneous groupings. In other words, it's possible that with low-level tasks, peer teaching could be boring and not very useful for gifted children, since the opportunity for complex explanations would not be present. However, with more open-ended and challenging tasks, which might provide opportunities for complex explanations, peer teaching may be more likely to provide benefits for gifted children. Again, however, this area needs to be examined.

Question generation is another area for further study. Research thus far indicates that question generation needs to be explicitly taught, and that it enhances learning. It would be helpful to better understand the difference in learning potential between questions asked in order to monitor others' understanding as opposed to questions asked

to enhance one's own understanding. It would also be interesting to examine the difference in cognitive benefits of question generation as opposed to providing complex explanations, and how these benefits vary according to subject matter being taught.

Research is also needed on non-standard peer teaching formats. This paper has described research on several types of peer teaching that are commonly used in K-12 settings. However, there is evidence that other types of peer teaching occur, and it would be helpful to gather evidence on the prevalence and effectiveness of these types of teaching strategies. For example, I know of an annual program at one elementary school that involves second graders becoming individual experts on a specific topic related to dinosaurs, and then teaching their topic to groups of first graders and kindergartners. I also know teachers who have worked with sixth graders to develop learning centers for kindergartners. Sixth graders then either led kindergartners from center to center or worked at one center as the younger children came through. Teachers in K-12 settings also sometimes create assignments involving development of lesson plans or curricular units for teaching other children in the class. These strategies of placing students in teaching roles are very diverse, and share some commonalities but are also different in many ways from peer tutoring, cooperative learning and reciprocal teaching. Examining effectiveness could provide insight into reasons why peer teaching works, which types are most effective for which outcomes, and which aspects of teaching others are not effective.

We also need more information on the extent to which both standard and non-standard forms of peer teaching are used. Further, although most teachers probably use peer teaching in order to enhance achievement of all students, teachers use these methodologies for diverse reasons, and it would be helpful to know the full range of reasons for using them. It would also be interesting and useful to find out how aware teachers are of the pedagogical abilities of individual students in their classrooms, and about whether this topic is of interest to teachers.

Also lacking in the knowledge base on peer teaching is qualitative information on peer teaching from the perspective of the students. Some studies have asked students their perceptions of tutoring or cooperative learning. Missing, however, are in depth qualitative examinations of peer teaching. Areas to explore include student experiences related to being placed in a teaching role, and of being taught by other students. We know that students are unlikely to effectively help each other without training; it would be interesting to understand students' perceptions of their own role and teaching ability with and without training. To what extent do student perceptions match what research tells us about effective teaching behaviors? Can students tell when they are benefiting academically from explaining things to other children? Do children placed in a teaching role perceive themselves to be exploited? Are there mutually-occurring teaching models in informal peer teaching that could provide grounds for a theory of early teacher development? These and many other questions could be effectively examined via case study and ethnographic research methods.

Conclusion

When children of all ability levels teach others across a variety of contexts it benefits them academically. Certain conditions must be in place it for peer teaching to be effective, but it is probably safe to say that developing pedagogical ability in students is

likely to enhance learning and achievement in the short term. What that means, based on research cited in this paper, is that training all children in effective helping, explaining, and questioning skills, and placing them in appropriately structured peer tutoring and/or cooperative learning situations in the classroom is likely to increase academic achievement. There may be other effective ways of structuring peer teaching opportunities for development of pedagogical skills and for enhancing achievement more generally, and research is needed to determine which types of non-standard forms of peer teaching are effective and why.

In the long-term, given the benefits of peer teaching, and the need to recruit qualified teachers in this country, it seems as though it would beneficial to further explore this relatively untapped area of teaching. It is generally assumed that children who show talent in areas such as mathematics and music at a young age will be talented in these areas as adults, and that cultivating these talents is a good idea. We don't as yet have evidence that being an effective pedagogue as a child will predict effective teaching as an adult, but there is probably no reason to assume that this would not be true. Why not develop structures to actually support and cultivate teaching skills in children, with a view toward developing a potential pool of talented teachers for the profession?

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