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ABSTRACT

This report synthesizes research on helping at-risk students meet academic standards. The studies chosen had to be published after 1984, be implemented in the United States, relate to K-12 students, directly assess students' academic achievement, address strategies that could be implemented in the regular classroom, and use strategies targeting low-achievement students. A total of 118 studies were sorted into six categories of classroom strategies: general instruction, cognitively oriented instruction, grouping structures, tutoring, peer tutoring, and computer-assisted instruction. Overall, results support the use of five of the strategies to help low-achieving students meet standards: cognitively oriented instruction, heterogeneous grouping structures, tutoring, peer tutoring, and computer-assisted instruction. There are positive findings for the effects of each strategy on the performance of low-achieving students, but in varying degrees, and with the exception of peer tutoring and computer-assisted instruction, only a minority of studies are considered high quality. Two appendices contain strategies to assist low-achieving students coding guide and meta-analysis methods. (Chapters contain references and annotated bibliographies.) (SM)

Helping At-Risk Students Meet Standards

A Synthesis of Evidence-Based Classroom Practices

Regional Educational Laboratory
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EXECUTIVE SUMMARY

The No Child Left Behind Act of 2001 has focused attention on the responsibility of schools and districts to help all children achieve at high levels. However, it is in classrooms that children receive the instruction and assistance that they need to achieve standards. For this reason, teachers need access to practices that target children who are low performing or at-risk of failure. Thus, this synthesis addressed the following research problem: What are effective instructional strategies that can be used in classrooms to assist low-achieving students?

The synthesis methods used to create this report follow established guidelines for conducting research syntheses in education and the social sciences. Students who are not meeting standards were defined as K–12 students who are low performing on an academic assessment or who are at risk for low performance based on factors such as high poverty. A strategy was defined as a practice or intervention designed to help low-achieving students at the classroom level. Based on these operational definitions and the research problem, the following inclusion criteria were established:

- The study concerned K–12 students.
- The study reported a direct assessment of students' academic achievement.
- The study concerned a strategy that could be implemented in the regular classroom.
- The study concerned a strategy that targeted low-achieving students.
- The study was published in or after 1985.
- The study was implemented in the United States.

To provide the broadest array of findings, the synthesis examined both published and unpublished studies and qualitative as well as quantitative research. Research on commercial programs was included if evaluation results were not previously reported in detail. Initial literature searches produced 4,291 citations and 727 articles from which 118 research studies were identified that met the inclusion criteria.

An instrument was developed for coding the content and research quality of each study. Studies were assigned a quality index of high, medium, or low based on characteristics related to research validity. To better analyze and communicate the findings, studies were sorted into six categories of classroom strategies.

The General Instruction category examined 15 studies that met the inclusion criteria. There were 10 studies of behaviorist strategies that utilized either explicit or repeated instruction and five studies of constructivist strategies that emphasized meaning and student understanding or balanced these with explicit instruction. Half of the behaviorist studies produced positive results on student achievement, but only one study was coded as high in research quality. All of the constructivist studies were coded as having medium or high quality, but only two of the studies — those of constructivist meaning-based

instruction — produced positive results on student achievement. The synthesis results on general instruction were insufficient to make recommendations. Because the schism between behaviorist and constructivist instruction is philosophically based, practitioners should consider how each approach views low-achieving students and the role of the classroom teacher.

The category of Cognitively Oriented Instruction examined 15 studies that met the inclusion criteria. There were nine studies of cognitively oriented instruction in reading, including two studies coded as high quality and four coded as medium quality. There were positive effects on student achievement in reading in studies where instruction addressed task planning/preparation, and how-to strategies such as summarizing were taught. There were four studies of cognitively oriented instruction in writing and oral language, all of which met the criteria for medium- or high-quality research. Positive effects on achievement occurred when students were taught strategies for task analysis and preparation and had opportunities for practice, feedback, and discussion about the writing task. One medium- and one high-quality study of cognitively oriented instruction in mathematics found positive results on student achievement and highlighted the benefits of using meaningful, relevant problems. Due to the small number of studies and the lack of research on long-term implementation, only preliminary conclusions can be made that cognitively oriented instruction is an effective strategy for assisting low-achieving students. However, the reviewed studies suggest to practitioners some indicators of effective cognitively oriented instruction.

The category of Grouping Structures examined 18 studies that met the inclusion criteria. There were 10 studies of grouping students across ability levels, four of which were coded as high quality. Nine of the studies found positive results on student achievement using cooperative learning approaches. Students were in middle grades or higher. There were eight studies of grouping students by ability levels, and all employed either direct instruction or teacher-led discussions. Five of these were implemented with lower elementary students. All but one of the eight studies found positive effects on student achievement, and the exception was the one study coded as high quality. Overall, the synthesis of research on grouping structures resulted in preliminary conclusions that cooperative grouping across ability levels is an effective strategy for low-achieving students. The lack of high-quality research on grouping by ability levels precluded recommendations regarding this practice. Practitioners should be aware of factors that can make student grouping successful, including presenting students with a clearly defined task, facilitating student helping and questioning behaviors, and providing teacher training in group facilitation.

The Tutoring category examined 23 studies that met the inclusion criteria. There were five studies of professional tutors, such as teachers. Four of the studies, including the one high- quality study, found positive effects of tutoring on student achievement. All four examined tutoring of K–1students in reading and utilized diagnostic-prescriptive approaches. There were 13 studies of volunteer tutoring of students in grades K–12, primarily in reading. Eight of the studies found positive results on student achievement, including three of the four high-quality studies. The successful volunteer tutoring programs utilized purposeful instructional frameworks to guide the tutoring. Recruiting and retaining volunteers were highlighted as logistical concerns. There were five studies of tutoring students in grades 1–9 in literacy where the tutors were older students. None of the studies was coded as high quality. Four of the studies found positive effects of cross-age student tutoring on reading achievement. Tutor training was an

important factor in cross-age tutoring as well as in professional and volunteer tutoring. Overall, the synthesis results for the category of Tutoring supported a preliminary conclusion that programs utilizing different types of tutors can result in positive effects on the achievement of low-performing students. Practitioners should be aware of the characteristics of effective tutoring programs including program monitoring, a purposeful instructional framework to guide the tutoring, and the attention given to the diagnostic and prescriptive interaction.

The Peer Tutoring category examined 30 studies within three types of peer tutoring that met the inclusion criteria. In classwide peer tutoring, typically pairs of students instruct and assist each other in learning basic information in a variety of subjects from two to five days each week. There were 10 studies of classwide peer tutoring, most of which occurred in elementary grades and in literacy-related subjects. All six studies for which the direction of results could be determined produced positive effects on the achievement of low-performing students. Two of the studies were high-quality longitudinal studies. There were eight studies of Peer-Assisted Learning Strategies (PALS), a peer tutoring protocol specifically designed to engage students in strategic reading activities. All eight studies of PALS were coded as high quality and concerned elementary students. Six studies included learning-disabled students. All the studies resulted in positive effects of PALS on reading achievement of low-performing students. There were six studies of Reciprocal Peer Tutoring, a strategy designed to improve mathematics achievement in elementary students. This method employs alternating student tutor and teaching roles and reinforcement for learning. All of the five studies that provided sufficient information concerning the results were high quality, random assignment studies; all found positive effects in the mathematics achievement of low-performing students. There was a final subcategory of six studies that included a mix of low-achieving students in grades 1–10 in a variety of subjects. Only three of these studies provided sufficient information about the direction of results, and of these, two found positive effects on achievement. Overall, the results of the synthesis of studies on peer tutoring supported preliminary conclusions that the strategy is effective for low-achieving and learning disabled elementary students in basic skills for both literacy and mathematics. Practitioners should be aware of the need for training of both teachers and students, complex classroom logistics, and careful teacher monitoring of tutoring behaviors and activities.

The category of Computer-Assisted Instruction examined 21 studies in which the computer was used to improve the achievement of low-performing students. Seventeen of the studies provided sufficient quantitative information to conduct a meta-analysis. Of these, eight studies concerned students in grades 1–6, and the remainder concerned students in grades 7–12. The subjects were literacy and mathematics. The meta-analysis produced an overall statistically significant effect size of .37, which means that students who received computer-assisted instruction scored an average of 14 percentile points higher than those who did not receive this strategy. Additional analyses found that computer-assisted instruction had a significantly larger effect on achievement in mathematics (.57) than in literacy (.16). There were no significant differences between the effect sizes of high- versus low-quality research studies. The statistically significant effect size from the meta-analysis provided conclusive evidence that computer-assisted instruction is an effective strategy for improving achievement of low-performing students, particularly in mathematics. Practitioners should note the advantages of computer-assisted instruction, which include individualized learning, immediate feedback, and the potential for increased student autonomy and motivation to learn.

Overall, this research synthesis provided evidence that supports the use of five strategies to help low-achieving students meet standards: cognitively oriented instruction, heterogeneous grouping structures, tutoring, peer tutoring, and computer-assisted instruction. The authors cited the need for more high-quality research studies and studies that build on previous findings in order to accumulate a body of knowledge about specific interventions. While practitioner guidance was not a goal of the synthesis, implementation issues associated with each strategy were identified. Practitioners should consult the resources cited at the end of each chapter for additional implementation guidance.

PREFACE

The No Child Left Behind Act of 2001 places responsibility on states to ensure that their schools help *all* students succeed, that is, to achieve standards, as the name of the Act reflects. In 12 years, all students must perform at a "proficient" level on state tests. Therefore, states are under more pressure than ever before to raise student achievement. Furthermore, states must monitor whether schools are making adequate yearly progress as measured by assessments aligned with state standards. This context has created the need to identify strategies that can assist students who are not meeting standards. The purpose of this report is to review and synthesize the research on such classroom practices.

In 2001, Mid-continent Research for Education and Learning (McREL) published a research synthesis on standards in classroom practice (Apthorp et al.). That report provided narrative reviews of research on standards-based instruction in literacy and mathematics and the practices and policies needed for professional development and school organizations in a standards-based education system. In 2002, we emphasize specific classroom practices that can help students who are struggling to meet the standards. This year we have conducted a research synthesis (see frontispiece) on the effectiveness of strategies designed to assist low-achieving students during the school day. In 2003, we intend to synthesize the research on strategies to assist low-achieving students outside the school day.

The goals for the current synthesis are the following:

1. Based on an extensive and representative collection of research studies, to identify evidence strategies designed to assist low-achieving students during the school day.
2. To assess the validity and reliability of the findings about the strategies according to the quality of the research.
3. To describe research-based strategies for researchers and practitioners based on our confidence in the findings.

Our approach was to examine systematically the research about classroom strategies and to consider in our analysis the degree to which the research meets standards of rigor. As the Director of the Institute of Education Sciences has indicated, all education research is not of equal merit, yet decisions in education should be based on sound research evidence (Whitehurst, 2001). Our methods reflect this view and follow established guidelines for conducting research syntheses.

As educators face new challenges to ensure that low-performing student achieve standards, we must find and adopt practices that are substantiated through rigorous research. These practices are more than merely research based in that their effectiveness has been demonstrated through testing in the field. One way to identify evidence-based practices is through a systematic research synthesis; a strategy recently given visibility by the U.S. Department of Education when it created the What Works Clearinghouse to conduct such syntheses.

Each of the federally funded Regional Education Laboratories has also been asked to conduct an annual research synthesis. A research synthesis is not a practitioner-oriented, how-to paper. The measure

of its success is whether or not it includes a systematically collected comprehensive set of research on a practice, a thorough assessment of the validity of the relevant research, and a clear statement of what can be learned from that research about the effectiveness of the practice. It is also valuable to learn proof is lacking. The conduct of a successful research synthesis requires the implementation of a rigorous methodology that includes

- exhaustively searching for studies in published and unpublished literature (to find both positive and negative results),
- assessing each study for validity to insure reliability of results, rejecting studies of insufficient quality, and
- deriving findings about the body of evidence in existence about the practice.

A synthesis answers researchers' questions about the adequacy of current research and highlights areas where the available research is insufficient. Practitioners learn to what degree a practice has been proven to work, but must determine for themselves the specifics of implementation in their settings.

We have organized this research synthesis into eight chapters. Chapter 1 provides a general overview of research on strategies to help low-achieving students and describes the methods that we used to search the literature and to select and code research studies. Chapters 2 through 7 review and synthesize research on each of the six general strategies that emerged from our literature searches. In Chapter 8, we summarize the findings across the six strategies and provide general conclusions.

The primary audience for this document includes education researchers and state administrators who have a general understanding of research methods and scientifically based evidence. The secondary audience includes district administrators and staff developers who have some background in research. Given the goals of this synthesis, we designed the document to be a hybrid of a highly technical synthesis and a report that can readily assist state departments of education and district personnel. We used systematic methods to review and analyze the content and quality of the studies based on research standards. To serve different types of audiences, we used both technical and non-technical language and description. Finally, although K–12 practitioners are not the primary audience for this document[1], each chapter concludes with an annotated bibliography and a section for practitioners that highlights the features of the strategy, research findings about the strategy, issues that occur when implementing the strategy, and resources on strategy implementation

[1] McREL intends to develop a follow-up document for practitioners that addresses strategies to help low-achieving students to meet standards.

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CHAPTER 1

BACKGROUND AND METHODS

Patricia A. Lauer

RESEARCH PROBLEM

The No Child Left Behind Act of 2001, which reauthorized the Elementary and Secondary Education Act, has focused attention on the responsibility of schools and districts to help all children achieve at high levels. The underlying assumption of the Act is that states will continue to implement standards for student learning and will measure students' progress through assessments that are aligned with these standards. Ultimately, it is in classrooms that children will receive the instruction and assistance that they need to achieve standards. In Marzano's (2000) analysis of the influences of school, teacher, and student variables on student achievement, variables related to teaching (e.g., instructional practices) accounted for 13.3 percent of the variation, while school-level variables (e.g., school climate) accounted for 6.6 percent. Student variables (e.g., socio-economic status) had the greatest impact at 80 percent. These results suggest that teachers' classroom practices have the potential to influence student outcomes to a greater degree than do school practices. It is important for teachers to have access to the most effective practices that target children who are at-risk of failure because of the influence of student variables. Thus, our synthesis addresses the following research problem: What are effective strategies that can be used to assist low-achieving students?

RESEARCH CONTEXT

Much of the prior research on ways to assist low-achieving students has centered around the notion of "at-risk." Although researchers define *at-risk* in different ways, the term generally refers to students who are at risk for school failure (Slavin & Madden, 1989). Analyses of large-scale data collections have found that lower student achievement and school dropout rates are associated with certain student characteristics, including low socio-economic status (SES), racial or ethnic minority background, single-parent family, mother with low education, and limited proficiency in English (Miller, 1993).

Waxman, Padrón, and Arnold (2001) described instructional practices that are effective for at-risk students through a review of research related to five areas: cognitively guided instruction, culturally responsive instruction, technology-enriched instruction, cooperative learning, and instructional conversation (student-centered discussion). Howe and Kasten (1992) and McLaughlin and Vacha (1992) wrote similar reports on practices and programs to assist at-risk students, and Means, Chelemer, and Knapp (1991) presented six instructional models for teaching at-risk students. These descriptive summaries provide helpful overviews and recommendations about strategies to help low-achieving students, the topic of the current synthesis. However, these prior reviews did not attempt to synthesize this research by examining research quality and research results and presenting evidence of the effectiveness of the strategies based on the body of studies.

Slavin and Madden (1989) conducted a best-evidence synthesis of classroom programs for at-risk students. With this approach, only studies that meet certain pre-established criteria are analyzed to reach conclusions. The authors cited four types of programs that were supported by evidence of effectiveness using their criteria: continuous progress programs in which students progress at their own pace and are taught in small groups, cooperative learning, remedial tutoring, and computer-assisted instruction. The current synthesis updates Slavin and Madden's report and identifies additional strategies.

Another source of research on assistance for low-achieving students are evaluations of strategies and programs funded by Title 1 (formerly called Chapter 1) of the No Child Left Behind Act. Title 1 provides federal funds to districts and states to improve education opportunities and outcomes for students who are at risk of failure due to low income. Borman and D'Agostino (1996) conducted a meta-analysis of federal evaluations on the relationship between programs funded by Title 1 and student achievement. The authors found "a modest overall impact" (p. 309) of Title 1-funded programs on student achievement. Rowan and Guthrie's (1989) study of Title 1 found large variations across schools in the content and quality of Title 1 instruction compared to the content of regular instruction not supported by Title 1. Due to this variation, the authors were unable to draw conclusions about effective Title 1-supported strategies. Other research has examined Title 1 comprehensive school reform models (Wang, Haertel, & Walberg, 1997; Fashola & Slavin, 1998). However, most of this research does not isolate the specific classroom strategies that are key to the success of low-achieving students in the programs.

In summary, reviews of research on assistance for low-achieving students have emphasized studies of strategies and programs that can help students overcome factors associated with risk of educational failure. To update and assess the quality of this research, we conducted a research synthesis of studies completed since 1985 and coded research quality as a mediator of the findings. We conducted an extensive search for studies, so we could examine the broad array of findings, both positive and negative. Research on at-risk students in whole-school reform models tends not to identify the specific strategies in a program that result in improved achievement. Thus, we focused on studies that isolate the effects of specific strategies or programs. Our synthesis fills the need for information about research-based strategies that schools and teachers can use to help their low-achieving students meet standards.

METHODS

As described in this section, we used systematic methods to conduct a review of research on strategies designed to assist low-achieving students. Where the research supported it, we used meta-analytic techniques. Otherwise, the reviews are narrative in form. In conducting the synthesis, we drew on guidance from previous researchers who have published on synthesis methodology (Cooper, Charlton, Valentine, & Muhlenbruck, 2000; Shanahan, 2000) and particularly from the work of Harris Cooper (1998). Cooper is directing a sub-contract for the U.S. Department of Education's newly funded What Works Clearinghouse, which will publish research reviews on the effectiveness of programs and strategies intended to enhance student achievement (U.S. Department of Education, 2002).

Literature Searches

The goal of our search methods was to accurately and comprehensively represent the research on the synthesis topic. To operationalize the topic, we defined students who are not meeting standards as K–12 students who are (a) low performing on an academic assessment, or (b) at risk for low performance based on factors such as high poverty. We defined a strategy as a practice or intervention designed to help low-achieving students. A strategy also could be a program, but we excluded school-wide programs because the components that are most responsible for improved achievement cannot be isolated. For example, our definition includes specific strategies that are funded by Title 1, such as tutoring, but excludes Title 1 comprehensive school reform models. Based on our operational definitions and goals, we established the following initial criteria for including a study:

- The study had to concern K–12 students.
- The study had to include some type of direct assessment of students' academic achievement, such as a classroom or standardized test. Measures of dropout and student motivation did not qualify as measures of academic achievement.
- The study had to be published or reported in or after 1985. (We chose this date as the approximate start of the standards movement in the United States.)
- The study had to be implemented in the United States.

Using 15 terms identified through a preliminary review of the research literature, we conducted an initial search of *ERIC* and *PsychInfo* related to strategies for low-achieving or at-risk students. Search terms included terms such as "extended time" and "tutoring." Initial searches indicated that strategies were either implemented during the school day, such as class-wide peer tutoring, or implemented outside the school day, such as summer school. Strategies implemented outside the school day are influenced by a different set of resource decisions, such as the need for additional instructional time and the funds to support additional instruction. We therefore decided to limit this synthesis to strategies that are implemented during the school day, and to address the outside-the-school day strategies following the completion of this study.

Abstracts from our initial search were the bases of additional searches of *ERIC* and *Psych Info* for the years 1985 through 2002. For these searches, we separately combined the terms "low achievement" and "at risk" with 20 terms that our initial searches indicated were used for strategies to assist low-achieving students during the school day, for example, "remediation and low achievement." These new searches produced 4,291 citations. After reading abstracts for these citations and determining which studies met initial criteria, we obtained 727 articles on research studies, reviews, and syntheses. We examined these articles and established the following additional inclusion criteria:

- The study concerned a strategy that is implemented in the context of a regular classroom setting. For example, we included studies of strategies to assist special education students if the classroom teacher implemented the strategy in an inclusion

setting. However, we excluded studies of strategies that special education teachers implemented to assist special education students in a resource classroom. We used the same logic to include or exclude studies of strategies for students who are limited in English proficiency.

- The study included an examination of the effectiveness of a strategy for low-achieving students or students at risk for low achievement. We excluded studies if data analyses related to achievement were incidental and not related to the purpose of the study.

- The study examined a commercial program for which evaluation results have not previously been described in sufficient detail. We conducted an additional literature search for each excluded commercial program. If this additional search confirmed the existence of sufficient previously reported research, we excluded the program from the synthesis.[2] For example, we excluded studies of Reading Recovery because of the breadth of research reported on this commercial program. However, our synthesis includes strategies such as tutoring that may be components of such commercial programs.

There are some additional review criteria that require explanation. To provide the broadest array of findings, we reviewed unpublished studies such as evaluation reports, conference presentations, and dissertations for inclusion. A benefit of this approach is that it helps researchers avoid the null hypothesis problem (Cooper, 1998) whereby studies that found no effect are excluded from a synthesis because they were not published. This problem tends to bias a synthesis in favor of finding positive results. We also reviewed qualitative as well as quantitative studies. The use of qualitative approaches has increased in recent years, especially in reading research; neglecting to examine these studies would have resulted in the exclusion of a significant number of findings (Shanahan, 2000). Further, including qualitative studies in a research synthesis can help explain results by identifying differences in processes used in different studies of a program or strategy (Light & Pillemer, 1982). As a counterbalance to the breadth of studies included, we rated each study for research quality and described findings in relation to this quality.

After reading studies and sorting them into the conceptual framework described in the next section, we obtained additional research studies from reference citations in the research articles. We applied the same inclusion rules to these studies that we used in our initial searches. A total of 118 research studies were synthesized.

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[2] Excluded programs are Cooperative Integrated Reading and Composition (CIRC), Direct Instruction (DI) Reading, Higher Order Thinking Skills (HOTS), Helping One Student to Succeed (HOSTS), and Reading Recovery.

Conceptual Framework

To better analyze and eventually communicate our findings, we read the study abstracts and sorted the studies into types of strategies. After trying different sorting frameworks, the following six categories of strategies emerged:

- General Instruction — instructional strategies that are used primarily in whole-group settings and that do not fit the definitions of the other five categories
- Cognitively Oriented Instruction — instruction on strategies for thinking and monitoring learning
- Grouping Structures — strategies for grouping students in a classroom for delivery of instruction
- Tutoring — one-on-one instruction to a student by an adult or older student
- Peer Tutoring — pairs of students working together in the learning process for mutual benefit
- Computer-Assisted Instruction — use of a computer to present materials for instruction and to monitor learning

A researcher assigned each study to one of the six categories based on the predominant strategy that the study addressed. A second researcher verified the category assignment. Where differences in assignment occurred, the researchers discussed and resolved their differences based on the definition of the category strategy and the strategy's emphasis in the study. Additional refinement in sorting occurred after analysis of the studies began. More detailed definitions of each category strategy are provided in the next chapters.

Conceptually, the six strategies represent two general types: approaches and interventions. General Instruction and Cognitively Oriented Instruction are *approaches* to assisting low-achieving students. Grouping Structures, Tutoring, Peer Tutoring, and Computer-Assisted Instruction are *interventions*. The primary difference between these two broad types is that the approaches are more general and theoretically based, whereas the interventions are more specific and applied.

Coding of Studies

An instrument was developed to code studies for content and quality. The instrument was pilot-tested by coding five different studies, three quantitative and two qualitative. The instrument subsequently was revised by consensus to enhance clarity and common understanding of terms used for coding and to include information needed in order to adequately describe study characteristics and quality. The instrument has four major sections: nature of the intervention, research design, data analyses (for quantitative studies), and quality of the study. The coding instrument can be found in Appendix A.

Content coding. Each study was coded for descriptive information about the program or intervention strategy being researched. This information included the nature and goals of the strategy, how the study identified students as low achieving, the qualifications of those implementing the

strategies, how implementers were assigned to the different groups of students in the study, the amount of students' exposure to the strategy during the course of the study, the subject areas that the strategy addressed, and the context of the school in which the strategy occurred. The student sample was coded for how students were assigned to different groups; the total number of students in the study and in each separate group; measures of group attrition; and student characteristics of grade level, gender, and ethnicity.

To code each study's research design, we identified the predominant research methodology — that is, the one on which study conclusions related to the strategy and performance of low-achieving students were based. We described quantitative research as either experimental or quasi-experimental research. Studies classified as experimental were those in which students were randomly assigned to treatment or control/comparison groups. The treatment group referred to those students for whom a specific strategy was implemented to raise achievement. The control group referred to students who received normal teacher-mediated instruction without the strategy. Comparison groups received combinations of strategies or different strategies. Studies classified as quasi-experimental were those that did not randomly assign students to control or comparison groups. For these studies, we described procedures used to equate or match the different groups in the studies. Most often, teachers, rather than students, were assigned to strategies, resulting in very few truly experimental studies. We also coded quantitative designs with respect to whether students were pretested on achievement prior to strategy implementation and then posttested or were only posttested.

We described qualitative research designs as case studies, action research studies, studies using grounded theory, and ethnographic studies. We noted when qualitative studies used more than one of these approaches. For both quantitative and qualitative studies, we described the relevant findings that supported use of the strategy as a way to assist low-achieving students.

Quality coding. In coding the quality of the research studies reviewed, our first consideration was whether the study provided sufficient information to index the quality of the research. If sufficient information existed, we used Cook and Campbell's (1979) framework on threats to validity and coded quantitative studies for information related to 13 threats. For example, one threat to validity is the loss of students from the treatment group prior to the study's conclusion. If those who drop out have lower achievement scores than those who stay, the conclusions could be invalid because results might be due either to the strategy or to the type of students remaining in the treatment group. To demonstrate consideration of this threat to validity in the findings, a researcher would need to document and discuss the number and characteristics of students who left the treatment and control/comparison groups.

Qualitative studies were coded for information related to 10 threats to validity. This coding emphasized the objectivity and reliability of methods used and the degree to which results are credible and can be transferred to other settings (Miles & Huberman, 1994). For example, we coded whether constructs used for analysis of qualitative data were clearly defined and whether the researcher conducted a search for evidence to disconfirm his or her explanations for the findings.

After coding each study for quality characteristics, we assigned a quality index of low, medium, or high. The index was used to communicate an overall rating with respect to the validity of the study's

conclusions. The higher the quality index, the greater the evidence of the study's validity. We excluded studies from the synthesis for which there was insufficient information to assign a quality index. Exclusions of this type are discussed separately for each strategy in the next chapters.

ANALYSES AND RESULTS

Although each strategy category was assigned to a different researcher for synthesis, researchers followed common procedures for identifying subcategories, evaluating and analyzing studies, and presenting results. These procedures were jointly developed prior to data analyses and modified through frequent discussions as data analyses were completed. We worked closely as a team throughout the process and read and critiqued one another's chapters, developing common approaches to the writing. The use of "we" throughout the report reflects this collaborative study approach.

The decision about whether to conduct a meta-analysis (quantitative synthesis) of the studies in each strategy category depended on the following criteria:

- Whether a sufficient number of studies provided the necessary quantitative information needed to compute effect sizes[3]
- Whether a single effect size, the result of a meta-analysis, would provide meaningful and useful information within the context of the category

The chapters that follow describe the analysis and results of a synthesis of research on each of the six strategy categories. Each of the chapters, which follow the same general format, includes tables of the studies analyzed. Individual studies are elaborated on if they have one or more of the following characteristics: high-quality research, informative for practitioners, highlights an implementation issue, is one of a combination of studies that give the most complete picture of the strategy. By adapting chapter content to the characteristics of studies for each strategy, we were able to more completely discuss results than if we had used a uniform presentation. For example, most of the research on computer-assisted instruction was quantitative and with sufficient sample sizes to allow for meta-analysis. However, for tutoring, the small samples sizes of studies necessitated a different type of analysis and presentation.

In drawing conclusions about the studies in each chapter, we focused on the extent and quality of the research. In some cases, there was insufficient evidence based on the number and quality of the studies to determine a result. In other cases, there were some high-quality studies that suggested preliminary findings. The final chapter suggests some overall conclusions about the six syntheses in relation to the research problem.

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[3] Effect size refers to the magnitude of the effect of a strategy/intervention on an outcome such as student achievement. In general, the larger the effect size, the stronger the relationship between the strategy/intervention and the outcome. Calculation of an effect size requires the following quantitative information: sample size, mean, standard deviations for both the strategy group and the control/comparison group, or the value for a t or F statistic and the sample size. (For an explanation of the practical use of effect size, consult Marzano, Pickering, and Pollock, 2001.)

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CHAPTER 2

GENERAL INSTRUCTION

Sheila A. Arens

Having limited resources outside the classroom (or lacking such resources altogether), the only opportunity that some students have to become literate — to learn to read or compute — is in the classroom. This places an enormous burden on classroom teachers, particularly teachers of students who exhibit large variations in academic performance. Although teachers are encountering and struggling with competing demands on resources (e.g., time, effort, materials), they must make decisions about their practice. Moreover, given the current emphasis on standards-based education aimed at holding all students to the same standards of learning and achievement, the expectation that teachers will improve student achievement toward standards necessarily influences classroom decisions for low-achieving students.

Clearly, difficulties emerge when teachers consider changing their classroom practices. Ostensibly one advantage of variations in general instruction provided within the context of the regular classroom is that students labeled "at risk" or "educationally disadvantaged" will be taught the same skills as their peers. A primary disadvantage is that approaches in whole-group settings tend to minimize or limit teachers' ability to focus additional energies on their low-achieving students.

BACKGROUND

The approaches to instruction reviewed in the following chapters offer viable strategies for teaching children who are low achieving or academically at risk. This chapter provides an overview of general instruction that is not as easily categorized by the nature of the intervention. We first categorize these approaches conceptually and then provide details about what works for implementation in the traditional classroom. The resulting broad conceptual subcategories of behaviorism and constructivism overlap with and encompass strategies presented in other chapters. We propose these subcategories in this chapter only as a means to better understand the ideology underlying given approaches and to suggest one means of understanding practice. Moreover, the overlap of *aspects* of practices presented in this chapter with aspects of strategies discussed in later chapters not only suggests a degree of coherence among strategies but also suggests difficulties that arise when attempting to differentiate the impacts of effective approaches. Thus, a strategy presented in this chapter may have aspects or specific elements in common with a strategy presented in later chapters, despite the fact that the interventions or practices appear to differ. When both strategies are deemed efficacious, it becomes difficult to determine whether this is due to the elements the strategies share in common or to the combination of convergent and divergent elements.

This chapter addresses the question: What can teachers do in their regular classrooms (in primarily whole-group settings) to effect positive gains in achievement? Although a diverse array of strategies for regular classrooms might be called "general instruction," conceptually these approaches to

general instruction fall into two general subcategories grounded in theories of knowledge — a behaviorist/cognitive perspective, and a constructivist/ developmental/ socio-cultural perspective.

METHODOLOGY

Selection/Exclusion of Studies

Based on the criteria described in Chapter One, an initial set of 26 studies was reviewed for inclusion. We excluded 11 studies from the final set for the following reasons: (1) the intervention used was either insufficiently developed or not clear, or multiple strategies were used without differentiation among these strategies (n = 6); (2) although the approaches identified were used in classrooms, the broader focus of the intervention (systemic) rendered it too complex for classroom implementation (n = 2); and (3) the research was compromised by design flaws and other biases such that the results could not be trusted (n = 3).

Subcategories within General Instruction

As previously mentioned, studies in the area of general instruction are conceptually conceived of as comprised by two subcategories: behaviorism and constructivism. Of the 15 studies that met inclusion criteria, we identified 10 studies as behaviorist and five studies as constructivist.

One approach to teaching and learning presented in this chapter corresponds to an underlying belief that students should be taught discrete skills through linear, somewhat scripted, and explicit instruction. Teachers and/or external agents (e.g., materials, computer programs) serve as the purveyors of knowledge and act as bearers of the skills and rules necessary for mastery. Researchers and educators label this a behaviorist approach (Oakes, 1986). The second approach — a constructivist approach — stresses the value of interaction (learners construct knowledge with teachers or peers in the social context) and endorses weaving students' experiences into teaching and learning activities (Oakes, 1986). Typically, the importance of "meaning making" is elevated over the importance of learning discrete skills. Historically, these approaches have been cast into a dichotomy; however, approaches to teaching and learning often are grounded in a more pragmatic tact than a theoretical or philosophical one. Consequently, some educators have blended characteristics from these two theories of knowledge. For purposes of this research synthesis, studies with this blend are presented as a constructivist approach. The remainder of this chapter provides further detail of the conceptual subcategories and the studies included in each.

BEHAVIORIST APPROACHES

Given the long history of behaviorist approaches to teaching, it is not surprising to find that a large number of studies have been conducted around the efficacy of the many approaches derived from this theoretical perspective. Proponents of compensatory education have suggested that learning the basics is foundational, that mastering the basics is essential to developing advanced skills. Most advocates of behaviorist strategies (at least implicitly) embrace the assumption that knowledge is incremental and discrete. Despite the large body of evidence about such programs, we did not include many of these

studies because they did not examine the impact of the intervention on student achievement, because the primary focus was not low-achieving students, or because the interventions were conducted and studied outside of the regular classroom.

One behaviorist strategy captured in this review is explicit instruction, which represents many of the strategies housed within a broader behaviorist tradition. These models represent

> a structured approach to teaching which uses scripted formats, extended practice and review, a fast pace of instruction, and student responses. . .[it] takes children through learning steps systematically, helping them see both the purpose and the result of each step. . . . Direct instruction does not mean repetition. It does mean leading students through a process and teaching them to use that process as a skill to master other academic tasks. (Lewis, Wilson, & McLaughlin, 1992, p. 264)

Other approaches classified in the behaviorist subcategory include less prescriptive approaches with a primary reliance on materials or structured experiences to facilitate learning and approaches requiring repeated practice.

Behaviorist approaches sometimes seem to infuse constructivist ideas — for instance, students may be placed in dyads or small groups — however, for the most part the components of explicit instruction associated with this approach prevail: independent practice, memorization of vocabulary or computations, use of worksheets and guided practice, and a perspective of teacher as bearer of knowledge and skills.

For instance, phonics-based instruction tends to stress learning in teacher-directed incremental steps that are relatively scripted; typically these phonics-based approaches are behaviorist in nature. In a review of research, Ebaugh (2000) suggests that the past 30 years have produced compelling evidence that phonological skills are a strong predictor of the facility with which students learn to read and that early intervention (prior to third grade) in remedial skills is crucial to effecting positive results. The phonological skills considered most critical for students to grasp are awareness of sounds and letters, memory, and decoding. Other researchers have offered similar prognoses for children who fail to reach basic language proficiency in their early development. For instance, Clapp (cited in DiChiara, 2001) "found that children who fail to develop proficiency in language during the first years of life are up to six times more likely to experience reading problems when they go to school" (p. 2). However, based on the research reviewed herein, we are unable to make strong claims related to the overall efficacy of such incremental, guided instruction representative of the behaviorist approach.

Overview of Studies

The majority of studies reviewed in the behaviorist subcategory examined impacts on elementary students (n = 7); one study focused on students at the middle school level; participants in the remaining two studies were in high school (see Table 2.1). In terms of subject matter, all but one of the studies focused — at least in part — on reading; one study examined mathematics. Finally, low-achieving children were defined in various ways — some based on test scores and others based on socioeconomic

background or other predictive indicators. In the next section, details on studies that were coded as high quality or were particularly noteworthy are provided.

Table 2.1. Characteristics of Studies on Behaviorist General Instruction

Author(s) & Year	Treatment size	Grade	Student Description	Strategy Description[a]	Subject Matter	Type of comparison	Results[b]
Foorman, Francis, Fletcher, Mehta, & Schatschneider (1998)	285	1–2	test scores; SES	explicit instruction	reading	3 gps pre-post nonrandom	Mostly positive
George-Remy (1991)	7	K	test scores	explicit instruction; repeated practice	reading	2 gps pre-post nonrandom	All positive
Goldenberg (1994)	24	K	SES	directed materials; additional exposure	reading	3 gps post nonrandom	Even
Gomer (1994)	65	9	SES; test scores	explicit instruction; additional exposure	reading	1 gp pre-post nonrandom	All positive
Hennenfent & Russell (2001)	27	K, 5	SES, test scores	explicit instruction	reading, writing	1 gp post nonrandom; 1 gp post nonrandom	Mostly positive
Jenkins, Jewell, Leicester, Jenkins, & Troutner (1991)	42	1–6	mild disabilities, LD	explicit instruction; in-class assistance	math, reading, writing	2 gps pre post nonrandom	Even
Marseglia (1997)	20	1	test scores	repeated practice	reading	2 gps pre post nonrandom	Even
Morris (1998)	67	9	test scores	explicit instruction; integrated curriculum	math, reading, writing, science, health	1 gp pre post nonrandom	Even
Su (1990)	104	4	test scores	repeated practice	math	1 gp pre post nonrandom	All positive
Turner (1993)	54	6–8	test scores	explicit instruction; additional exposure	reading	1 gp pre post nonrandom	Even

[a]The type of instruction.
[b]The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

Findings

Behaviorist Approach: Direct Instruction. Seven studies included in this review explicitly examined the effects of interventions categorized as direct instruction; however, arguably, all of the studies in the behaviorist subcategory have components of such an approach. These studies examined the

impact of explicit instruction in such areas as decoding, that is, determining the constitutive elements of text and locating elements that facilitate interpretation or inference.

The highest quality study of direct instruction behaviorist approaches among the research reviewed was an exploration of differences among a variety of approaches to reading instruction. Foorman, Francis, Fletcher, Mehta, and Schatschneider (1998) compared the effects of three different decoding strategies to a control group that received the standard district-endorsed instruction. The experimental groups consisted of (1) highly explicit decoding in which phonemic rules were practiced with controlled vocabulary text; (2) an embedded phonics approach in which letter sound and spelling patterns instruction was provided within the context of selected, predictable texts; and (3) implicit decoding, in which feedback on reading literature was provided and meaning was emphasized. Foorman et al. concluded that "instructional intervention makes a difference [but]. . . not all instructional approaches have the same impact" (p. 51). That is, students who were directly instructed in alphabet principles showed more rapid rate of word-reading skill than those children who received indirect instruction. Coupled with a belief that students must learn vocabulary and decoding early in their education and that these skills are fundamental, these findings may suggest a viable means of rapidly training primary school students in the basics of reading.

Other studies included behaviorist interventions (some of which were direct instruction approaches) coupled with additional materials or out-of-school experiences, such as library visits, parental support/at-home guidance. For instance, Goldenberg (1994) reports findings from a follow-up study that examined the impact of general instruction (with little exposure to written texts), highly structured, academic instruction (direct instruction in letters, sounds, words; drills, practice and seat work), or instruction supplemented with predictable Spanish books (used at school and possibly at home) to Spanish-speaking beginning readers. Findings suggest that providing Spanish books resulted in measurable gains in literacy development compared to general instruction (with reported effect sizes of .7 to .8). However, students receiving structured, direct instruction showed even greater gains (with reported effect sizes of 1 to 3).

Another approach that emphasizes the role of external agents (e.g., teacher as guide) has resulted from the decline in use of pull-out programs. Although primarily used with mainstreamed special education students, the use of in-class consultants has been identified as a viable option for teachers of otherwise low-achieving students (Lewis et al., 1992). One study in the set reviewed herein (Jenkins et al., 1991) utilized a classroom consultant to facilitate improvement in skill areas among at-risk students. Unfortunately, it was not possible to determine what the intervention actually was in terms of how in-class consultants interacted with the students.

Of the seven research studies reviewed for this chapter that examined direct instruction methods, only one was rated high quality. Indeed, six failed to adequately control for alternative explanations, particularly gains as a result of normal growth. Consequently, reviewing these approaches must be accompanied by caution regarding the supporting evidence. Several issues emerged with the research studies reporting mixed results regarding efficacy focused on learning the rules through direct instruction in skill areas (e.g., letter-sound associations, decoding strategies, basic phonics principles, word family concepts, punctuation skills, reading skills in isolation and in context, applying text elements, learning

and applying high frequency words, learning and applying vocabulary skills, learning and applying phonemic rules, and learning and applying figurative language).

Behaviorist Approach: Repeated Instruction. Another intervention showing moderate effects was repeated practice — having students practice and receive feedback in both reading and mathematics until mastery is achieved. The assumption with these approaches is that repeated exposure (sometimes coupled with explicit instructions) will increase skill levels or comprehension (George-Remy, 1991). Obviously, repeated-practice strategies can be creatively approached; some interventions utilized within- and between-class competitions in conjunction with flashcards and structured recall episodes (Su, 1990); others used audio-taped student storytelling in conjunction with listening to stories, reading aloud with a peer partner, or round robin reading (Gomer, 1994; Marseglia, 1997). However, given the number of design flaws associated with the research reviewed on these interventions, additional research is certainly warranted. These flaws included failing to sufficiently report data, failing to take into account pre-test scores or account for subject maturation, or drawing unsupported inferences about the treatment (mismatch between evidence and claims).

CONSTRUCTIVIST APPROACHES

Proponents of the constructivist view of teaching and learning believe that "concepts are not something given to the child but rather are constructed by the child who interacts with that environment" (Means & Knapp, 1991, p. 9). Moreover, they resist embracing a deficit view of low-achieving students that

> focuses on the inability of at-risk students to complete tasks and encourages decomposing complex tasks into . . . levels of ability that are structured linearly from lower-level . . . skills like spelling and punctuation to higher level . . . intellectual processes like synthesis or critical analysis. (Bryson & Scardamalia, 1991, p. 155)

As opposed to using closed-ended questions about known information and recounts of text or formulae such as round robin reading, orientation questions focused on vocabulary, guidance in decoding, and rote memorization, interventions falling into this subcategory encourage students to engage with texts and to attempt to understand at a deeper level.

Overview of Studies

All five studies reviewed in the constructivist subcategory examined impacts on elementary students (see Table 2.2). In terms of subject matter, all of the studies collected data on reading or writing; one study examined mathematics achievement as well. As in the studies of behaviorist approaches, at-risk children were defined in these studies in a variety of ways. In the next section, details on studies that were coded higher quality or were particularly noteworthy are provided.

Table 2.2. Characteristics of Studies on General Constructivist Instruction

Author(s) & Year	Treatment size	Grade	Student Description	Strategy Description[a]	Subject Matter	Type of Comparison	Results[b]
Brown, Pressley, Van Meter, & Schuder (1996)	30	2	test scores; grades; teacher assessment	meaning-based instruction	reading	2 gps pre post nonrandom	Mostly positive
Knapp, Shields, & Turnbull (1992)	NA (140 classrooms)	1–6	test scores	meaning-based instruction	math, reading, writing	2 gps pre post nonrandom	Mostly positive
Simmons, Fuchs, Fuchs, Mathes, & Hodges (1995)	29	2–5	test scores	balanced	reading	2 gps pre post nonrandom	Even
Sylva (2000)	105	2	LD or teacher assessment	balanced	writing	2 gps pre post nonrandom	Even
Wolf (1998)	17	3–4	school identified for pull out or remedial	interactive	reading	qualitative	Even

[a]The type of instruction.
[b]The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

Findings

In general, the research in this area examined attempts to emphasize meaning and eschew behaviorist methods (such as direct instruction) or attempts to infuse some behaviorist strategies within a predominantly constructivist approach. We rated all of the studies included in this subcategory as high or mid to high quality.

The most compelling evidence for constructivist approaches to teaching is offered by a study coded as high quality in which researchers engaged in a three-year study of 140 classrooms in 15 schools (Knapp et al., 1992). Researchers categorized teachers' existing practices as either traditional (behaviorist) or alternative (constructivist). Knapp and his associates found that, regardless of subject area, instruction that emphasized meaning and understanding led to greater gains in advanced skills (e.g., mathematical understanding, problem-solving ability, reading comprehension, written expression). Moreover, findings suggested that an emphasis on meaning worked "at least as well for low-performing as high-performing students" (p. 27). The researchers viewed this as evidence counter to the notion that skills building is foundational to advanced understanding. Moreover, the researchers found that the amount of instructional time, the time spent teaching discrete skills, and individual characteristics of teachers did not independently account for the findings. However, they did find that outcome scores related to student learning were impacted by poverty-related factors such as support at home and understanding of school culture.

Wolf (1998) worries that packaged "skill and drill" programs, although perhaps useful for inculcating socially acceptable classroom behaviors, fail to engage students in deeper understanding. She suggests that when the act of reading is viewed simply in terms of comprehension of text, the implicit assumption is always that the meaning inheres in the text itself and that there are no other interpretations of author intent, author meaning, or ways that one could connect the text to one's own experiences. Wolf reported on classroom theatre as an alternative approach to teaching literacy in a qualitative study coded as having mid-level quality. She examined impacts in terms of enhancing low-achieving students' reading and comprehension skills by building connections through text interpretations. Although Wolf's results were mixed with respect to longer term benefits of the approach, she continues to argue for the use of an alternative method of teaching literacy, while conceding that such experiences need to be accompanied by additional structure. She suggests that those skills formerly considered prerequisites (e.g., structural elements, grammar, phonics) may not develop naturally in authentic (real-world) contexts, thus some blend with behaviorist strategies may be most beneficial.

In a study rated mid to high quality that compared a blended approach to instruction (explicit instruction combined with a reflective dialogue journal) with a wholly constructivist approach (reflective journal) among students in the primary grades, Sylva (2000) found no significant differences over time in achievement scores. However, the researcher also noted that problems with treatment fidelity likely impacted findings. That is, Sylva suggested that teachers may not have maintained a completely blended approach or a completely constructivist approach. Other examinations of the impact of direct or explicit teaching provided some evidence against strictly behaviorist approaches. One such study rated as high quality indicated "no reliable independent effect" for explicit teaching (Simmons et al., 1995, p. 401) when students receiving explicit teaching were compared with students either receiving a combination of behaviorist and constructivist approaches (blending explicit teaching and peer tutoring) or students in a control group. The researchers found that breaking student tasks into small steps with repeated practice was no more effective for low-achieving students than other approaches. It is important to note, however, that Simmons and colleagues were unable to ensure the fidelity of teaching approaches; that is, some teachers who were trained to teach explicitly failed to teach more explicitly than control group teachers.

On the other hand, other research studies have provided evidence that blended approaches — perhaps more patchwork-like strategies in which inclusion of constructivist modalities is inconsistent — may not be as effective as wholly constructivist approaches. Brown et al. (1996) compared the effect of "transactional teaching" (linking reading to prior knowledge, reading in groups toward co-construction of knowledge, and group engagement to co-determine one another's meanings about texts) with conventional teaching (represented by an amalgam of behaviorist and constructivist approaches). The researchers of this study rated as high quality found positive short- and long-term impacts in terms of student acquisition of information, understanding and personalization of material, awareness of strategies, and reading comprehension among teachers using the transactional teaching approach.

Across the five constructivist studies reviewed for this chapter, the combined findings of two of the studies found that low-achieving students benefited as much as their higher achieving counterparts by instruction that emphasized meaning construction and that repeated practice and learning in steps did not provide an additional advantage. However, blended approaches that used both behaviorist-like strategies

and constructivist-like strategies for instruction also were shown to work with at-risk students. Future research efforts that not only compare the efficacy of wholly behaviorist approaches, wholly constructivist approaches, and a blend of these, but also control for factors such as degree of teacher adherence to the approach, are needed.

SUMMARY OF FINDINGS ACROSS STUDIES OF GENERAL INSTRUCTION

It is obvious from this synthesis of research categorized as General Instruction that little evidence exists to demonstrate the efficacy of different approaches under varied contexts and characteristics of students. Given our focus, unfortunately we do not have a large enough body of evidence to suggest whether behaviorist strategies are superior to constructivist strategies or vice versa. Nor do we have sufficient data to support claims about the efficacy of a blended approach. It is important to note again that behaviorist approaches to instruction may have merit, but only a small number of studies met the inclusion criteria for this chapter of the review. Of those studies falling in the behaviorist subcategory, only one was coded as high quality and two as mid-level quality. On the other hand, all five of the studies comprising the constructivist subcategory were coded as either high or mid to high quality. Claims or recommendations for or against behaviorist or constructivist subcategories are clearly not warranted given the body of evidence reviewed. Much has been said about both of these conceptual understandings of teaching and much remains to be discovered. Comparative studies that carefully examine these two approaches should be consulted.

On a socio-political level, arguments against behaviorist approaches suggest that teachers embracing a deficit perspective of low-achieving students are more directive, teach discrete and isolated facts, and offer few opportunities for exercising higher order thinking. For constructivists, this view of learners further disadvantages low-achieving students — their peers progress, but they are held back until they master the basics. Thus, the gap between high- and low-achieving students widens. At-risk students may begin to equate rote skills and rules with learning rather than viewing learning as a process that includes higher order thinking skills and active engagement (Palinscar & Klenk, 1991). Additional attention to the differential impacts of varied instructional approaches for diverse students may provide necessary information about the intended and unintended consequences of adopting such approaches.

Naturally, proponents of behaviorist approaches have strongly attacked constructivists for failing to meet the needs of all children in neglecting the basics. Other counter-arguments to constructivist approaches suggest that failing to provide at-risk students with instructional leaders places them at a further disadvantage because their access to teachers as sources of knowledge is effectively cut off (Palinscar & Klenk, 1991).

A FINAL WORD TO PRACTITIONERS

Behaviorist approaches to instruction are typically characterized by instructors delivering information to students, students engaging in independent learning, and students practicing and receiving feedback regarding their acquisition of the target set of skills. Tasks are typically broken down into smaller units to facilitate learning — though expository teaching (providing *explanations* of facts and

ideas) also may be present (Woolfolk, 1998). On the other hand, constructivist approaches to instruction consist of instructors facilitating the discovery of information, learning situations that are authentic, and students engaged in collaborative learning activities aimed at the co-construction of meaning. Students are encouraged to be active discoverers and cooperative learners, and the relationship between teaching and learning is viewed as reciprocal and collaborative (Woolfolk, 1998).

Philosophically, the schism between these approaches to instruction runs deep. Although the pendulum continues to swing between strong behaviorist and strong constructivist approaches to teaching and learning, some have opted to take a middle ground and borrow components or aspects of what seems to work from both sides. For instance, Danoff, Harris, and Graham (1993) suggest that a body of research "demonstrates that many students with learning problems do not acquire a variety of cognitive and metacognitive strategies unless detailed and explicit instruction is provided" (p. 297). Likewise, Resnick, Bill, Lesgold, and Leer (1991) maintain that approaches embracing "more careful explanations, more practice, and more frequent testing to monitor progress . . . seem to work — up to a point" (p. 27). The incorporation of direct strategy instruction within classrooms that also honors students' context may be what works. This balanced approach would carefully consider *what* should be taught explicitly versus whether to teach explicitly (McIntyre, 1995), yet also consider *how* to capitalize on life experiences and discovery. It is to these questions and concerns that we will be continually drawn.

Readers interested in learning more about behaviorist approaches to instruction may wish to consult Bransford, Brown, and Cocking (2000) or Woolfolk (1998). Each of these study provides a broad overview of theories of learning, their history, and their application in the classroom, as well as additional details about specific approaches and references to foundational works. Readers seeking information on Direct Instruction, a behaviorist program outside the scope of this synthesis (see Chapter 1), may find the following resources useful: Adams and Engelmann (1996); Becker and Carnine (1980); Engelmann and Carnine (1991); or Gersten, Woodward, and Darch (1986). Finally, readers interested in constructivist approaches to instruction may wish to consult Oakes and Lipton (1999) or Resnick, Bill, Lesgold, and Leer (1991). Oakes and Lipton provide a comprehensive overview of the constructivist theory of learning and embed it in classroom practice. Resnick and her colleagues provide an historical overview of alternative classroom practices juxtaposed with traditional practices as well as a fairly balanced critique of both perspectives.

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ANNOTATED BIBLIOGRAPHY OF SELECTED REFERENCES

This annotated bibliography provides additional information on studies included in the research synthesis that were identified as being of mid to high quality.

Simmons, D. C., Fuchs, L. S., Fuchs, D., Mathes, P., & Hodges, J. P. (1995). Effects of explicit teaching and peer tutoring on the reading achievement of learning-disabled and low-performing students in regular classrooms. *The Elementary School Journal, 95*(5), 387–408.

In this research study, the authors compared the impact of explicit teaching (a behaviorist approach) with a combination of explicit teaching and peer tutoring (a combination of behaviorist and constructivist approaches). The researchers found explicit teaching approaches (e.g., breaking student tasks into small steps with repeated practice) no more effective for low-achieving students than other approaches. Furthermore, they suggest that general education instruction may prove insufficient for increasing student achievement but that additional teacher training and exemplary instructional conditions may positively impact achievement.

Foorman, B. R., Francis, D. J., Fletcher, J. M., Mehta, P., & Schatschneider, C. (1998). The role of instruction in learning to read: Preventing reading failure in at-risk children. *Journal of Educational Psychology, 90*(1), 37–55.

Foorman and colleagues compared the effects of three different decoding strategies to a control group that received the standard district-endorsed instruction. The experimental groups consisted of (1) highly explicit decoding in which phonemic rules were practiced with controlled vocabulary text; (2) an embedded phonics approach in which letter sound and spelling patterns instruction was provided within the context of selected, predictable texts; and (3) implicit decoding, in which feedback on reading literature was provided and meaning was emphasized. The researchers concluded that instructional interventions do make a difference but that interventions have differential impacts. For instance, students who were directly instructed in alphabet principles showed more rapid rate of word-reading skill than those children who received indirect instruction. The authors thus draw attention to the importance of recognizing the dynamic link between student instruction and student assessment.

Knapp, M. S., Shields, P. M., & Turnbull, B. J. (1992). *Academic challenge for the children of poverty: Study of academic instruction for disadvantaged children. Summary report.* Washington, DC: U.S. Department of Education, Office of Policy and Planning.

Knapp and colleagues describe results from their three-year study of 140 classrooms in 15 schools. To determine whether teaching influences student outcomes, teachers' practices were categorized as either traditional (behaviorist) or alternative (constructivist). The researchers found that, regardless of subject area, instruction emphasizing meaning and understanding leads to greater gains in advanced skills (e.g., mathematical understanding, problem-solving ability, reading comprehension, written expression). Moreover, their findings suggested that an emphasis on meaning works "at least as well for low-performing as high-performing students" (p. 27). The researchers viewed this as evidence opposing the notion that building skills is foundational to advanced understanding. And although the researchers found

that the amount of instructional time, the time spent teaching discrete skills and the individual characteristics of teachers did not independently account for findings, they did find that learning outcomes are impacted by poverty-related factors (e.g., support at home and knowledge of school culture).

Wolf, S. A. (1998). The flight of reading: Shifts in instruction, orchestration, and attitudes through classroom theatre. *Reading Research Quarterly, 33*(4), 382–415.

In this case study of a classroom that elected to approach teaching literacy through interactive classroom theatre as opposed to round-robin reading, Wolf examined impacts on student reading and comprehension skills. Classroom theatre is presented as a means of allowing children to build their own connections with texts and co-construct interpretations of text. Although changes were documented related to improved opinions of reading, increased reading, and successful reading, Wolf's results were mixed with respect to longer term benefits of the approach. The researcher acknowledges that alternative methods of teaching literacy (such as classroom theatre) are not a panacea for complex, orchestrated endeavors such as learning to read but may be best used in conjunction with additional guidance related to learning structural elements, grammar, and phonics.

Brown, R., Pressley, M., Van Meter, P., & Schuder, T. (1996). A quasi-experimental validation of transactional strategies instruction with low-achieving second-grade readers. *Journal of Educational Psychology, 88*(1), 18–37.

In a quasi-experimental study, Brown, Pressley, Van Meter, and Schuder (1996) compared the effect of "transactional teaching" (linking reading to prior knowledge, reading in groups toward co-construction of knowledge, and group engagement to co-determine one another's meanings about texts) with conventional teaching (represented by an amalgam of behaviorist and constructivist approaches). The researchers found positive short- and long-term impacts in terms of student acquisition of information, understanding and personalization of material, awareness of strategies, and reading comprehension for teachers using the transactional teaching approach. Indeed, Brown and colleagues suggest that the second-grade students in the transactional reading group lessons learned more daily compared to their conventional counterparts and showed better performance on standardized tests over the course of the year.

CHAPTER 3

COGNITIVELY ORIENTED INSTRUCTION

Helen S. Apthorp

Critics of compensatory education highlight the absence of opportunities for students to develop higher order problem-solving and reading comprehension abilities (Means & Knapp, 1991a). Observers of classroom instruction under this model report unnecessary repetition of content through drill and practice, an overemphasis of teacher-directed, whole-group instruction, and few questions and little discussion about complex issues. To some observers, these classroom practices have resulted in student passivity (Waxman, Padrón, & Arnold, 2001). Cognitively oriented instruction, on the other hand, emphasizes learning as an active process, assumes that students need to apply cognitive strategies in order to learn, and views teaching as a means of facilitating active student mental processing (Waxman et al., 2001). This chapter focuses on cognitively oriented approaches to instruction as a means for raising achievement of low-achieving or at-risk students.

BACKGROUND

In this chapter, cognitively oriented instruction is defined broadly to include instruction designed to help students improve the quality of their thinking, become independent learners, and develop proficiency at accomplishing complex, higher order, academic tasks (Andrews, Short, & Mulcahy, 1991; Jones, 1986; Pressley, Woloshyn, & Associates, 1995). These goals are congruent with the goals of standards-based education. In all content areas, standards specify deep understanding of important concepts and principles and disciplined, expert thinking as learning targets. All children deserve an education that improves the quality of their thinking and prepares them to be lifelong learners.

Cognitively oriented instruction has the potential to inspire students' initiation and use of powerful strategies, such as recognition of task demands, planning ahead, visual imagery, verbal elaboration, systematic problem solving, and self-checking. Cognitively oriented instruction refers to the same approach Waxman et al. (2001) call "cognitively guided instruction." In this chapter, we use the term "cognitively oriented instruction" because "cognitively guided instruction" is the term usually associated with Cognitively Guided Instruction (GCI), an approach specific to mathematics instruction (Peterson, Fennema, & Carpenter, 1991). The research cited by Waxman et al. (2001) supporting the effectiveness of this approach primarily involved English Language Learners (e.g., Padrón & Knight, 1989). The present review extends Waxman's et al. (2001) review by including studies on the effectiveness of cognitively oriented instruction for low-achieving or at-risk students other than English Language Learners.

Cognitively oriented instruction includes both metacognitive and cognitive strategies. These strategies serve three common functions across different content areas: (1) planning/preparation and idea generation, (2) guidance on "how-to" accomplish tasks, and (3) self-regulation. In the literature, strategies serving the first and third functions are described as *metacognitive*, that is, they involve thinking about

one's own thinking and task demands. Strategies serving the second function are described as *cognitive*, that is, they are the mental processes themselves. The distinction between metacognitive and cognitive strategies, however, is often vague and changing. Strategies for reading comprehension, for example, once considered cognitive (e.g., establishing a purpose for reading), are now considered metacognitive (Dickson, Collins, Simmons, & Kameenui, 1998).

Cognitively oriented instruction also has four instructional components: (1) presentation of strategies (through modeling, explicit teaching, or self-reflection and self-report); (2) exercise of strategies (e.g., through guided and independent practice); (3) strategy evaluation, reflection, and feedback (provided through instructional conversations and/or cooperative work groups); and (4) the social and emotional qualities of the strategies and learning tasks. Cognitively oriented instruction "encourages teachers to focus on affective, motivational, metacognitive, developmental, and social factors that influence students because they all occur simultaneously and are all critical to students' learning" (Waxman et al., 2001, p. 142).

In this chapter, we first present our methodology for identifying and including/excluding studies in this review. Next we provide an overview of the included studies, describing their study characteristics and results. More detailed review of the studies, their findings, and the implications for classroom practice are provided under three subcategory headings: Cognitively oriented instruction in (1) Reading, (2) Writing and Oral Language, and (3) Mathematics. In each subcategory, both the content of the strategy instruction and the methods or components of instruction included in the interventions are described and a review of the evidence on their effectiveness is provided.

METHODOLOGY

Selection/Exclusion of Studies

This chapter synthesizes research evidence on cognitively oriented instruction, including ideas from theoretical articles that explain and define the construct of cognitively oriented instruction, evidence from prior research reviews, and evidence from primary studies. In all, four reviews and 15 primary studies were included. Of the four reviews, one addressed reading comprehension in particular (Dickson et al., 1998), and the other three addressed cognitively oriented instruction across the content areas (Means, Chelemer, & Knapp, 1991; Pressley et al., 1995; Waxman et al., 2001).

To be included in the present review, primary studies had to meet the criteria identified in Chapter 1. An initial set of 43 studies was reviewed for inclusion; of these, 15 are included in this chapter. Of the 28 studies excluded from the final set, 14 were excluded for failing to meet the criteria identified in Chapter 1. Fourteen other studies were excluded because the instruction being studied was not cognitively oriented instruction. Instead, these excluded studies examined instruction that was (1) characterized as whole language; (2) designed primarily to utilize multimedia, background music, and/or manipulatives; or (3) designed to tailor instruction to different learning styles.

Overview of Primary Studies

Table 3.1 summarizes the characteristics of the set of 15 primary studies.

Table 3.1. Studies on Cognitively Oriented Instruction for Low-Achieving Students

Author(s) &Year	Treat-ment Size	Grade	Student Description[a]	Subject Matter	Type of Comparison	Results[b]
Bottge (1999)	17	8	Low-achievers	Mathematics	2 grps pre-post nonrandom	Mostly positive
Brown (1995)	55	8	At-risk	Content-area reading	1 grp pre-post nonrandom	Mostly positive
Brown, Pressley, Van Meter, & Schuder (1995)	30	2	Low-achieving	Reading	2 grps pre-post nonrandom	All positive
Cardelle-Elawar (1990)	80	6	Low-achieving	Mathematics	8 grps pre-post random	Mostly positive
Dermody (1988)	14	4	Low-achieving	Reading	6 grps pre-post random	Mostly positive
Dimino, Gersten, Carnine, & Blake (1990)	32	9	Low-achieving	Reading	2 grps pre-post random	All positive
Englert, Raphael, Anderson, Anthony, & Stevens (1991)	52	4 & 5	Low-achievers	Writing	3 grps pre-post nonrandom	Mostly positive
Guastello, Beasley, & Sinatra (2000)	62	7	Low-achieving	Content-area reading	2 grps pre-post nonrandom	Mostly positive
Jakupcak, Rushton, Jakupcak, & Lundt (1996)	107	High school	LD and low-achievers	Content-area reading	1 grp pre-post nonrandom	Mostly positive
Ketter & Pool (2001)	23	9	Low-achieving	Writing	1 grp pre-post nonrandom	Mostly positive
McLain (1991)	108	3 & 5	At-risk	Reading	3 grps pre-post nonrandom	Even
O'Malley, Chamot, Stewner-Manzanares, Russo, & Kupper (1985)	53	High school	ELL	Oral language	3 grps pre-post random	All positive
Spiegel, Jackson, Graham, & Ware (1990)	17	6	At-risk	Reading	2 grps pre-post random	Mostly negative
Waxman, deFelix, Martinez, Martínez, Knight & Padrón (1994)	52	1 to 5	ELL	Reading	3 grps pre-post nonrandom	Mostly negative
Wong, Butler, Ficzere, & Kuperis (1996)	18	8 & 9	LD and low-achieving	Writing	2 grps pre-post nonrandom	Mostly positive

[a] *Low-achieving* refers to students performing below grade level or below average on achievement tests or who met eligibility criteria for remedial classes or Title I. *At-risk* refers to students in urban or rural schools and identified in the report as at-risk. *LD* refers to students receiving special education support for identified learning disabilities. *ELL* refers to students learning English as a second language.

[b] The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

As can be noted, nearly all the studies were published in the 1990s. The size of the treatment group in seven studies included between 30 and 62 students; the other treatment group sizes ranged above and below this, from 9 to 107 students. Five studies were conducted at the elementary level (grades 1–5); ten studies, at the secondary level (grades 6–12). The majority of the studies involved low-achieving, learning-disabled, or at-risk students. Subject matter in the majority of the studies was reading, either as part of English language arts or content-area instruction. Four studies focused on written or oral language; two studies focused on mathematics. The majority of studies were quasi-experimental with nonrandom assignment of students to treatment and control conditions. One study (Ketter & Pool, 2001) involved a qualitative research design. Finally, the majority of results were positive, that is, posttest scores were higher for students who received cognitively oriented instruction compared to those who did not.

This review focuses first on the evidence of the effectiveness of cognitively oriented instruction on reading. Conclusions from a prior review of research are summarized, followed by a synthesis of findings from studies not included in the prior review. Implications for practice also are discussed. Findings and implications for practices are then discussed with regard to studies of the effectiveness of cognitively oriented instruction in writing and oral language and, finally, in mathematics.

COGNITIVELY ORIENTED INSTRUCTION IN READING

In 1998, Dickson et al. reviewed 22 research articles on cognitively oriented instruction for improving the reading comprehension of diverse learners. Dickson et al. included eight theoretical and descriptive articles and 14 empirical studies. In five of the empirical studies, Dickson et al. found that low-achieving students, but not normally achieving students, benefited from instruction that taught students two or more metacognitive strategies, or a combination of metacognitive and cognitive ("how-to") strategies. Instruction that taught both planning and self-regulatory strategies, or combined either planning or self-regulatory strategies with "how-to" strategies, had a positive influence on low-achieving students' reading comprehension. The common "how-to" strategies found to be effective were summarizing, identifying main ideas, using visual imagery, and mapping elements and concepts of texts (Dickson et al.).

Additionally, Dickson et al. (1998) found that for low-achieving students, teachers' attention to two or more instructional components was more effective than attention to one component. For example, for remedial readers, modeling the target strategy plus providing feedback on the results of strategy use was more effective for enhancing reading comprehension than modeling alone (Schunk & Rice, 1992, as cited by Dickson et al.). Strategy-value feedback involves showing or telling students how performance on comprehension tasks is linked to productive or less productive strategy use. Consistent with Dickson's et al. findings, Pressley and Harris (1990) claim that "students need to see evidence that the strategies they are learning really do lead to improved performance. Nothing motivates students to use a strategy like seeing that the strategy increases competent completion of an important task" (p. 33). Moreover, Dickson et al. concluded that to present combinations of strategies, implement multiple components of instruction, and for students to practice new strategies sufficiently, ample time must be allocated to cognitively oriented instruction in reading for low-achieving students.

For the present review, we found nine primary studies not included in or cited by Dickson et al. (1998). Analyses of findings from these studies confirmed Dickson et al.'s conclusions.

Overview of Studies

Table 3.2 summarizes the nature of the interventions and outcomes in the nine primary studies included. The studies in Table 3.2 are listed according to the direction of the results. Thus, from the top to the bottom of Table 3.2, studies with all positive results are listed first, followed by studies with mostly positive results, followed by studies with even results, followed by studies with mostly negative results. In each study, the direction of results refers to a comparison of the treatment group's performance versus the comparison group's performance on the posttest (where treatment involved participation in cognitively oriented instruction).

Table 3.2. Content and Components of Cognitively Oriented Instruction in Reading for Low-Achieving or At-Risk Students

Author(s) & Year	Strategy Content	Instructional Components	Results[a]
Dimino, Gersten, Carnine, & Blake (1990)	How to analyze story grammar and generate theme statements	Purpose of strategy stated; strategy modeled; explicit explanations; peer-guided practice; sample theme statements given	All positive
Brown, Pressley, Van Meter, & Schuder (1995)	Active reading strategies (identify genre; assess difficulty; predict/revise; ask & answer questions; visualize; summarize; problem-solve words)	Instructional conversations about strategies; peer-guided and independent practice	All positive
Dermody (1988)	Comprehension strategies (predict/evaluate; clarify; summarize) and analysis of task demands	Modeling and explicit explanations; peer-guided and independent practice	Mostly positive
Brown (1995)	Reading strategies (e.g., K-W-L; READ — read, encode, annotate, ponder)	Peer mentors; new criterion identified and used to recognize high quality student work	Mostly positive
Jakupcak, Rushton, Jakupcak, & Lundt (1996)	Use of mnemonics, concept mapping, RAP (Read, Ask questions; Put in own words), visualization, learning styles identified	Could not be determined.	Mostly positive
Guastello, Beasley, & Sinatra (2000)	Semantic mapping and use of map to study for test	Modeling; explicit explanation; assisted practice; no independent practice	Mostly positive
McLain (1991)	Predict/revise; self-monitoring understanding	Checklist of steps and reminders	Even
Spiegel, Jackson, Graham, & Ware (1990)	Mapping main idea & details	No guided or independent practice; no evaluation of or feedback on strategy usage	Mostly negative
Waxman, deFelix, Martinez, Knight, & Padròn (1994)	Verbalization, problem solving, imagery, graphic mapping	Inquiry-based instructional approaches	Mostly negative

[a]The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

Two of these studies met our criteria for high-quality studies (Dimino, Gersten, Carnine, & Blake, 1990; Brown, Pressley, Van Meter, & Schuder, 1995). Four met our criteria for medium quality

(Dermody, 1988; Guastello, Beasley, & Sinatra, 2000; Spiegel, Jackson, Graham, & Ware, 1990; Waxman, deFelix, Martínez, Knight, & Padròn, 1994). Three studies did not meet these criteria. In one of these studies (Brown, 1995), there was no comparison or control group, and thus, maturation could have explained the mostly positive gains from pre- to posttest. In the remaining two low-quality studies (Jakupcak, Rushton, Jakupcak, & Lundt, 1996; McLain, 1991), there was insufficient information reported to assess threats to statistical conclusions (e.g., no mean scores or standard deviations were reported, and the covariate was mentioned but not identified). The following analyses and review are based on the six studies meeting our criteria for medium or high quality.

Findings

A comparison of the top and bottom two studies presented in Table 3.2 suggests a distinguishing feature of effective cognitively oriented instruction in reading. In both Dimino et al. (1990) and Brown et al. (1995), with all positive results, but in neither Spiegel et al. (1990) or Waxman et al. (1994), with mostly negative results, the strategies taught included *both* task planning/preparation strategies *and* "how-to" strategies. In the Dimino et al. and Brown et al. studies, students learned to plan or prepare for an upcoming reading task by analyzing the story's structure and/or identifying its genre and assessing task difficulty. Additionally, the students learned how to generate theme statements or ask and answer questions and summarize. In contrast, the strategies taught in the Spiegel et al. and Waxman et al. interventions included *only* "how-to" strategies (e.g., mapping and verbalization of ideas and details). This contrast in the content and results of the interventions match Dickson's et al. (1998) conclusion that teaching students combinations of metacognitive and cognitive strategies brings about improved reading performance for low-achieving students.

Moreover, the positive results of the Dimino et al. (1990) and Brown et al. (1995) studies were associated with interventions characterized by use of multiple instructional components. The instruction in the Dimino et al. study involved strategy modeling, explicit explanation of strategies, and student-guided and independent practice. The Brown et al. intervention, termed "transactional strategies instruction," involved instructional conversations about strategy use and peer-guided and independent practice. Students reading below grade level participated in both of these studies. In both studies, the comparison groups received conventional reading instruction (i.e., an emphasis on phonics and skills for the second graders in the Brown et al. study and implementation of lessons and discussion questions as scripted in the teachers' manual for the ninth graders in the Dimino et al. study).

The effectiveness of the cognitively oriented instruction in the Brown et al. (1995) study may be attributed to two particular factors in addition to the nature of the strategy content and use of multiple instructional components. The duration of the intervention was long, lasting a full academic year; second, the teachers were highly experienced in using the approach, with at least three years prior experience using transactional strategies instruction.

Importantly, in the Dimino et al. (1990) study, interaction effects were found. When posttest results were disaggregated by pretest achievement (measuring recognition of story grammar components), the positive results for the cognitively oriented instruction were found to be significant *only* for those students who performed low initially. Although all students were reading at least one year below grade,

only the students showing poor story grammar recognition, per se, benefited from this particular form of cognitively guided instruction. In practice then, these findings suggest that in order to accommodate the diverse learning needs of students, in addition to story grammar analysis, a variety of strategies should be taught, including, for example, theme generation, summarization, and asking and answering questions. Other ways to accommodate diverse learning needs include using a variety of text types, including narrative texts, informational texts, and other expository texts.

Summary

To summarize, in reading, research evidence indicates that effective cognitively oriented instruction has the following characteristics:

1. Combinations of metacognitive and cognitive strategies are taught (e.g., planning ahead and summarizing).
2. Multiple instructional practices are used (i.e., modeling and explicit explanation of strategies, instructional conversations about strategy use, and peer-guided and independent practice).

The evidence also suggests that practitioners should take care when addressing the needs of low-achieving students not to ignore the needs of students who are proficient. To accommodate diverse needs, practitioners should teach multiple types of strategies and use multiple texts. Finally, one uncertainty remains. The effectiveness of complex cognitively oriented instruction in reading (such as Brown et al.'s [1995] transactional strategy instruction) when teachers try it out for the first or second time is unknown. More than a single year of practice and professional development may be needed before cognitively oriented instruction in reading positively impacts student achievement. This issue of sufficiency of teacher preparation and professional development needs to be addressed in future research.

COGNITIVELY ORIENTED INSTRUCTION IN WRITING AND ORAL LANGUAGE

Overview of Primary Studies

With respect to writing and oral language, four studies addressed the effectiveness of cognitively oriented instruction for low-achieving students. These four studies are summarized in Table 3.3. Each of these four studies met our criteria for medium- or high-quality research. The O'Malley, Chamot, Stewner-Manzanares, Russo, and Kupper (1985) study focused on improving oral language, while the other three studies focused on improving writing.

Findings

O'Malley et al. (1985) conducted two experiments, one examining the effectiveness of cognitively oriented instruction for oral presentation skills and one examining the effectiveness of cognitively oriented instruction for listening comprehension. Participants in the O'Malley et al. study were English Language Learners (ELLs) performing at a beginning or intermediate level of English proficiency. In the oral presentation experiment, students were randomly assigned to one of three groups:

(1) metacognitive instruction and cooperative work groups, (2) cooperative work groups alone, or (3) a control group. Students in the metacognitive instruction and cooperative work group were taught functional planning, that is, they learned to identify the task demands of an oral presentation assignment, self-assess their knowledge of the language elements needed to meet those demands, and acquire the language elements they identified as missing. Additionally, in this group, students worked cooperatively rehearsing, providing corrective feedback, and polishing their oral presentations. Students in the second group worked cooperatively rehearsing, providing corrective feedback, and polishing their oral presentations, but were not given metacognitive instruction. Students in the control group were told to prepare oral presentations as they normally would. All students prepared multiple presentations about topics they selected from a list of six possible topics.

Table 3.3. Content and Components of Cognitively Oriented instruction in Writing and Oral Language for Low-Achieving or At-Risk Students

Author(s) & Year	Strategy Content	Instructional Components	Direction of Results[a]
O'Malley, Chamot, Stewner-Manzanares, Russo, & Kupper (1985)	Functional planning (identify task demands); self-assess; selective attention	Peer review of draft presentations using specified criteria	Mostly positive
Englert, Raphael, Anderson, Anthony, & Stevens (1991)	Analysis of text structure; self-regulatory questions (e.g., "What do I know?"); planning, drafting, and revising strategies with peer feedback	Modeling, think aloud, think-sheets, instructional conversations about writing strategies; group, guided, and independent practice	All positive
Wong, Butler, Ficzere, & Kuperis (1996)	How to plan, draft, and revise opinion essays	Modeling, think aloud, plan-sheets, peer-guided practice	Mostly positive
Ketter & Pool (2001)	Formulaic process (TAPF = Topic, Audience, Purpose, and Form); use of Think-abouts for idea generation	Guided and independent practice, evaluation and feedback	Mostly positive

[a]The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

At posttest, the students who received the metacognitive instruction *and* participated in cooperative work groups gave significantly higher quality oral presentations than the control group students (O'Malley et al., 1985). In particular, the former groups' oral presentations were rated significantly higher on the dimension of organization as measured by more clear subordination and sequencing of ideas. Students in the cooperative work groups alone also produced higher quality oral presentations, but did *not* achieve higher ratings on organization. Thus, the combination of learning how to analyze and prepare to meet task demands plus opportunity to prepare and polish presentations with peer feedback resulted in significantly improved performance.

In the O'Malley et al. (1985) listening experiment, students were randomly assigned to one of three groups: (1) metacognitive instruction in listening (i.e., use of selective attention) and cooperative work groups to verify what they heard, (2) cognitive strategy instruction in listening (i.e., notetaking) and cooperative work groups to verify their notes, and (3) a control group for which students were told to listen and prepare notes as they normally would for a lecture. On the listening comprehension posttest, neither the metacognitive nor the cognitive groups significantly outperformed the control group.

O'Malley et al. attributed the lack of positive impact to the difficulty of the listening tasks given the unfamiliarity of the content. Since the lecture was so unfamiliar to all of the student participants, the students derived little help from one another or from practicing selective attention and/or notetaking.

The Englert, Raphael, Anderson, Anthony, and Stevens' (1991) study examined the effects of a cognitively oriented strategy instruction approach that combined (1) planning/preparation strategies that involved analyzing and identifying text structures and task demands; (2) self-regulatory strategies with the aid of "think-sheets" ("Who am I writing for?" "What do I know?"); (3) group composition; (4) instructional conversations about writing problems and strategic solutions; and (5) peer sharing, editing, and feedback. This instruction was compared to district writing instruction emphasizing the recursive processes of brainstorming, planning, editing, and revising. Neither instructional conversations about problems and strategic solutions or peer sharing and feedback were included.

Two different types of texts were studied and written: explanation texts and compare-and-contrast texts. On a posttest requiring students to compose an expert text, the cognitively oriented strategy group outperformed the control group even though neither group had been exposed to or taught how to write expert texts. The expert papers written by the strategy-trained students were particularly high on reader sensitivity scores. Englert et al. (1991) attributed this pattern to student participation in peer sharing, editing, and feedback. The public sharing of written compositions reinforced the value of and effort in writing interesting papers.

The Wong, Butler, Ficzere, and Kuperis (1996) study also reported positive results associated with cognitively oriented strategy instruction in writing, but flaws in the designs threatened the validity of concluding that the cognitively oriented strategy instruction per se influenced the experimental students' achievement. Without a novel task administered at posttest (i.e., a writing assignment that neither the strategy group nor the control group had practiced), Wong et al.'s study did not eliminate simple exposure to and familiarity with task demands rather than cognitively oriented instruction as a viable explanation for the results. An analysis of their findings, however, contributes information that helps develop our understanding of the effectiveness of cognitively oriented instruction.

One of the five posttests used by Wong et al. (1996) is notable for its sole nonsignificant results. This particular posttest assessed students' metacognitive awareness about writing, asking for example, "What things does a person have to learn to be a good writer?" and "What goes on in you head when you write?" (Wong et al., p. 201). At posttest, the students in this study who received the cognitively oriented instruction (instruction focused on "how to" plan, draft, and revise essays through modeling, plan-sheets, and peer-guided practice as listed in Table 3.3) nonetheless showed no more insight about the mental strategies involved in writing than students who did not receive cognitively oriented instruction. Notably lacking from Wong et al.'s instruction, but present in other effective instruction (i.e., Brown et al., 1995; Englert et al., 1991), was opportunity to reflect on and engage in conversations about the strategies students were learning and applying. This contrast in content and results suggests that instructional conversations, in particular, may help low-achieving students develop self-awareness and insight about their roles and responsibilities as learners and academic performers.

The fourth and final study in this subcategory by Ketter and Pool (2001) is a qualitative study. They used in-depth interviews, observations, and writing sample analyses to examine the impact of cognitively oriented instruction on students' interpretation of writing and developing proficiency. Ninth-grade students who previously failed the state writing exam participated in this study involving a semester-long course that taught students how to use a formulaic strategy (TAPF) and self-prompts (identify the "think-abouts") to analyze and identify the task demands of a writing prompt and to plan and write a response that would meet criteria for passing. Ketter and Pool's data illustrate how narrow the teachers' and students' interpretation of writing had become as they progressed through this test-preparation course. Although final student writing samples contained the requisite details and structure, they did not reveal the meaning of the experiences that were the topics of the essays, nor did the student writers establish relationships with their audience or explore relationships between ideas expressed in their essays (Ketter & Pool). The teachers were focused on "having students pass the test rather than on having students develop a wide range of writing skills" (Ketter & Pool, p. 384). Although these teachers were successful (98% of the 23 students passed the state writing exam), their instructional approach had its trade-offs. The unintended consequence appeared to be that students learned to write to pass a test, but failed to learn the value of any other kind of writing that required discovery of new meaning or understanding. Other observers have similarly identified trade-offs of standards-based reforms and accountability pressures as a vehicle for improving instruction provided to low-achieving or at-risk students, writing, "While high-stakes tests can motivate schools to try new strategies to raise student achievement, they may also provide a disincentive to adopting richer, more in-depth curricula" (AEL, 2002, p. 3).

Summary

To summarize, evidence indicates that effective cognitively oriented instruction in writing and oral language for low-achieving students has the following characteristics:

1. a combination of strategies for analyzing and preparing to meet task demands are taught;
2. students are given opportunities to prepare, practice, and polish compositions and presentations with peer audiences and feedback; and
3. instructional conversations are conducted allowing students to discuss task difficulties and possible strategic solutions.

Furthermore, evidence indicates that there were trade-offs and/or unintended consequences of effective cognitively oriented instruction. Approaches that over-emphasized task analyses, use of cognitive strategies, and task success often did help students succeed, but appeared to do so at the expense of developing a deeper, more complex, multidimensional, and meaningful understanding of literate behavior. In the O'Malley et al. (1985) listening experiment, students were taught how to use selective attention and learned to take notes, but were not taught how to ask for clarification or what to do when the lecture content was unfamiliar. This approach, therefore, taught cognitive strategies in isolation, failing to acknowledge the academic content. Ketter and Pool (2001) reported a 98 percent success rate on the state writing exam, but student compositions lacked attention to meaningful relationships between ideas. In a

related reading study, the Dimino et al. (1990) study showed that although story grammar analysis instruction was successful for students who had specific difficulties with story grammar, the narrowly focused instruction and selection of reading materials failed to meet the needs of a number of other students in class. Taken together, these findings point to the need to check for and guard against decontextualizing strategy instruction and focusing too narrowly on remediating specific deficits.

COGNITIVELY ORIENTED INSTRUCTION IN MATHEMATICS

In mathematics, cognitively guided approaches to instruction emphasize and support teachers taking an expansive view of mathematical knowledge and thinking by inquiring about and recognizing students' diverse intellectual skills as they enter school or class. This emphasis derives from the conviction that "children from all kinds of backgrounds come to school with an impressive set of intellectual accomplishments" (Means & Knapp, 1991b, p. 286). What is needed is instruction that builds on these accomplishments and complements rather than contradicts what children already know and can do. To address this need, Peterson et al. (1991) developed an approach to mathematics instruction that involves researchers sharing with teachers research-based knowledge about children's mathematical knowledge and thinking and letting teachers themselves interpret what this knowledge means for their instruction. This approach is called Cognitively Guided Instruction (CGI). Having teachers learn how students learn is a defining feature of CGI.[4]

More so than cognitively oriented instructional approaches to reading, the cognitively oriented approaches to mathematics utilize meaningful, whole, everyday tasks from outside the classroom. One way of making tasks meaningful for young children is to use their names in story problems. Another way is to bring everyday problems into the classroom and, from this context, pose questions such as, "Can you afford to build a kite frame given this kite plan, this amount of money, and this particular supply of wood?" (Bottge, 1999). Another distinguishing feature of CGI, in particular, and cognitively oriented instruction in mathematics in general, is recognition, encouragement, and exploration of multiple solutions through dialogue about solutions (Peterson et al., 1991).

Peterson et al. (1991) summarize the findings from a dissertation study by Villansenor on the effectiveness of CGI in first-grade classrooms in inner-city schools. Villansenor compared first-grade students' mathematics achievement over one year under two conditions. In one condition, children attended classes with teachers trained in CGI, and in another condition, children attended classes with teachers trained in problem solving approaches to mathematics instruction. In both conditions, the schools served student populations with an average 79 percent eligible for free and reduced lunch. Children were administered pre- and posttests in problem solving and knowledge of number facts. Using the pre-test as a co-variate to adjust for initial differences in achievement, the students in the CGI condition significantly outperformed students in the comparison classrooms in both problem solving and recall of math facts.

[4] We are grateful to reviewer Robert Floden for making this point about CGI.

The CGI teachers in Villansenor's (as cited in Peterson et al., 1991) study participated in a summer CGI workshop that involved deepening their understanding of different types of word problems, developing assessment practices, and planning how they would use their new knowledge in their classrooms (including listing problem types and developing a tentative unit plan). During the school year, the CGI teachers met once a month on Saturday mornings to share CGI ideas and to talk about implementing CGI in their classrooms. In contrast, control group teachers met twice during the same school year for a one-and-one-half-hour workshop on problem solving once in October and once in January. These contrasting teacher-learning opportunities in association with the positive direction of the CGI student results suggest a critical role for ongoing, discussion-oriented professional development with a focus on classroom implementation. Another mathematics intervention reviewed for the present chapter (Cardelle-Elawar, 1990) also utilized ongoing, discussion-oriented professional development that focused on classroom implementation.

Overview of Studies

Two studies examining cognitively oriented instruction in mathematics, but not CGI per se, were included in this review. The nature of the content and instructional components and the findings from these two studies are summarized in Table 3.4. In both studies, students were randomly assigned to either cognitively oriented instruction or control/comparison condition. Both studies met our criteria for medium- or high-quality research.

Table 3.4. Content and Components of Cognitively Oriented Instruction in Mathematics for Low-Achieving or At-Risk Students

Author(s) & Year	Strategy Content	Instructional Components	Results[a]
Cardelle-Elawar (1990)	Problem type identification; identification of key errors and error types (i.e., language error or computational error)	Pre-test assessment and analysis of knowledge, errors, and strategies; finding exemplars of concepts in classroom environment; explaining pretest results to individual students; metacognitive coaching	Mostly positive
Bottge (1999)	How to read, paraphrase, visualize, hypothesize, estimate, compute and check to solve word problems	Use of contextualized, everyday problems; student work groups (dyads or triads); emphasis on multiple solutions	Mostly positive

[a]The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

Findings

The Cardelle-Elawar (1990) study involved four teachers enrolled in a graduate course on mathematics for bilingual teachers. Each concurrently taught two sixth-grade bilingual mathematics classes. One of the two classes was randomly assigned to be the experimental, cognitively oriented instruction class; and one was assigned to be the control class. In the cognitively oriented class, teachers tried out instructional practices they were learning in the graduate course, and in their control class, they continued to teach in the manner in which they normally taught. The experiment lasted a total of six hours over a three-week period. Distinctions between the experimental and control classes are summarized in Table 3.5.

Table 3.5. Distinctions between Cardelle-Elawar's (1990) Cognitively Oriented Instruction and Control Classes

Feature	Cardelle-Elawar (1990) Classes	
	Cognitively Oriented Instruction	Control
Assessment	Pre- and posttests administered and pretest results analyzed for key errors, which determined instruction	Pre- and posttests administered, but pretest results not analyzed or used to determine instruction
Strategy instruction	Problem-embedded discussion and feedback	Lecture and teacher-modeling at blackboard
Corrective feedback	Teacher inquired about and gave feedback on students' strategies (e.g., "Which of these procedures you used is correct?")	Teacher said "wrong" or "right"
Teacher role	Guide	Evaluator

The defining features of Cardelle-Elawar's (1990) cognitively oriented instruction were (1) use of pretest results to identify students' key errors and lack of understanding problem types followed by (2) discussion and metacognitive coaching to guide students toward more sophisticated and self-aware selection and implementation of solution strategies. Teachers brought students' pretest results to the graduate class and, with guidance from the instructor, analyzed the results and rehearsed new methods of providing feedback and instruction to students; subsequently, they implemented the new methods in their experimental classrooms.

On Cardelle-Elawar's (1990) posttest of problem solving, students in the cognitively guided instruction significantly outperformed the control students. These results are consistent with the findings of research on the effectiveness of CGI (Peterson et al., 1991) and show how ongoing professional development experiences for teachers that focus on discussing student work, mathematical thinking, and classroom implementation issues positively impact student achievement.

The design of the Bottge (1999) study allows examination of the impact of embedding cognitively oriented instruction in meaningful problem contexts. Students were assigned to one of two treatments. One treatment was "anchored instruction," which involved a semantically rich problem-solving environment presented on video (*Bart's Pet Project*) plus explicit instruction and guidance on how to use a five-step problem-solving strategy (paraphrase, hypothesize, estimate, compute, and check). The other treatment was "word problem instruction," which involved explicit instruction and guidance on how to use the same five-step problem-solving strategy, but *without* the video context for the problems. In the "word problem instruction" condition, word problems were presented in typical textbook-like format. Bottge's (1999) research also involved multiple methods of data collection. In addition to measuring achievement, students were observed during problem-solving posttests and interviewed about their learning experience and successes.

On the transfer posttest (construction of wooden skateboard ramps), the "anchored instruction students" significantly outperformed the "word problem instruction" students (Bottge, 1999), supporting the conclusion that the combination of meaningful contexts for problem-solving and cognitively oriented instruction effectively helps students raise their achievement in mathematics. Computational performance, however, was not positively impacted, thus indicating that the benefits were specific to problem solving.

Student comments and observations confirm the importance of social context and interest to student success. Bottage highlights the experience of one student:

> [The student] explained that School math did not make sense to her and served no useful purpose. For her, the contextualized and applied problems did not look like math, which she regarded as a set of exercises unrelated to events in her life. (p. 91)

Additionally, when students saw others in the class working on the problem, they became motivated, stopped arguing, and generated workable solutions. These observations reveal the potential of peer modeling for motivating effort and task initiation. When considering classroom applications of Bottge's research, however, it is important to note that the "anchored instruction" and transfer posttest were made possible by the presence of certain resources at the research site, namely, the video-based vignette (*Bart's Pet Project*) and a technology education teacher with 20 years of experience who helped plan and supervise the posttest transfer problem involving construction of wooden skateboard ramps.

Summary

To summarize, three features of effective cognitively oriented instruction in mathematics were identified in the present review of research:

1. Ongoing professional development for teachers involving discussions about student work and thinking in mathematics and a focus on classroom implementation issues.

2. Combinations of cognitively oriented instruction with the use of contextualized learning activities that involve posing meaningful, relevant problems and arranging for peer groups rather than individuals to generate solutions.

3. Incorporation of affective, motivational, metacognitive, developmental, and social features in the instruction.

SUMMARY OF FINDINGS ACROSS STUDIES OF COGNITIVELY ORIENTED INSTRUCTION

Across the three areas or reading, writing and oral language, and mathematics, the majority of studies on cognitively oriented instruction reported positive results for low-achieving students. Several study designs allowed comparison of effects associated with different strategy content and instructional components. Findings suggest that combinations of metacognitive and cognitive strategies are more effective than either one type of strategy alone. Findings also suggest that teachers' attention to several, rather than single, instructional components is more effective.

In reading, student comprehension was aided with instruction that brought students' attention to task demands and that taught, and had students practice, summarizing what they read. In writing and oral language, student performance was aided with instruction that combined instruction in strategies for task completion (including planning, drafting, and revising) with opportunities to share products and discuss

processes of writing with peers. In mathematics, student problem-solving achievement increased with instruction that utilized meaningful, contextualized problems, taught students how to prepare and solve problems systematically, and provided social contexts and peer modeling.

Overall, the evidence reviewed in this chapter for the effectiveness of cognitively oriented instruction for low-achieving students is based on a small set of studies. Conclusions about the effectiveness of cognitively oriented instruction drawn from this review also are limited by time of posttest. None of the studies examined maintenance of teachers' cognitively oriented instruction or student strategy use and achievement over longer periods of time than a couple of months or one academic year. More research is needed that examines the long-term benefits of cognitively oriented instruction.

A Final Word to Practitioners

Cognitively oriented instruction is designed to help students improve the quality of their thinking, become more independent learners, and become proficient in complex, higher order academic tasks. In this chapter, research on the effectiveness of cognitively oriented instruction for improving the achievement of low-achieving or at-risk students was reviewed. The results suggest that effective cognitively oriented instruction in classrooms is characterized as follows:

- Teachers are modeling, explaining, prompting, and discussing combinations of metacognitive and cognitive strategies.
- Students are modeling, explaining, prompting, practicing, and discussing combinations of metacognitive and cognitive strategies.
- The content of instruction includes strategies for analyzing and preparing to meet task demands (e.g., problem or genre identification and identification of text structure elements).
- The content of instruction includes "how-to" or formulaic, step-by-step solutions, procedures, and aids to comprehension.
- Activity materials include a variety of text types and problem types.
- Activity materials include texts and problems that are meaningful and/or relevant to students.
- Teachers and students, and students and students, are engaged in two-way interactions in which preliminary products or solutions are discussed or shared and feedback on effectiveness is provided.
- Students successfully perform complex, higher order academic tasks.
- Students achieve at or above proficiency levels on tests involving complex, higher order academic tasks.

Research suggests that when these indicators of effective cognitively oriented instruction are met, students benefit. Many students become interested in academic content and tasks, are engaged, and

successfully perform complex, higher order academic tasks. Readers are referred to Pressley et al. (1995) for practical guidance in how to implement cognitively oriented instruction. Effective implementation of cognitively oriented instruction, however, may require certain resources and organizational capacities, including (1) materials and technical know-how for creating authentic problem environments inside the classroom, and (2) ongoing professional development with external technical assistance providers or researchers that gives teachers opportunity to share and discuss student work and thinking and classroom implementation issues. Further research is needed that systematically examines the processes for securing such resources and their impact on classroom practices and student achievement.

Finally, research also suggests that there are trade-offs or potential negative consequences to the implementation of cognitively oriented instruction for low-achieving or at-risk students. Teachers and education leaders need to be aware of and guard against focusing too narrowly on remediating strategic deficits to the exclusion of acknowledging, representing, and honoring the intellectual depth and breadth of content-area knowledge and skills (Ketter & Pool, 2001; O'Malley et al., 1985).

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ANNOTATED BIBLIOGRAPHY OF SELECTED REFERENCES

This annotated bibliography provides additional information on several research studies included in the chapter on cognitively oriented instruction. The following studies were selected because they were of high quality, showed clear effects on achievement, and provided detailed accounts of the intervention.

Bottge, B. A. (1999). Effects of contextualized math instruction on problem solving of average and below-average achieving students. *The Journal of Special Education, 33*(2), 81–92.

Sixty-six middle school students, including 17 remedial math students, participated in one of two types of mathematics instruction. Both types of instruction involved explicit instruction in a 5-step problem solving strategy but one type utilized textbook-presented word problems and the other utilized video vignettes that presented contextualized, everyday problems. On a word problem posttest, results showed that students provided the contextualized problems during instruction significantly outperformed students provided the textbook problems. Interviews and observations of students showed that remedial students were more motivated and engaged in learning in the contextualized mathematics instruction.

Brown, R., Pressley, M., Van Meter, P., & Schuder, T. (1995). *A quasi-experimental validation of transactional strategies instruction with previously low-achieving, second-grade leaders.* Reading Research Report No. 33. Universities of Georgia and Maryland, National Reading Research Center.

Achievement on standardized tests of reading comprehension and word skills was examined for two groups of second graders who were initially reading below grade level. One group participated in instruction emphasizing phonics and skills and the other group participated in transactional strategy instruction which emphasized active reading strategies (e.g., identify genre, assess difficulty, ask and

answer questions, visualization). On both the reading comprehension and word skills posttests, students in the transactional strategy instruction classrooms outperformed the students in the skills-based classrooms. In this study, teachers providing the transactional strategy instruction were highly experienced having used the approach for at least three years.

Dimino, J., Gersten, R., Carnine, D., & Blake, G. (1990). Story grammar: An approach for promoting at-risk secondary students' comprehension of literature. *The Elementary School Journal, 91*(1), 19–32.

Thirty-two low-achieving ninth-grade students in English language arts were randomly assigned to either traditional textbook-scripted approach to story comprehension instruction or to story grammar analysis instruction. On posttests involving textbook comprehension questions, theme questions, and written retells, students who received the story grammar analysis instruction outperformed students who received the traditional instruction. Significant interaction effects, however, showed that only the students who initially performed poorly in story grammar analysis gained from the story grammar analysis instruction. These results show how focusing too narrowly on remediating specific strategy deficits can have negative consequences. More varied sets of strategies and types of texts ought to be taught to meet the diverse learning needs of students.

Englert, C. S., Raphael, T. E., Anderson, L. M., Anthony, H. M., & Stevens, D. D. (1991). Making strategies and self-talk visible: Writing instruction in regular and special education classrooms. *American Educational Research Journal, 28*(2), 337–372.

Expository writing of low-achieving fourth- and fifth-grade students who received instruction in how to analyze and prepare to meet task demands, ask self-regulatory questions, and engage in peer feedback was compared to expository writing of low-achieving fourth- and fifth-grade students who received district writing instruction emphasizing the recursive processes of brainstorming, planning, drafting, editing, and revising. Results showed that the former group of students wrote higher quality expository texts than the latter. Englert et al. (1991) attributed the results to making self-talk visible and public sharing and feedback of written compositions.

O'Malley, J. M., Chamot, A. U., Stewner-Manzanares, G., Russo, R. P., & Kupper, L. (1985). Learning strategy applications with students of English as a second language. *TESOL Quarterly, 19*(3), 557–584.

High school students learning English as a second language were randomly assigned to one of three types of instruction. One type involved instruction in how to analyze and prepare to meet the demands of an oral presentation assignment plus opportunity to prepare and polish presentations within a cooperative work group. The second type involved only opportunity to prepare and polish presentations within a cooperative work group. The third type was a control condition in which students were told to prepare presentations as they normally would. On the oral presentation posttest, students in the task-demand analysis and preparation instruction outperformed students who received the other two types of instruction. O'Malley et al. (1985) attributed the results to the combination of task analysis strategy instruction with cooperative work group opportunities.

CHAPTER 4

GROUPING STRUCTURES

Kerry S. Englert

Traditionally, schools have used tracking and other grouping strategies to help tailor instruction to the needs of diverse learners. Although tracking has allowed teachers to focus instruction on the needs of a homogenous classroom, it also has been problematic. The use of tracking has led to a lower standard for some students including English language learners, special education students, and a disproportionate number of minorities. Tracking also has resulted in a less rigorous and enriched curriculum, which has allowed many students to slip through the cracks academically (Oakes & Wells, 1998).

Current thought relative to standards-based education is to increase learning for all students and to hold all students to the same high standards of learning and achievement. As a result, schools across the country are working to reduce the number of formal tracking programs. Students are in increasingly more diverse classrooms that include English language learners and special education students. This has created challenges for teachers who must find ways to tailor lessons to meet the needs of a diverse student body. The strategies presented below illustrate some methods teachers might use to improve student achievement for low-performing students in order to help them reach specified standards.

BACKGROUND

For purposes of this research synthesis, the strategy of Grouping Structures refers to different ways of dividing classrooms into smaller groups of students for instructional purposes. Grouping strategies range from designing instruction for the specific needs of a small number of students of the same ability level to mixed-ability groups of students who work cooperatively. The research described in this chapter examines the potential of grouping structures for improving the achievement of low-performing students.

There are many examples of grouping structures in education research. Slavin (1995) and Allen (1991) discuss methods such as comprehensive grouping, within-class grouping, and grouping for specific subject areas. Comprehensive grouping, which focuses on grouping students into ability-based classes, has similar goals to those of tracking. This type of grouping is typically implemented by schools, not by teachers, and is no longer a common practice in education. Therefore, this method is not discussed in the current synthesis.

The two strategies of within-class grouping and grouping for specific subject-area instruction are strategies that can be implemented by teachers. Within-class grouping includes methods such as grouping students by ability within a class both homogenously and heterogeneously to differentiate instruction or to conduct cooperative learning groups. Grouping for subject-area instruction refers to grouping students for instruction in particular content areas.

METHODOLOGY

Selection/Exclusion of Studies

Although much research has been done to examine the impacts of various grouping structures on student achievement, this chapter examines only studies that provide explicit strategies to teachers on using grouping on regular classrooms, including mainstream classrooms. We excluded studies that addressed grouping for pull-out programs such as those used for Chapter 1 (currently Title 1) students and special education students because the regular teacher is not actively engaged in the instructional process after the students leave the classroom. We also excluded studies that incorporated multiple treatments where the effect of the grouping structure on student achievement could not be isolated. Based on these exclusions, we eliminated 43 of the 61 studies that the literature review produced.

It is also important to note that seminal research studies on cooperative learning (e.g., Johnson, Johnson, Holubec, & Roy, 1984; Slavin, 1995) were not included because they fell outside the dates established for research synthesis (1985–current); they did not include achievement data or data on low-achieving or at-risk students; or they were commercial programs that were associated with a sufficient amount of research (e.g. Cooperative Integrated Reading [CIRC]). For information on some of the research excluded from this synthesis, see Johnson et al. and Slavin.

Subcategories within Grouping Structures

The following sections describe research on the within-class and subject-area grouping strategies mentioned earlier. To increase clarity and to eliminate potential overlap, the two grouping structures have been reorganized into subcategories — grouping students by ability levels and grouping students heterogeneously or across ability levels. Examining the literature on grouping structures through these two lenses leads to insights into how these groups function differently in a classroom, what the issues are in implementing such groups, and how grouping impacts student achievement. Based on this information, educators can make more informed decisions about which grouping structures might work best in their classrooms.

GROUPING STUDENTS ACROSS ABILITY LEVELS

Ten studies addressed grouping students across ability levels. All the studies used quantitative measures.

Overview of Studies

A great deal of research has been conducted in the area of mixed-ability groups and specifically in the area of cooperative learning and its effectiveness in helping at-risk students (Waxman, Padrón, & Arnold, 2001; Johnson et al., 1984; Slavin, 1996). Cohen (1994) defines cooperative learning in her review of small-group research. Cooperative learning, she maintains, consists of "students working together in a group small enough that everyone can participate on a collective task that has been clearly

assigned" (p. 3). It is important to note that Cohen's definition stresses the need for participation of all students and clear assignment of the collective task.

Researchers have identified other critical components of successful cooperative learning. These factors include the clarity of the directions that are given to students, the level of interaction between and among students, and the helping behaviors of the students (Webb & Farivar, 1994). The research studies presented in this section considered these and other factors in their research designs in order to examine the efficacy of cooperative learning. Other issues, such as teacher training in facilitating groups and the length of program implementation, also contribute to the effectiveness of the grouping structure.

As Bossert (in Cohen, 1994) points out, many cooperative learning studies use a black-box approach and simply compare a cooperative learning approach to one that is non-cooperative. A research design such as this is deficient because it does not measure the impact of related factors that can influence the results. High-quality research studies of cooperative learning consider one or more of these factors. This characteristic, coupled with the quality criteria outlined in our coding protocol (see Appendix A), provided the rationale for judging the quality of research studies on mixed-ability groups. Using these standards of quality, we coded four of the ten studies in this subcategory as high-quality studies. Although all 10 studies were considered as contributing to the evidence base supporting the overall impact of the intervention, more weight was given to the four high-quality studies by Henderson and Landesman (1992), Repman (1993), Webb and Farivar (1994), and, Yager, Johnson, and Johnson (1985).

Findings

The research reviewed indicates that mixed-ability grouping can be effective in increasing the achievement of low-achieving and at-risk students. Table 4.1 indicates the effectiveness of strategies based on the direction of findings from 10 studies. Results ranged from mostly positive to all positive, with only one study showing a negligible effect. This substantiates past reviews that consider the effectiveness of cooperative learning for all students (Webb, 1991; Slavin, 1996), which found that grouping students across ability levels produced generally favorable achievement results.

A primary component to the success of mixed-ability grouping is the clarity of the directions that are provided to the students. Grouping works best when students are not given loosely defined tasks and roles (Repman, 1993):

> Structured activities specify roles and behaviors that students are to engage in during the collaborative learning session. Structure can be used to ensure that all group members participate in both giving and receiving help, as well as providing students with models of successful thinking and problem solving behaviors. (p. 151)

By giving clear directions to students, teachers can ensure that students are more focused on the task and that they understand expectations for participation. Providing students with clear directions helps ensure that students of all ability levels have effective opportunities to learn the content and that they play active and important roles in the group.

Table 4.1. Characteristics of Studies Grouping Students Across Ability Level

Author(s) &Year	Treatment Size	Grade	Student Description	Strategy Description	Subject Matter	Type of Comparison	Results[a]
Henderson & Landesman (1992)	52	7	Low achieving and ESL	Small collaborative learning groups and hands-on activities to help students make sense of math concepts	Math	2 grps pre-Post nonrandom	Mostly positive
Hooper & Hannafin (1988)	40	8	Low achieving	Computer-aided instruction with grouping and individual incentives	Math	2 grps post test random	Mostly positive
Klingner & Vaughn (2000)	38	5	ESL	Cooperative learning and helping behaviors	Science	1 grp pre-post test	All positive
Miller (1995)	41	8	Low achieving	Use of cooperative learning groups that were student led	Social Studies	2 grps pre-post nonrandom	All positive
Repman (1993)	64	7	Minority and at risk of failure	Collaborative computer-based learning	Social Studies	3 grps pre-post random	Mostly positve
Riley (2000)	24/24	6	Low achieving	Metacognition and strategic training in cooperative groups compared to direct instruction in cooperative groups	Math	3 grps pre-post nonrandom	Mostly positive
Singhanayok & Hooper (1998)	46	6	Low achieving	Cooperative learning using computers	Science	2 grps pre-post test nonrandom	All positive
Udupa (1993)	10	10	Low achieving	Concept mapping in a cooperative learning environment	Science	2 grps pre-post nonrandom	Even
Webb & Farivar (1994)	91	7	Low-achieving and minority	Cooperative learning with instruction and practice in basic communication and helping skills	Math	2 grps pre-post nonrandom	Mostly positive
Yager, Johnson, & Johnson (1985)	25/ 25/25	2	Low achieving	Three groups were studied: Cooperative learning that had structured oral discussion, cooperative learning that had unstructured oral discussion, and individual learning	Lang. Arts	2 grps pre-post random	All positive

[a]The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

Instructions to students also should consider students' individual ability levels. Research on heterogeneous groups shows that students of different abilities assume different roles in a group. Higher achievers tend to provide more explanations; lower achieving students tend to ask more questions. Each

of these roles is critical to the learning process of the whole group. Low achievers are provided with information about the content in a timely manner, and higher achievers are able to solidify their own knowledge by responding to challenges and resolving disagreements (Henderson & Landesman, 1992; Webb & Farivar, 1994). Research indicates that cooperative learning can be an effective instructional strategy for both high and low achievers when adequately implemented (Singhanayok & Hooper, 1998; Yager et al., 1985).

Research indicates that instruction may be especially important for low-achieving students because these students tend to be more passive during group learning situations (Repman, 1993). These students must be taught to ask clear and precise questions and to be persistent in getting needed information. With this type of instruction, students can more fully participate and obtain responses to their questions, which is important given the strong correlation between the degree of communication and student achievement in student groups (Webb & Farivar, 1994). Conversely, high-achieving students must be instructed that simply providing answers to a problem is not enough. They must elaborate on their explanations and make them "relevant, specific, timely, and clear" (Webb & Farivar, p. 371). Only then will the interaction benefit their peers.

Yager et al.'s (1985) study also found a powerful group-to-individual transfer of knowledge in mixed-ability groups. When a question-and-answer dialogue was used as a cooperative leaning experience, *all* students (high, medium, and low ability) benefited. This research also examined the effectiveness of cooperative learning with and without training for students in structured oral participation and constructive listening. Students who performed the highest had been placed in cooperative learning groups and trained in structured participation. Yager et al.'s study reinforces the need for training to ensure that students have the skills they need to fully participate in mixed-ability groups.

A final consideration when implementing mixed-ability grouping is the maturity level of the students. Eight out of ten of the studies examined implemented cooperative learning with students who were in middle school or higher. Teachers may find that using mixed-ability grouping with younger students is difficult because of the requirement placed on students to provide detailed explanations and to ask probing questions. Teachers might need to adjust the student training and grouping format to accommodate younger students.

GROUPING STUDENTS BY ABILITY LEVELS

Overview of Studies

Eight research studies addressed grouping students by ability levels. Seven of the eight studies were quantitative; one study used mixed quantitative and qualitative research methods (Colby, Parker, & Wilson, 1995). It is worth noting that relative to the body of research on mixed-ability grouping, these studies were coded as being of lower research quality for a number of reasons. Four of the eight studies used small sample sizes, ranging from six to 12 students, for their treatment groups. Further, four out of the eight study designs did not use a control group, making it difficult to determine whether increased achievement was due to the student grouping structure or to student maturation. Based on these considerations, only one study (Bode, 1996) met the criteria for high quality.

In the studies in this subcategory, students were selected for a mixed-ability group based on teacher recommendations or their low test scores. Teachers then provided the groups of students with differentiated instruction in order to correct specific deficiencies. Instruction usually took the form of direct instruction or teacher-led group discussions. Across the eight studies, ability grouping was used most frequently in elementary schools. As indicated in Table 4.2, six out of the eight studies were conducted in lower grade levels. Only two were conducted at the middle school level, perhaps because elementary teachers are more apt to target students with limitations in specific content areas such as reading.

Findings

As previously mentioned, the group of studies in this section tended to be of lower quality than studies in the subcategory of grouping students across ability levels. However, there was one study coded as high quality that provided additional insight into the effects of ability grouping (Bode, 1996). This research was a secondary analysis of the Second International Mathematics Study (SIMS). The study connected background variables collected on the survey portion of SIMS to student assessment results. Using pretest and posttest scores, the study showed that ability grouping did not influence the achievement of low- or high-ability students. Although only one ability grouping study was coded as high quality, some of the other studies examined do provide insights into the effective use of ability groupings. Several of these studies reported that ability grouping increased achievement for low-performing students. The studies used a variety of instructional methods, but most targeted a specific skill. In six of the studies, teachers led the small groups and directed the instruction and student interaction patterns. For example, in a study by Paliscar, Brown, and Campione (1989), teachers read passages to groups of six students and then assessed listening comprehension by discussing the text with students. In studies by Hawley (2001) and Morris and Nelson (1992), supplemental reading instruction was provided and teachers used scaffolding to increase text difficulty throughout the year. Both studies reported positive effects when using ability grouping to improve the beginning reading and writing skills of low-achieving students.

Several caveats should be considered when implementing ability grouping in the classroom. In her research synthesis on ability grouping and tracking, for example, Lindle (1994) points out that the practice of ability grouping is not a panacea. She suggests that segregating students by ability might result in lower student self-esteem and might impact achievement by resulting in lower expectations rather than "enriched, differentiated instruction" (p. 8). In addition, trends in cognitive psychology refute the tenets on which the theories for ability grouping are based. In particular, some uses of ability grouping reflect the notion that students must master basic skills before moving on to problems involving higher order thinking. However, as Lindle states, "skills have no prerequisites to content" and that "skills have no meaning unless they are tied to content" (p. 5).

In the studies involving students in higher grade levels, student direction of the groups became more prevalent than in lower grades. Harris, Dyer, and Tracz (1988) reported some positive effects for low-achieving students by training them in study skills such as vocabulary, report writing, and grammar using cooperative learning methods. Students were told to apply these methods in their academic subjects. However, some complications can occur when applying these methods. As already discussed, cooperative learning tends to employ heterogeneous groupings of students, and in order for cooperative learning to be

effective, teachers must structure the cooperative learning sessions rather than expecting students to apply it themselves (Webb & Farivar, 1994).

Table 4.2. Characteristics of Studies Grouping Students by Ability Level

Author(s) & Year	Treatment Size	Grade	Student Description	Strategy Description	Subject Matter	Type of Comparison	Results[a]
Bode (1996)	3991	8	Low achieving	Large-scale study looking at effects of general grouping	Math/ Science	2gps pre-post nonrandom	Even
Bruce, Snodgrass, & Salzman (1999)	11	1	Low achieving	Guided reading in small groups	Reading	1grp Pre-post	All positive
Colby, Parker, & Wilson (1995)	6	3	Below grade level in reading and writing	Mini-writing lesson, free writing, and group sharing	Writing	1 grp pre-post	All positive
Harris, Dyer, & Tracz (1988)	79	8	Low achieving	Taught study skills using a cooperative learning approach	Study skills	2 grps post random	Mostly positive
Hawley (2001)	12	K	Low SES and low achieving	Small-group instruction in phonological and phonemic awareness and literacy acquisition	Reading	1 grp pre-post	All positive
Morris & Nelson (1992)	10	2	Low achieving	Supplemental instruction provided by teacher	Reading	2 grps pre-post nonrandom	Mostly positive
Palinscar, Brown, & Campione (1989)	36	1	Low achieving	Teacher-led reading and student discussion of passages	Reading	2 grps pre-post nonrandom	All positive
Welch, Richards, Okada, Richards, & Prescott (1995)	600	4–6	Low achieving	Paraprofessional under teacher supervision provided direct instruction in cross-grade groupings	Reading and Math	2 grps pre-post nonrandom	Mostly positive

[a]The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

SUMMARY OF FINDINGS ACROSS GROUPING STRUCTURES

This research synthesis on Grouping Structures examines two very different approaches to grouping students — heterogeneous, or mixed-ability grouping, and homogenous, or ability-level grouping. Studies of both of these grouping interventions report positive impacts on low-achieving students or at-risk students. All but two studies included in this chapter produced mostly positive to positive results. The two remaining studies found no influences of groups on student achievement. This indicates that as teachers work in increasingly diverse classrooms, the application of small groups might be one way to modify instruction to increase student achievement.

With regard to mixed-ability groupings, results of the high-quality studies were consistent. All of these studies reported mostly positive to positive results on the effects of grouping on student performance. In particular, cooperative learning, when rigorously implemented, can provide students with enriched instruction through peer interaction resulting in improved student achievement. It is important to bear in mind that the research also indicates the importance of training and professional development on the successful implementation of this classroom practice (Webb, 1991; Repman, 1993). Research studies stress the importance of the processes that occur in groups and of the teachers' role as critical to student learning in groups.

The lack of high-quality research limits our ability to make confident statements about the efficacy of ability grouping. As a whole, the research on ability grouping shows that there may be positive outcomes associated with this intervention, although the one high-quality study in this subcategory found neither positive nor negative effects on student achievement and thus does not support the favorable findings reported by the lower quality research studies reviewed.

A FINAL WORD TO PRACTITIONERS

The studies reviewed in this chapter demonstrate the effectiveness of applying different grouping structures in classrooms of low-achieving students. These studies, and in particular the high-quality studies, showed that there are several critical components of successful group learning. When forming groups across ability levels, such as cooperative learning groups, important factors include the clarity of the directions given to students, the level of interaction that exists between and among the students, and the helping behaviors of the students (Webb & Farivar, 1994). Other mediating factors, such as teacher training in facilitating groups and the length of program implementation, also contribute to the effectiveness of the intervention.

Grouping by ability level was the second type of grouping structure discussed in this chapter. The one high-quality study of ability grouping was a secondary analysis of a large-scale dataset, but it did not include program descriptions that could be of use to practitioners in implementation. The other studies of ability grouping are not of sufficient rigor to make conclusive recommendations about effectiveness.

Teachers who are considering implementing a particular grouping strategy should consult additional resources. Cooperative learning is an instructional approach supported by a large amount of general research and with specific programs that support its use. One comprehensive source of

information is *Cooperative Learning: Theory, Research, and Practice* (1995), by Slavin, a seminal researcher in this area. The author shares theoretical information that helps explain why cooperative learning works. In addition, he translates the research into practical guidelines for the most widely used cooperative learning strategies with step-by-step instruction for implementation.

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ANNOTATED BIBLIOGRAPHY OF SELECTED REFERENCES

This annotated bibliography provides additional information on several research studies included in the chapter on grouping structures. The following studies were selected because they provided detailed accounts of the intervention and were of high quality.

Bode, R. K. (1996, April). *Is it ability grouping or the tailoring of instruction that makes a difference in student achievement?* Paper presented at the annual meeting of the American Educational Research Association, New York.

In this study, Bode used SIMS data to examine the impact that within-class ability grouping had on student achievement. As part of the SIMS data collection, a nationally representative sample of eighth-grade students was tested at the beginning of the school year and at the end of the school year. Teachers responded to questions about the class environment such as the amount of time spent in small-group instruction, the type of grouping arrangement that was used, and the amount of instructional tailoring the teacher conducted. Hierarchical Linear Modeling was used to examine the effects of ability grouping and tailoring on student achievement. The researcher determined that ability grouping had no impact on student achievement for low-performing students.

Henderson, R. W., & Landesman, E. M. (1992). *Mathematics and middle school students of Mexican descent: The effects of thematically integrated instruction* (Research Report No. 5). Washington, DC: National Center for Research on Cultural Diversity and Second Language Learning, Center for Applied Linguistics.

These researchers examined the impact that small collaborative learning groups had on students. Researchers examined the impact of cooperative learning activities that included hands-on activities on helping students make sense of real-world mathematical concepts. These students were primarily of Mexican descent, and the school was generally low achieving. Researchers found that both comparison and treatment groups of students made equivalent gains in computational abilities. However, the treatment group surpassed the comparison group in mathematics achievement related to concepts and applications. Researchers hypothesized that students in the theme-oriented instructional group would be exercising their computational skills in a meaningful, problem-solving context rather than practicing computation in isolation.

Repman, J. (1993). Collaborative, computer-based learning: Cognitive and affective outcomes. *Journal of Educational Computing Research, 9*(2), 149–163.

In research conducted by Repman, seventh-grade social studies students were randomly assigned to one of three treatment groups to examine the impact of collaborative, computer-based learning. Students were to work together once a week for nine weeks on activities that focused on critical thinking and problem solving. The first treatment group used unstructured collaboration. The only instruction these students were given was to take turns using the keyboard during each activity. In treatment group 2, structured collaboration, students were given a protocol sheet to promote and direct elaboration of responses and questioning. The students in treatment group 3, structured collaboration with training, were given explicit instructions in providing elaborative explanations to other students' questions and providing explanations when errors occurred. Results showed that differences in achievement occurred between treatment group 1 and the combined results of treatment groups 2 and 3. Thus, students who were given instruction or information on elaborated responses scored higher on the posttest.

Webb, N. M., & Farivar, S. (1994). Promoting helping behavior in cooperative small groups in middle school mathematics. *American Educational Research Journal, 31*(2), 369–395.

The goal of this study was to examine the impact on achievement of providing instruction to students in helping skills. Classes were randomly assigned to the treatment or comparison group. The treatment group was given instruction and practice in both basic communication and helping behavior; the comparison group was given only instruction in basic communication. This study found that minority students were more likely to received and give help in the treatment group. These students also performed better on the mathematics posttest than did their peers in the comparison group. However, their gains were not enough to close the achievement gap with the White students.

Yager, S., Johnson, D. W., & Johnson, R. T. (1985). Oral discussion, group-to-individual transfer, and achievement in cooperative learning groups. *Journal of Educational Psychology, 77*(1), 60–66.

Researchers examined the differential effects of two types of cooperative learning: structured and unstructured oral discussion. The researchers were attempting to address if there was a group-to-individual transfer of knowledge and, if so, under what conditions. The members of the structured cooperative learning group were given role assignments to help direct their participation in the group assignment. The unstructured oral discussion group was told only to collaborate and the students were not given specific roles to play. The students in the control group were placed in an individualistic learning situation where the students' achievement goals were independent of the other students. Researchers found that students in the both cooperative learning groups did better on achievement tests immediately after the treatment and 18 days later. Their analyses also showed that the structured cooperative learning group performed higher than the unstructured group. The achievement gains in both treatment groups were consistent across ability levels.

CHAPTER 5

TUTORING

David Snow

As schools address the problem of bringing low-achieving students up to proposed standards, they are forced to decide how best to use limited resources. Among the more aggressive approaches to the problem are interventions that involve tutoring. The money, time, space, and effort that schools dedicate to tutoring tax limited school resources, but these efforts are the most attentive means to address the needs of at-risk students. The good news is that research brings to light a number of program variations that ease the need for significant resources. This chapter reviews tutoring research that focuses on improved achievement for low-achieving students, describing program characteristics as well as evidence of success.

BACKGROUND

For the purpose of selecting the studies for this chapter, tutoring is defined as a one-on-one interaction between tutor and student. The tutors in the programs studied varied widely, from children to retirees, but in most cases the tutees were young readers. Studies of cross-age student tutoring interventions were included if the tutor was not expected to gain academically from the interaction. Tomlin (1995), for example, describes a tutoring program that paired academically strong high school students with at-risk middle schoolers. Since improved academic achievement was not expected from the high school tutors, this study was included in the chapter. Note that studies examining cross-aged tutoring for mutual curricular gain are not included here. These cross-aged tutoring studies are synthesized along with other peer tutoring research in Chapter 6.

METHODOLOGY

Two recent syntheses of tutoring studies preceded this synthesis. In the first, Fager (1996) lists a number of positive outcomes that she attributes to tutoring programs: encouraging community relationships, improving self-esteem and confidence, and increasing achievement. These outcomes were drawn from a review of prior research, which included studies from 1988 to 1995, and were reinforced by the author's own study of seven tutoring programs in the American Northwest. Fager does not report quantitative evidence of program success such that comparisons could be made or the level of success predicted, but the work includes citations and is a good resource for practitioners.

The second synthesis is more relevant to this paper. In a meta-analysis of tutoring program research, Elbaum, Vaughn, Hughes, and Moody (2000) quantitatively combined results of reading

program studies published between 1976 and 1998 that utilized adult tutoring interventions to improve the achievement of at-risk students. As a result, the authors report a combined effect size[5] of more than 0.5 standard deviations for the tutored students. They suggest that a well-designed, carefully implemented program need not be staffed by trained professionals in order to be effective. Because the work of Elbaum et al. is current and thorough, we see no need to reconstruct their meta-analysis. Instead, we separated our pool of tutoring studies into three small, homogenous subcategories: professional tutoring, volunteer tutoring, and student tutoring. This grouping of studies allows us to best identify common issues most important to tutoring program implementation.

Selection/Exclusion of Studies

Of the 31 studies identified as tutoring research after the initial screening described in Chapter 1, eight additional studies were excluded here. Three were not research studies, and five of the studies simply did not report enough methodological information to support their inclusion. Thus, 23 studies have been included in this chapter's synthesis. These studies are a collection of reported research and program evaluations, each revealing unique perspectives on issues related to tutoring and the effect of tutoring programs on at-risk students.

It is important to note that five of the studies reviewed in this chapter are works that were coded as high in quality. These studies had random assignment of students in thoughtful experimental designs, careful descriptions of implementations, and thorough quantitative and qualitative analyses. These attributes increase confidence in reporting the effects of tutoring programs. Thus, we rely heavily upon the work of McCarthy, Newby, and Recht (1995), Cobb (1998, 2001), Baker, Gersten, and Keating (2000), and Meier and Invernizzi (1999) in drawing conclusions.

Subcategories within Tutoring

The sections of this chapter synthesize the 23 tutoring studies in three groups. First, studies of professionals as tutors are presented (n = 5). This group of studies examines the most qualified and least affordable pool of tutors: certified teachers, reading specialists, and paraprofessionals. The McCarthy et al. (1995) study that was coded as high quality is included in this section. The second group of studies is a set analyzing adult volunteer tutoring programs (n = 13). This set includes programs that recruit tutors from the ranks of retirees, college students, and other civic-minded adults in school communities. The remaining four studies that were coded high quality (Cobb, 1998; Cobb, 2001; Baker et al., 2000; Meier & Invernizzi, 1999) are included in this section. The last group is a small group of studies that examine cross-age tutoring programs (n = 5). Several important issues result from these studies of the most readily available tutors. None of the studies in this last group was coded as high in quality.

In each section of this chapter, the issues surrounding the tutoring programs will be reported, along with a review of program effects.

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[5] The effect size is the difference between the treatment and comparison groups expressed in standardized units. An effect size of .3 or greater is considered large enough to be practically meaningful.

PROFESSIONAL TUTORING

Tutoring in schools is a variation of the long-standing apprenticeship and mentoring practices viewed as successful in a variety of professions. The use of experienced professionals in the tutoring roles — master plumbers and veteran doctors being good examples — gives strength to the notion that professional teachers are best suited for the role of tutoring. The tutors in this subgroup are such a set of professionals: licensed teachers, trained specialists, and the like. A review of these studies reinforces the synthesis reports of the effectiveness of tutoring programs (Elbaum et al., 2000; Wasik, 1998; Wasik & Slavin, 1993) and emphasizes the effective characteristics of tutoring.

Overview of Studies

The five studies presented in Table 5.1 represent recent, more rigorous research on programs that provide professional tutoring for students at risk for academic failure. The table displays the varying professional status of the tutors, from aides to certified teachers, while also emphasizing the fact that the tutees were a far more homogeneous group: all very young, at-risk readers. The ages of the students probably reflects recent program and research emphasis on early literacy, and the small number of studies is likely a reflection of the limited use due to the expense of professional tutoring efforts.

Table 5.1. Characteristics of Studies involving Professional Tutors

Author(s) &Year	Treatment Size	Tutors	Grades of Tutees	Student Description	Subject Matter	Type of Comparison	Results[a]
Johnson (1987)	1,417	trained adult aides	K, 1	low test scores	reading	pre-post treatment only	Mostly positive
Mantzico-poulos, Morrison, Stone, & Setrakian (1992)	111	trained teachers	K	low test scores	reading	3 grps pre-post random	Even
Matz 1989	1	researcher	young child	teacher-identified low performer	reading	case study	All positive
McCarthy, Newby, & Recht (1995)	19	trained specialists	1	teacher-identified low performer	reading	2 grps pre-post nonrandom	Mostly positive
Morris, Tyner, & Perney (2000)	43	trained teachers	1	low test scores	reading	2 grps pre-post nonrandom	Mostly positive

[a]The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

Findings

Despite the small number of studies in this subcategory, there are several emerging conclusions from this group that are worth mentioning. McCarthy et al. (1995), for example, reported lasting effects of a first-grade reading program. These researchers found significant differences between a tutored group of students and a control group two years after the completion of the program. These results are consistent with those from a large-scale program synthesis conducted by Wasik and Slavin (1993). However, McCarthy et al. note that sustained gains were accomplished without the added expense commonly associated with large-scale efforts. These two observations of lasting effects provide evidence that early

tutoring intervention, whether in the form of large- or small-scale programs, can be effective with at-risk readers.

As noted earlier, strong theoretical backing was used in the design of the tutoring programs analyzed by Mantzicopoulos, Morrison, Stone, and Setrakian (1992). Each treatment was a series of methods driven by differing reading theories, and the authors reported that the purposive aim of the tutoring program gave the effort needed support. Similarly, Matz (1989) describes stages of intervention influenced by a variety of common methodologies, and Johnson (1987) describes tutoring sessions influenced by Direct Instruction. In each of these studies, a strong purposive implementation in the program being studied led to increased achievement.

One study also tied program success to thorough, specific tutor training and continued program monitoring. Morris, Tyner, and Perney (2000) describe Early Steps, an early intervention reading program similar to Reading Recovery (a large-scale methodology) in terms of its careful tutor training and the formative evaluation of the tutoring sessions throughout program implementation.

Most prevalent in this group of studies is the conclusion that tutoring is characterized by thorough and frequent diagnostic and prescriptive interchanges between tutor and tutee. McCarthy et al. (1995) conducted a thorough study of a program adapted from an approach used in Reading Recovery. Four credentialed tutors were trained by the lead researcher to promote reading fluency and phonological awareness prior to program implementation. At the heart of the tutoring program, however, were the weekly meetings throughout the intervention between the researchers and the tutors in which the pedagogical training continued. In these sessions, the students' performances were used to guide the tutors in their approaches to instruction. Matz (1989) described smaller and more frequent diagnoses in his successful experience in tutoring a young reader by means of a series of informal evaluations that prompted individualized approaches in his teaching. Whether formal or informal, it is apparent in these studies, as well as others (in fact, each of the studies listed describes active diagnostic/prescriptive interaction), that the diagnostic-prescriptive function of the tutor is essential to taking full advantage of one-on-one instruction. The existence of this complex interaction in tutoring programs encouraged Johnson (1987) to suggest more careful consideration of the diagnostic-prescriptive process in program design.

The importance of this interaction, therefore, suggests that trained tutors are best suited for the role. As McCarthy et al. (1995) note, "instruction was individually shaped by the teacher in the role of the expert evaluator" (p. 288). This expertise, the authors suggest, was instrumental in producing the strong effects they reported on a long list of reading and writing measures (effect sizes ranging from 0.50 to 0.79 for experimental variables). Within this group of studies, the tutors' expertise was called upon repeatedly to evaluate skills and to adapt instruction. The Early Steps program studied by Morris et al. (2000) expected professional teachers to rely on their understanding of instruction in word families, vowel patterns, and complex contrasts while tutoring first-grade readers. Mantzicopoulos et al. (1992) described a more complex program in which the tutors delivered instruction through visual, motor, auditory, body image, and intermodal means. Specifically, "the visual cluster consists of visual discrimination and recall, visual sequencing, and visual figure-ground tasks, all considered essential to reading" (p. 578). These authors imply that tutor expertise is nearly essential to the task of tutoring.

It is clear that the implementers rely upon tutor expertise, but is such expertise necessary? In his study of professional tutors, Mantzicopoulos et al. (1992) reported significant gains in only one of the five instructional modes listed above. Although the other studies in this subcategory reveal more positive results, we cannot conclude that the level of training exhibited by the tutors in the other studies is necessary for the achievement of the tutees. This issue is explored further in the sections to follow as the adult volunteer and cross-age student studies are analyzed and results are compared.

VOLUNTEER TUTORING

Any societal notion that a school is an institution working in isolation within the larger community is a notion challenged by programs that gather community volunteers and enlist them as tutors for school children. This subgroup of studies examines tutoring programs that do not carry the expense associated with the professional tutoring programs described above. These works provide a rich sense of the volunteer programs, their relevant issues, and the program effects. Note that most of these studies describe their volunteers in the strictest sense, giving their time for merely intrinsic rewards, but this collection also includes studies of programs that offer tutor stipends and those that provide college credit for tutoring work.

Overview of Studies

The studies in this group are again characterized by small samples of students exposed to early literacy interventions. Four of these studies are coded as being high in quality: the recent quantitative studies by Baker et al. (2000), Cobb (2001), and Meier and Invernizzi (1999), and the qualitative work of Cobb (1998). We are able to draw preliminary conclusions based on these studies with supporting evidence provided by the other volunteer tutoring studies in this group (see Table 5.2).

Findings

The Baker et al. (2000) study of SMART, a volunteer tutoring program implemented in Oregon, was one with a larger number of students studied. Among the results of this work is a set of reported effect sizes that are comparable to those reported in Elbaum et al. (2000) and Wasik and Slavin (1993). The SMART volunteer tutors found effect sizes ranging from .32 to .53 on a series of five different reading measures. Can volunteers be as effective as professional teachers when serving as tutors? The results of the SMART study, supported by other studies in this set, indicate that positive achievement results from tutoring programs do not rely on professional tutors.

The group of studies in this section reinforces some programmatic characteristics that were noted in the previous section. The importance of a purposive treatment is one such example. We consider a strong "purposive treatment" to be any instructional framework that is used by tutors to guide instruction. We found no studies that compared purposive treatments to a more casual approach, but there are several examples of studies in this subcategory in which a well-defined purpose seemed to be central to the tutoring effort.

Table 5.2. Characteristics of Studies involving Adult Volunteer Tutors

Author(s) &Year	Treatment Size	Tutors	Grades of Tutees	Student Description	Subject Matter	Type of Comparison	Results[a]
Baker, Gersten, & Keating (2000)	43	adults	1, 2	teacher-identified low performer	reading	2 grps pre-post nonrandom	Mostly positive
Cobb (1998)	4	College students	4	low test scores	reading	case study	All positive
Cobb (2001)	30	College students	2, 3	teacher-identified low performer	reading	2 grps pre-post random	Even
Juel (1991)	1	College students	1	teacher-identified low performer	reading	case study	All positive
Knapp & Winsor (1998)	8	adults	2, 3	teacher-identified low performer	reading	2 grps pre-postnon random	Mostly positive
McCarthy, Newby, & Recht (1995)	4	Senior citizens	1, 2, 3	teacher-identified at-risk, Learning Disabled, or Dyslexic	reading	case study	All positive
Meier & Invernizzi (1999)	28	Senior citizens	1	low test scores	reading	2 grps pre-postrandom	Mostly positive
O'Sullivan, Puryear, & Oliver (1994)	16	College students	9	teacher-identified low performers	all	2 grps pre-postnonrandom	Even
Ramey (1990)	8	adults	2, 3, 4, 5	identified to be in need of services	reading	4 grps pre-post nonrandom	Even
Ramey (1991)	77	adults	2, 3, 4, 5	identified to be in need of services	reading	4 grps pre-postnonrandom	Mostly positive
Richardson, Abrams, Byer, & DeVaney (2000)	24	College students	7, 8, 9, 10, 11, 12	teacher/district identified as "being in need of reading assistance"	reading	1 grp pre-postnonrandom	Even
Rimm-Kaufman, Kagan, & Byers (1999)	21	senior citizens	1	teacher nomination	reading	2 grps pre-postrandom	Even
Vadasy, Jenkins, Antil, Wayne, & O'Connor (1997)	20	adults	1	low test scores	reading	2 grps pre-post nonrandom	Mostly positive

[a]The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

Cobb (2001) describes a simple yet clear programmatic aim in experiences that strove to make curricular connections using puppets and games. The absence of results from this study was attributed to the small number of subjects, a problem seen throughout the research on tutoring. Richardson, Abrams, Byer, and DeVaney (2000) report the use of an interest inventory taken by the tutees therefore customizing the upcoming tutoring sessions as well as providing a guiding purpose for the interactions. The challenge of providing a clear aim was eased in the successful SMART Program mentioned above (Baker et al., 2000). The authors describe a successful tutoring program in which the tutoring curriculum was intentionally independent of the students' classroom work. By not struggling to directly support the classroom teachers' lessons, the tutors were apparently freed to concentrate on a simpler set of guidelines.

As noted under Professional Tutoring, constant supervision and regulation of the tutoring sessions was again a reoccurring issue in this literature. Knapp and Winsor (1998) report that program supervisors

worked with tutors to adjust the reading level of books on a regular basis. Vadasay, Jenkins, Antil, Wayne, and O'Connor (1997) and Rimm-Kaufman, Kagan, and Byers (1999) also describe programs with thorough formative assessment of their tutoring sessions, while Meier and Invernizzi (1999) conclude their work with a call for "intensive, ongoing training and supervision of tutoring under the guidance of a knowledgeable reading specialist" (p. 332).

Additional issues come to light as a result of comparing these studies. The logistical quality of volunteer tutoring programs is one strong concern. The studies in this section describe logistics of impressive quality, like a program that provided its tutors with tote bags filled with classroom supplies: dry erase boards, tablets, pencils, markers, and manipulatives (Cobb, 2001). But poor logistical quality also was reported. For example, O'Sullivan, Puryear, and Oliver (1994), in their study of a program utilizing college-aged tutors, explain that the tutors were not made to feel welcome in the host high schools.

The strongest issues, however, seem to center around the volunteer tutors themselves. One important question is where these tutors are to be found. Ranks of retirees and college students seem to be the most frequent sources. One of the described programs managed to recruit a number of retirees who were at one time professional teachers (Rimm-Kaufman et al., 1999), while another used college-age student athletes who had experienced trouble in school themselves (Juel, 1991). Retirees and college students are not the only tutors described in these studies however. The programs described several creative approaches to finding willing and patient volunteers: parents and grandparents (Vadasay et al., 1997), preservice teachers (Cobb, 1998), and working adults (Baker et al., 2000; Meier & Invernizzi, 1999).

In programs where competent volunteers could be found, trained, and retained, the reported effects were in several cases as large as those programs employing professional teachers as tutors. Returning again to the report of the SMART Program (Baker et al., 2000), the authors report a 50 percent annual retention rate in the program tutors. This retention rate, the authors claim, is one good reason for the success of the program and the reason that the program is cost-effective. Accepting this claim suggests that finding and retaining good tutors may be the most important issue faced by volunteer tutoring programs. In any case, it is clear that providing training that is appropriate for the wide variety of tutors in these studies is a creative challenge.

Compared to the cost of implementing a tutoring program using professional teachers, the cost of using volunteer tutors is quite low. This is not to say that the effort is cost free. In an investigation of volunteer tutoring programs, Wasik (1998) reviews program characteristics, including information about specific program implementation costs.

STUDENT TUTORING

Five studies fall into this grouping of the use of student tutors. These studies describe programs in which the students' tutors were significantly older or otherwise advanced beyond the skill levels of the tutees. Unlike the peer tutors described in Chapter 6, these tutors are not expected to gain academically

from the tutoring interactions. Although small in number, this group of studies does help to inform the issues already presented.

Overview of Studies

As reported in the previous sections, the five student tutor studies in this section illustrate the research focus on early literacy (see Table 5.3). The programs studied employed tutors of varying ages; most of the programs resulted in positive effects. We were again limited in our ability to make generalizations from these works due to a small number of tutored treatment samples, although these studies do introduce new issues and support conclusions draw from the previous sections.

Table 5.3. Characteristics of Studies involving Cross-Age Student Tutors

Author(s) &Year	Treatment Size	Grades of Tutors	Grades of Tutees	Student Description	Subject Matter	Type of Comparison	Results[a]
Harris, Marchand-Martella, & Martella (2000)	88	11, 12	9	low test scores	reading	2 grps pre-post nonrandom	Mostly positive
Jenkins, Jewell, Leicester, Jenkins, & Troutner (1991)	15	interme diate	1, 2, 3	low test scores	reading	2 grps pre-post nonrandom	Even
Taylor, Hanson, Justice-Swanson, & Watts (1997)	19	4	2	teacher-identified low performer	reading	2 grps pre-post nonrandom	Mostly positive
Tomlin (1995)	36	high school	6, 7, 8	documented at-risk (school records)	all	2 grps pre-post nonrandom	Mostly positive
Zukowski (1997)	1	5	3	teacher-identified low performer	reading/ writing	case study	All positive

[a]The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

Findings

Student tutors are certainly a readily available group. Taylor, Hanson, Justice-Swanson, and Watts (1997) studied a program that drew fourth-grade tutors from within the school to work with second graders. Their availability was somewhat tempered, however, by the work needed to coordinate schedules between the two classes. It is not clear what the tutors in this program were expected to gain from the experience, and it is important to consider the instructional time these older students were missing during their school day. For this reason, it is likely that programs of this type tend to be scheduled outside the school day, and this observation may well explain the lack of available school-day research on at-risk tutoring interventions.

Regardless of the logistics, there does seem to be potential in this type of program. Zukowski (1997) relates a qualitative account of a fifth-grade tutor's pairing with a third-grade tutee. Raymond, the tutor, was pleased to take the lead in his work with Ian, the struggling student. As described, Ian was motivated through his work with Raymond. The author describes this as a reciprocal effort in a powerful pairing. Unfortunately, it is not clear from the study just how exceptional such a pairing is. In more

general terms, Harris, Marchand-Martella, and Martella (2000) report a successful program that relied on minimal tutor training. An analysis of specific pairing within this study may have revealed a fair number of pairings similar to Raymond and Ian.

In the previous section, we described the importance of appropriate and substantial tutor training with the volunteers. Here, too, we see this need as it applies to even younger tutors. Taylor et al. (1997) describe tutor training that includes specific approaches to teaching. When the reader is stuck on a word, for example, the tutor should not automatically say the word. In an effort to determine the lack of results seen in their study, Jenkins, Jewell, Leicester, Jenkins, and Troutner (1991) suggest that it may have been inappropriate instruction that was the cause. Again, we see that there is no strong need for complexity in the training and resulting instruction, but it does appear that the training needs to be well suited to the tutor, and that the instruction does need to be purposive. And, although having purpose does appear to be important, this purpose does not necessarily need to be driven by theory or even curriculum for that matter. Tomlin (1995) describes a tutoring program that is just as much a program of mentoring. The high school-age tutors were clearly guided by the program, and the program yielded positive academic results.

SUMMARY OF FINDINGS ACROSS TUTORING SUBCATEGORIES

A review of the tutoring literature makes it clear that success is achieved through tutoring. Elbaum et al. (2000) reports meta-analytic effect sizes of 0.5 standard deviations, Wasik (1998) reviews 17 programs illustrating varying degrees of success, and Fager (1996) lists a number of positive effects of tutoring programs. The Wasik and Slavin (1993) review of studies examined five large-scale tutoring models of reading students identified as at-risk for failure in reading skills. The authors report significant academic effects of tutoring programs using professional tutors and provide evidence that these effects show signs of permanence.

We have attempted to move beyond these results toward a better understanding of the common characteristics of successful tutoring programs. Unfortunately, the insufficient sample sizes and research quality found in the tutoring studies leave some important questions unanswered. For example, we would like to report whether or not the amount of tutor training correlates with the achievement of their tutees. But no research comparison between professional and volunteer tutors was available. We would also like to report whether the duration and frequency of the sessions resulted in significant gains. Again, research that isolates these variables for comparative purposes was not among the available studies. Further research is needed in these areas.

In the absence of specific supporting research, however, we are able to compile a list of characteristics common to the successful tutoring programs described in this chapter. These results are presented as a guide to tutoring practitioners in the following section.

A Final Word to Practitioners

The recent studies on tutoring research in this chapter suggest that tutoring can be an effective approach in serving at-risk students. The studies presented here are largely studies of early literacy, and it is from this body of work that we draw the following preliminary conclusions:

- Tutors with virtually every level of education have been used, provided the intervention was proceded by appropriate tutor training.
- Effective tutoring sessions are characteristically monitored and adapted with appropriate frequency by program implementers.
- A strong guiding purpose (one that directs tutors in their decision making) seems to integral in an effective tutoring program.
- The diagnostic and prescriptive interaction is encouraged in effective tutoring practice.

The research also suggests the importance of these programmatic considerations:

- Program logistics such as availability of materials, instructional space, and scheduling may have a significant effect on program results.
- Finding and retaining quality tutors should be a primary concern.

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ANNOTATED BIBLIOGRAPHY OF SELECTED REFERENCES

This annotated bibliography provides a description of two prior syntheses along with three of the research articles that were coded as high in quality for this synthesis. This group of five references was chosen in an effort to present a strong primary source for current at-risk tutoring research.

Elbaum, B., Vaughn, S., Hughes, M. T., & Moody, S. W. (2000). How effective are one-to-one tutoring programs in reading for elementary students at risk for reading failure? A meta-analysis of the intervention research. *Journal of Educational Psychology, 92*(4), 605–619.

Elbaum et al. conducted this meta-analysis of reading program studies published between 1976 and 1998. Each of the studies synthesized utilized adult tutoring interventions in an effort to improve the achievement of at-risk students. In their results, the authors report a combined effect size of more than 0.5 standard deviations for the tutored students. They suggest that a well-designed, carefully implemented program need not be staffed by trained professionals in order to be effective.

Wasik, B. A. (1998). Volunteer tutoring programs in reading: A review. *Reading Research Quarterly, 33*(3), 277–292.

This is a thorough review of early literacy volunteer tutoring program studies that was conducted in response to the America Reads Challenge Act of 1997. In this review, Wasik describes 17 studies that report evaluative evidence of program success and then draws comparisons between them. The early literacy programs have strikingly similar intervention strategies while being characterized by widely varying levels of tutor training. The appendix of the work is a comprehensive table that clearly illustrates comparisons between program logistics and evidence of programmatic success.

*McCarthy, P., Newby, R. F., & Recht, D. R. (1995). Results of an early intervention program for first grade children at risk for reading disability. *Reading Research and Instruction, 34*(4), 273–294.

In this study of 38 at-risk first-grade readers in the Early Intervention Program (EIP), McCarthy et al. report results on a variety of reading and writing measures. The tutored students (n = 19) received 30 minutes of instruction three times each week for 20 weeks. These sessions are described by the authors in detail, details that are similar to the characteristics of the large-scale Reading Recovery program. The EIP tutors were reading specialists who were given additional training by the senior researcher. The combined result of the tutoring program is reported in an effect size of 0.7 standard deviations.

Baker, S., Gersten, R., & Keating, T. (2000). When less may be more: A 2-year longitudinal evaluation of a volunteer tutoring program requiring minimal training. *Reading Research Quarterly, 35*(4), 494–519.

This Baker et al. article is a study of SMART, a volunteer tutoring program implemented widely in Oregon. SMART is an early intervention reading program characterized by its low cost, its brief tutor training phase, and the high return rates of program volunteers. The first- and second-grade student participants (n = 127) were tutored for two half-hour sessions each week of the school year. Among the results of this work is a set of reported effect sizes ranging from .32 to .53 standard deviations on a series of five different reading measures.

Cobb, J. B. (2001). The effects of an early intervention program with preservice teachers as tutors on the reading achievement of primary grade at risk children. *Reading Horizons, 41*(3), 155–173.

Manipulatives and games were used in a program described by Cobb in this study. Sixty at-risk students were studied as they learned phonological awareness and comprehension strategies by preservice teachers. The tutors met with their students for 45 minutes twice each week during the 10-week program. Cobb's presentation of quantitative and qualitative results gives the reader a strong sense of program dynamics and success. Among the results, the author reports that the program encouraged significant gains in grade one, while the second- and third-grade results were inconclusive.

CHAPTER 6

PEER TUTORING

Zoe Barley

From the group of studies focused on assisting low-achieving students to meet standards, peer tutoring was identified as an intervention that has been studied fairly extensively. Peer tutoring is different from tutoring in the sense that peer tutoring involves pairs of students working with each other in the learning process. Peer tutoring dates back to the late 18th century when two British superintendents of schools for disadvantaged children adopted peer tutoring in the 1700s as an efficient means to provide more instruction to the children. It became popular subsequently in Britain, but the practice waned there, and in the U.S., after the late 1800's. Then in the 1960s, there was a resurgence of interest and use as an economical means to increase achievement especially for poor and minority students (Topping, 1988). Given the intent of the No Child Left Behind Act of 2001 that all children attain standards, peer tutoring again becomes a strategy of importance. Since peer tutoring responds to "an implicit skepticism about classroom teachers' capacity to provide intensive, systematic, effective instruction to a broad range of learners via conventional large-group instruction" (Fuchs, Fuchs, Mathes, & Simmons, 1997, p. 180), it seeks to provide means for teachers to provide one-on-one attention to low-achieving students.

BACKGROUND

Peer tutoring is "the individualized instruction of one student by another" (Ehly, 1986, p. 2). Given the concern of this synthesis with strategies for the regular classroom teacher, for the purposes of this chapter peer tutoring is typically as an arrangement of students in the classroom into pairs with the pair assisting each other to learn basic facts in a variety of subject areas. Two meta-analyses have been completed on peer tutoring, one in 1977 (Hartley) and one in 1982 (Cohen, Kulik, & Kulik). Although there were other earlier reviews, Cohen et al. (1982) note limitations with them: "None provided precise statements about the size of the learning gains to be expected from tutoring or about the conditions under which positive effects are likely to occur" (p. 238). Similarly, a narrative review by Gensemer (2000) does not examine the quality of studies nor provide an overall estimate of the effect of peer tutoring.

Hartley's (1977) review, a meta-analysis resolving some of the concerns of the earlier reviews, focused only on mathematics and had some methodological weaknesses. Cohen et al. (1982) designed their work to build on Hartley's work. More recently, a best evidence synthesis (Mathes & Fuchs, 1994) was conducted focusing on peer tutoring as a means of support for children with mild disabilities. The best evidence synthesis discusses several other reviews focused on students with disabilities. Since the current synthesis is interested in strategies for the regular classroom teacher, these reviews and many of the studies they reviewed are less pertinent to this paper. To reiterate, our focus is on low-achieving students and includes students with a broad array of handicapping conditions, but the studies included are about strategies that occur within the purview of the regular classroom teacher.

Researchers describe the value of peer tutoring to be based in its typically teacher-friendly materials, comprehensive manuals (for some versions), the fact that it does not intrude on instructional time replacing independent seatwork with peer work, and its ability to reach the low-achieving students in today's increasingly diverse classrooms. Although training of teachers to use peer tutoring methods is not arduous, typically researchers provide assistance with training of student pairs and ongoing technical assistance to ensure that the tutoring is carried out as designed. This support raises untested questions about teacher ability to implement peer tutoring in the absence of such support.

Peer tutoring may involve role reciprocity in which equal-ability students trade roles of tutor and tutee during a session. Or an academically stronger student may be paired with an academically weaker student. If they are in, or close to, the same grade level, it is peer tutoring; large differences in grade levels are more often designated as tutoring. Thus, included in this section of the paper are studies in which upper grade children worked with lower grade children if it was a mutual process — that is, if the older child also was expected to benefit academically from the tutoring. In some cases, the older child was the low-achieving student for which the strategy was intended. But if the older child was academically stronger, the study was categorized as tutoring rather than peer tutoring.

METHODOLOGY

Selection/Exclusion of Studies

An initial set of 46 studies with peer tutoring referenced was reviewed for inclusion: of these, 30 are included in this section of the synthesis. Sixteen studies were excluded for the following reasons: (1) peer tutoring was part of a complex intervention and could not be examined apart from the full set of strategies (n = 7); (2) although called peer tutoring, the strategy did not meet the definition for this review (n = 3); or (3) the research was so compromised by design flaws and other biases that the results could not be trusted (n = 6). Three of these latter six were single-subject quantitative designs. The comparability of the results of single-subject quantitative studies to group designs is not sufficiently clear to include them in the review.

Subgroupings within Peer Tutoring

The studies on peer tutoring that met the inclusion criteria were then organized into four subcategories based on four variations developed by author groups who have conducted the bulk of the research in peer tutoring. The most predominant approach in the literature from 1985 to the present is Classwide Peer Tutoring (CWPT), developed by Greenwood, Delquadri, and Carta (1988) as part of the Juniper Gardens Children's project at the Schiefelbusch Institute for Life Span Studies at the University of Kansas. There are 10 studies, post-1985, from the group included in this review. Deborah Simmons and Douglas and Lynn S. Fuchs and colleagues (Simmons, Fuchs, Fuchs, Hodge, & Mathes, 1994) also studied aspects of CWPT including the addition of Peer Assisted Learning Strategies (PALS). There are eight studies in this review from their work. H. Edmund Pigott and John W. Fantuzzo and colleagues developed Reciprocal Peer Tutoring (RPT) and focused much of their work on mathematics achievement. There are six studies included from their work. Finally, six studies, including three from Larry Maheady

and colleagues (Maheady & Harper, 1987; Maheady, Sacca, & Harper, 1987, 1988), also have explored variations on CWPT. An evaluation of multiple grantees of a federal program completes the set.

In the rest of this chapter, the four subcategories are discussed one by one with a table including brief details for each included study. For each group, there is a description of the studies included, salient features of the studies including individual studies of note, and overall conclusions about the group. Finally, the paper closes with a summary across groups.

CLASSWIDE PEER TUTORING

Classwide Peer Tutoring (CWPT) uses a period of time, approximately 30 minutes, in each day or for two to five days of the week for pairs of students to work together in learning basic information within a subject area. Typically this is time that would otherwise be spent on workbooks or other self-directed activities. The teacher must prepare materials for the pairs to use (scripted tutor and tutee interactions that include task presentation, question asking, error correction, point earning, feedback, and positive reinforcement), assign students to pairs, train the students how to serve as both tutor and tutee, prepare assessment materials based on the materials, and monitor the tutoring sessions. In each session, the pairs rotate roles, serving as both a tutor and a tutee. In addition, pairs are assigned to teams, and the points are awarded to the pairs, according to the mastery of the material by each student, are aggregated into team scores. The winning team receives a reward. Usually students are reassigned to new pairs weekly (Greenwood, 1991b).

Multiple studies have been done on CWPT variants. Some are not included in this review because they did not include student achievement as an outcome, others because they did not include low-achieving students or were not pertinent to regular classroom practice. Some studies specifically looked at the relative efficacy of implementation variants (e.g., Greenwood, Terry, Arreaga-Mayer, & Finney, 1992; Kohler & Greenwood, 1990) and may or may not have included achievement variables. In a recent article, Greenwood and associates (2001) describe their 18-year "program of research designed to improve literacy of poor culturally and linguistically diverse students and English language learners" (p. 34). They go on to say:

> Peer-tutoring roles in CWPT are designed to be reciprocal; that is, each student serves as both tutor and tutee during each CWPT session. In CWPT, unlike in teacher mediated instruction, it is possible for students to experience one-on-one pupil-tutor dyads during sessions; relatively immediate error correction; fast pacing and multiple opportunities to respond; both teacher and learner roles; written and oral learner response formats; inclusion; and social and academic goals addressed during the same instructional time. (p. 35)

Several longitudinal studies and several replications have been completed. Greenwood, Carta, and Kamps (1990) summarized the main components that lead to effectiveness as (1) tutoring activities are highly structured, (2) teachers carefully monitor tutoring behaviors, (3) tutoring participants receive specific training, (4) students are well prepared for the tutoring role, and (5) during tutoring sessions teachers monitor the tutoring activity and provide feedback on proper procedures.

Overview of Studies

The 10 post-1985 studies in this review of CWPT include nine elementary level and one high school: seven focused on spelling (three of which also included mathematics and or reading); one on reading, mathematics, and language; one on literacy for English language learners; and one on Spanish vocabulary (the high school study). The nature of at-risk varies across these studies: two, as indicated in Table 6.1, involve language learners; three involve mainstreamed students with mild disabilities; three involve comparing students with low socio-economic status (SES) to students with high SES; and two involve poor performers identified by standardized tests or low scores on the pretest in the study.

Preferably studies would have a fairly large sample of students in order to see if there is a difference between groups, would use standardized approaches to assessing results, and would compare peer tutoring to regular classroom practice. In this case, five studies follow 20 or fewer students in one or two classrooms; only one of these has a way to compare to regular teacher practice for low-achieving students. Only the two longitudinal studies and the follow-up study used standardized measures with a no-treatment comparison group. The rest used weekly teacher-derived tests. Table 6.1 reports the results in terms of whether the effect of peer tutoring was either positive for low-performing students in the treatment group compared to those in the no-treatment group, even, or negative. When NA is used in the "Direction of Result" column, it typically means insufficient information was provided to determine the result.

Findings

Overall, CWPT is well defined as an intervention, and methods in the studies monitored that it was correctly implemented. Tools are available for teacher use (Greenwood, Hou, Delquadri, Terry, & Arreaga-Mayer, 2001). Various types of at-risk children have been studied. Several studies are of insufficient size or use inadequate measures to add to evidence of the effectiveness of CWPT. Most promising as sources of research evidence are the two longitudinal studies and the follow-up study two years later. In the case of the 1991 study, the following effect sizes[6] were obtained: first-grade reading and language .36 and .33 respectively, comparing the treatment group to a control group of similarly low-SES students; for a high-SES comparison group with no treatment, the effect sizes compared to control were .71 and .48 respectively. Thus, high-performing students also fared well in peer tutoring. The follow-up study at sixth grade showed effect sizes of .55, .23, .40, .22, and .49 in reading, mathematics, language, social studies, and science. Another way to think of this is that low-SES students who received CWPT outperformed their peers who did not earn up to 30 percentage points above them. Even more impressive as evidence of the effectiveness of CWPT is the Greenwood 1991a and 1991b study, a longitudinal study tracking students from first through fourth grade and comparing low-SES schools in experimental and control conditions to students in two high-SES schools in the same district. Despite high losses of students due to relocation, and highest in the experimental schools, the effect sizes of the experimental group at the end of fourth grade of .57 in reading, .37 in mathematics, and .60 in language are very

[6] The effect size is the difference between the treatment and comparison groups expressed in standardized units. An effect size of .3 or greater is considered large enough to be practically meaningful.

encouraging. Although the high-SES comparison group had higher effect sizes, there were no statistically significant differences in rate of gain; that is, the low-SES group at least held its own.

Focusing on the six studies with useable results, there is preliminary evidence to support the use of CWPT for at-risk elementary children, in particular those from low-SES backgrounds in reading, mathematics, and spelling.

Table 6.1. Post-1985 Studies on Classwide Peer Tutoring (CWPT)

Author(s) &Year	Treatment Size	Grade	Student Description[a]	Strategy Description	Subject Matter[b]	Type of Comparison	Results[c]
DuPaul, Ervin, Hook, & McGoey (1998)	19	1–5	ADHD	CWPT	math, spelling	ABAB 2 grp post nonrandom	NA
Greenwood (1991a) (longitudinal)	241	1, 2	SES	CWPT	spelling, reading, math	3 grps pre-post nonrandom	All positive
Greenwood, Arreaga-Mayer, Utley, and Gavin, & Terry (2001)	117	1–5	ELL	CWPT	spelling, vocabulary	1 grp pre-post nonrandom	All positive
Greenwood, Delquardi, & Hall (1999) (longitudinal)	56	1–4	SES	CWPT	Reading mathematics language	3 grps pre-post nonrandom	All positive
Greenwood, Dinwiddie, Bailey, Carta, Dorsey, Kohler, et al. (1987)	174	1, 2	low test scores	CWPT	spelling	ABAB 1 grp post nonrandom	Mostly positive
Greenwood, Terry, Utley, Montagna, & Walker (follow-up to 1991) (1993)	216	6	Follow up of Greenwood, 1991	CWPT	spelling, reading, mathematics	Follow up	Mostly positive
Madrid, Terry, Greenwood, Whaley, & Webber (1998)	16	1	low test scores	2 versions of PT	spelling	ABC 1 grp pre-post nonrandom	Mostly positive
Mortsweet, Utley, Walker, Dawson, Delquadri, Reddy, et al. (1999)	4	2, 3	mild mental retardation	CWPT	spelling	ABAB 1 grp nonrandom	NA
Sideridis, Utley, Greenwood, Delquadri, Dawson, Palmer, et al. (1997)	3	6	mild disabilities	CWPT	spelling	ABAB 1 grp nonrandom	NA
Wright, Cavanaugh, Sainato, & Heward (1995)	16	High School	LD or poor performance	CWPT	Spanish vocabulary	1 grp pre-post nonrandom	NA

[a] ADHD=Attention Deficit Hyperactivity Disorder; ELL=English language learner; LD=learning disabled
[b] ABAB=no treatment, treatment repeated periods; ABC=no treatment, treatment B, then treatment C
[c] The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

PEER-ASSISTED LEARNING STRATEGIES (PALS)

A second group of researchers at Peabody College of Vanderbilt University built on the foundation of CWPT. Their work has pursued several different avenues to expand on the earlier research. One of their concerns, evidenced in all but one of the studies reviewed, has been the mainstreamed, learning-disabled student. Another has been various modifications of CWPT (Simmons et al., 1994) as well as how the student dyads are assigned and how teachers are supported in using CWPT. The 1994 Mathes, Fuchs, Fuchs, Henley, and Sanders article provides an overview of the method.

Within this group of researchers are those who developed the Peabody PALS (Peer Assisted Literacy Strategies) for lower elementary grades. This intervention expanded the original CWPT to engage students in strategic reading activities (Mathes, Howard, Allen, & Fuchs, 1998) designed to increase student abilities to (1) cumulatively review information read, (2) sequence information, (3) summarize paragraphs and issues, (4) state main ideas in as few words as possible, and (5) predict and check outcomes. PALS versions are described as subject specific and grade specific and include content materials for teacher and student use (e.g., First Grade PALS was developed as an earlier grade version of Peabody PALS). Students are paired within the classroom and complete a tutoring routine. (In several studies, a stronger student assumed the tutor role and a low-achieving student was assigned the tutee role; that is, the tutoring was not reciprocal.) Pairs earn points and are assigned to teams such that a winning team can be announced at the end of the week. The incorporation of critical content identified through research sets the literacy PALS apart.

Overview of Studies

Within this author group's work, eight studies were found that met the inclusion criteria (see Table 6.2). Each of them examined peer tutoring with elementary age children, and all but one focused on learning disabled children in the regular classroom. The remaining one identified low-achieving students through performance on a series of screening tests. The Simmons, Fuchs, Fuchs, Mathes and Hodge study (1995) examined the use of Explicit Teaching (ET), a form of direct instruction, given the general thinking that it is a better methodology for the lower performing student. In the most recent study looking at PALS and elementary mathematics, kindergarten students as reciprocal peers were studied.

The studies in this group are of high quality with careful attention to fidelity of implementation, teacher satisfaction, training of teachers, and increasingly more rigorous use of measurements and analyses. Limitations generated in part by the implementation methods used to ensure rigor are that the support for teachers (e.g., assistants often train the students in CWPT methods) and the observations and consultation for teachers by the researchers during implementation may compromise generalizability. Most peer tutoring studies are coded as nonrandom in the sense that teachers are assigned to experimental or control groups but not students whose scores are the unit of analysis.

Findings

To a degree, the variety in the studies of grade levels, subject matter, and aspects of peer tutoring adds complication to determining what we now know or do not know about the use of peer tutoring in

elementary classrooms. One of the more recent studies is a replication (Mathes & Babyak, 2001) in which the use of teacher-directed advanced mini-lessons for the low-achieving students was added to give them a boost as they engaged in peer tutoring. This study also did not use reciprocal tutoring but paired a stronger student with a weaker. Despite some problems with teacher implementation of the mini-lessons, effect sizes of 1.22, 1.14, 1.37, and .50 on word identification, word attack, basic skills, and passage comprehension for low-average students offer great promise for use with low-achieving early readers. The most recent mathematics study with kindergarten children (Fuchs, Fuchs, & Karns, 2001) produced mixed and somewhat difficult to interpret results on its two outcome measures but does demonstrate that kindergarten students can engage in peer tutoring. Effect sizes of .46 and .41 for low-achieving and disability students on a math readiness measure, and .31 and .22 on a primary mathematics measure, also show promise for peer tutoring in the early grades.

This set of studies provides preliminary evidence on the effectiveness of peer tutoring with elementary level children who are learning disabled in math and reading.

Table 6.2. Post-1985 Studies on Peer-Assisted Learning Strategies (PALS)

Author(s) &Year	Treatment Size	Grade	Student Description[a]	Strategy Description	Subject Matter	Type of Comparison	Results[b]
Fuchs, Fuchs, Hamlett, Phillips, & Bentz (1994)	30, 30	2–5	LD, LP as determined by testing	PT + weekly feedback to teachers, feedback only	Math	3 grps pre-post nonrandom	Mostly positive
Fuchs, Fuchs, & Karns (2001)	84	K	Spec ed + low test scores	PALS	Math	2 grps pre-post nonrandom	All positive
Fuchs, Fuchs, Mathes, & Simmons (1997)	60	2–6	LD & low test scores	PALS	reading	2 grps pre-post nonrandom	All positive
Fuchs, Fuchs, Phillips, Hamlett, & Karns (1995)	120	2–5	LD & low test scores	PALS	math	2 grps pre-post nonrandom	Mostly positive
Mathes & Babyak (2001)	130	1	Teacher determined LP + low test screening	PALS, PALS + mini lessons	reading	3 grps pre-post nonrandom	All positive
Mathes, Howard, Allen, & Fuchs (1998)	96	1	Low screening test	PALS	reading	2 grps pre-post nonrandom	All positive
Simmons, Fuchs, Fuchs, Hodge, & Mathes (1994)	118	2–5	LD + teacher determined LP	4 modifications of CWPT	reading	4 grps pre-post nonrandom	Mostly positive
Simmons, Fuchs, Fuchs, Mathes, & Hodge (1995)	68	2–5	LD + teacher determined LD	Explicit teaching (ET), ET with PT	reading	2 grps pre-post nonrandom	Mostly positive

[a] LD=learning disabled; LP=low performing

[b] The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

RECIPROCAL PEER TUTORING IN ELEMENTARY MATHEMATICS

Fantuzzo, Davis, and Ginsburg (1995) describe the Reciprocal Peer Tutoring (RPT) strategy as follows:

> The RPT strategy is designed to enhance learner control and peer cooperation. It provides a pair of students with the opportunity to alternate between the student and teacher roles. The intervention includes a structured peer-tutoring format to guide the dyad through the learning process and a cooperative reward system that the students help design, evaluate, and use to manage their own reinforcement procedures. (p. 273)

Ginsburg-Block and Fantuzzo (1997) add, "RPT emphasizes having the peer teacher prompt and praise the student and seek the classroom teacher's help if needed, rather than having the tutor provide instruction or elaborate explanations beyond their ability level" (p. 136).

Overview of Studies

In the earliest study of this post-1985 group (see Table 6.3) Pigott, Fantuzzo and Clement (1986) trace the development of RPT to literature supporting an intervention that "combines the benefits of peer tutoring, interdependent group reward contingencies, and individual accountability procedures" (p. 93). The 1986 study is a replication and expansion of an earlier Pigott study. This study does not use pairs of students, typically what is meant by peer tutoring, but assigns groups of four classmates to four tutoring roles. The three groups of low-achieving students increased their performance to a level indistinguishable from their higher performing peers.

There are five additional studies in this group. Following the Pigott et al. study (1986), Fantuzzo, Polite, and Grayson (1992) found that the combination of two components — the interdependence of the members of the pair in achieving their goals and student pair choice in selecting rewards — was most effective in increasing mathematics computation rates. He called the two elements the *structure* of the RPT (structured so the members of the pair are interdependent) and the *reward* (that the pairs receive rewards of their own choosing). When both elements were present, the low-performing pairs outperformed the comparison groups with one or none of the elements. Across all groups, choosing the reward resulted in higher performance, but the same was not true for the structure of interdependency. Heller and Fantuzzo (1993) added a parent involvement intervention and compared RPT, with and without parent involvement, to a control group. The 1995 Fantuzzo et al. study, an extension of the Heller and Fantuzzo study, separated out the parent involvement component for individual study. Ginsburg-Block and Fantuzzo (1997) built on a Fuchs, Fuchs, Hamlett, Phillips, and Bentz (1994) study that compared peer tutors trained in the process to those not trained. This study added observations of the actions of the peer tutors and an achievement outcome measure — math computations — as well.

Findings

Increased achievement for low-achieving students was evidenced with the use of RPT in each of these studies (except the Pigott study and the 1995 Fantuzzo study, which only looked at RPT combined

with parent involvement). Three studies explored mediating factors of the intervention, and two looked at added parent involvement elements. These studies were able to randomly assign students by selecting them from their regular classes and placing them in an experimental classroom. This classroom was managed as a classroom teacher would but conducted by the research team. What has not been examined here is the management of RPT by typical classroom teachers. Teachers were actively involved; whether there would be difficulty in managing RPT as part of the regular classroom experience has not been demonstrated. Adding the parent involvement, although a strong component, adds a management burden for the teacher.

Given that these studies used random assignment of children to groups, the six studies provide conclusive evidence for the effectiveness of peer tutoring for elementary children identified as low achieving in math. However, whether these findings can be generalized to the regular classroom has not been demonstrated.

Table 6.3. Post-1985 Studies on Reciprocal Peer Tutoring (RPT)

Author(s) &Year	Treatment Size	Grade	Student Description[a]	Strategy Description	Subject Matter	Type of Comparison	Results[b]
Fantuzzo, Davis, & Ginsburg (1995)	26	4–5	LP in math, Afr Amer	RPT+ parent involvement, parent involvement	math	3 grps pre-post random	All positive
Fantuzzo, King, & Heller (1992)	16	4–5	LP, Afr Amer	Full RPT, reward only, structure only	math	4 grps pre-post random	All positive
Fantuzzo, Polite, & Grayson (1990)	12	4–5	LP, low SES	RPT	math	2 grps post random	All positive
Ginsburg-Block & Fantuzzo (1997)	20	4–5	LP, low SES	RPT	math	2 grps pre-post random	All positive
Heller & Fantuzzo (1993)	28	4–5	LP, Afr Amer	RPT, RPT + parent involvement	math	3 grps pre-post random	All positive
Pigott, Fantuzzo, & Clement (1986)	12	5	LP	RPT – 4 member group	math	2 grps ABAB pre-post random	NA

[a] LP=low performing

[b]The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

ADDITIONAL PEER TUTORING STUDIES

Six additional peer tutoring studies were found (see Table 6.4) — four of which are further examinations of Classwide Peer Tutoring (CWPT); one of which (Maheady et al., 1988) is a further development of CWPT called CSTT; and a sixth, which is simply designated as peer tutoring. One of the studies examines peer tutoring at the middle school level in math, and three examine peer tutoring at the high school level in math, social studies, and history. Four of the six studies use ABAB single-group reversal designs with comparisons made between periods of treatment and baseline or periods of no treatment. Several upper-grade-level studies note that the use of peer tutoring has been applied only to

basic skills and that much remains to be understood about applications to higher order thinking skills. One study (Allsopp, 1997) examining eighth-grade student achievement in algebra did develop more complex worksheets for the tutor pairs to use. This study, which had a nonrandom comparison group using class as the unit of analysis, found no effect.

Table 6.4. Post-1985 Studies on Various Forms of Peer Tutoring

Author(s) Year	Treatment Size	Grade	Student Description[a]	Strategy Description	Subject Matter	Type of Comparison[b]	Results[c]
Allsopp (1997)	140	8th	Low-achieving in math	CWPT	algebra	2 grps pre-post non-random	Even
Bell, Young, Blair, & Nelson (1990)	59	9,10	LD in diverse classroom	CWPT	history	1 grp pre-post	NA
Cardona & Artiles (1998)	19	1st	ESL in diverse classrooms	PT and mixed ability grps	math	1 grp pre-post nonrandom ABAB	Mostly positive
Maheady & Harper (1987)	70	3,4	Low-achieving in spelling	CWPT	spelling	1 grp pre-post nonrandom ABAB	All positive
Maheady, Sacca, & Harper (1987)	91	9,10	Mild handicapped in diverse classrooms	CSTT – 3 person teams	math	1 grp pre-post nonrandom ABAB	NA
Maheady, Sacca, & Harper (1988)	50	10th	Mild handicapped in diverse classrooms	CWPT	Social studies	1 grp pre-post nonrandom ABAB	NA

[a] LD=learning disabled; ESL=English as a second language
[b] ABAB=no treatment, then treatment periods repeated.
[c] The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative, from Cooper, Charlton, Valentine, and Muhlenbruck (2000).

Finally, one additional study (Pringle, Anderson, Rubenstein, & Russo, 1993), an evaluation of the fundees of a large federal program, not included in the table, warrants comment. The program funded 31 one-year grants to explore innovative ways of helping disadvantaged secondary students attain proficiency in basic and more advanced skills. Data from 13 grantees were used in the report. Findings suggest that peer tutoring and mentoring can be useful in addressing the needs of disadvantaged secondary students. Eight programs showed modest positive effects on academic achievement. However, the wide variance in both implementation factors and outcome measures limits the useable data from the programs. And, to a large extent, the tutoring seems to have occurred outside the regular classroom.

SUMMARY OF FINDINGS ACROSS STUDIES OF PEER TUTORING

Reviewing the studies of CWPT both in the Greenwood group and in the final group of studies, we find that the moderate to higher quality studies provide evidence of effectiveness of CWPT for low-

SES and low-achieving elementary students in spelling, reading, and math. There are well-developed materials to support teacher use. Across all studies of peer tutoring, a variety of types of at-risk students have been studied. With the exception of Allsopp's study (1997) and the studies on the use of the PALS materials, the focus has been understandably on basic skills. Researchers express some concern about the amount of training required, of both teachers and students, and more important, the classroom management logistics of tutoring materials including weekly quizzes, assignment and reassignment to peer pairs, score-keeping processes, and rewards.

The Fuchs, Fuchs, and Mathes PALS studies move the use of peer tutoring beyond basic skills. The development of materials therefore requires more than assembling lists of spelling words or basic arithmetic computations. Some PALS materials are available for teacher use. Results are positive, with large effect sizes for PALS plus teacher-provided advanced mini-lessons on new material.

The six Fantuzzo and associates studies also found positive effects and, with random assignment of students to groups, were able to rule out alternative explanations for the results. Their emphasis on student peer pairs being involved in goals setting and selecting rewards from a menu of choices is an enhancement of peer tutoring that has evidence of effectiveness. These studies provide conclusive evidence for the use of RPT with low-performing elementary students in math.

A Final Word to Practitioners

Overall, there is evidence that peer tutoring, when well developed and well supported, can improve achievement for low-achieving students. For CWPT, there is a body of recent evidence supporting its application with low-SES elementary children in reading, mathematics, and spelling. The body of evidence supporting the use of PALS extends this to elementary students classified as learning disabled. And the Fantuzzo and associates' work with variations on reciprocal peer tutoring further confirms the efficacy of forms of peer tutoring for low-achieving elementary students in learning basic material in math.

The main components of PT that lead to effectiveness are as follows:

- tutoring activities are highly structured,
- teachers carefully monitor tutoring behaviors,
- tutoring participants receive specific training,
- students are well prepared for the tutoring role, and
- during tutoring sessions, teachers monitor the tutoring activity and provide feedback on proper procedures.

Thus, to use peer tutoring in a setting, materials must be developed for weekly use, including tutoring materials such as flash cards and assessment materials. The time and process for the tutoring

sessions must be established and pairing arrangements planned. Teachers will need training and logistical support to initiate peer tutoring.

The following references are good resources for examining the requirements and deciding whether and how to conduct peer tutoring:

Fuchs, D., Fuchs, L. S., & Burish, P. (2000). Peer-assisted learning strategies: An evidence-based practice to promote reading achievement. *Learning Disabilities Research & Practice, 15*(2), 85–91.

Greenwood, C. R., Carta, J. J., & Kamps, D. (1990). Teacher-mediated versus peer-mediated instruction: A review of advantages and disadvantages. In H. C. Foot, M. J. Morgan, & R. H. Shute (Eds.), *Children helping children* (pp.177–206). Chichester, England: Wiley.

Greenwood, C. R., Carta, J. J., & Hall, R. V. (1988). The use of peer tutoring strategies in classroom management and educational instruction. *School Psychology Review, 17*(2), 258–275.

Greenwood, C. R., Hou, L. S., Delquadri, J., Terry, B., & Arreaga-Mayer, C. (2001). The Class Wide Peer Tutoring Learning Management System (CWPT-LMS). In J. Woodward & L. Cuban, *Technology, curriculum, and professional development: Adapting schools to meet the needs of students with disabilities.* Newberry Park, CA: Corwin.

Topping, K. (1988). *The peer tutoring handbook: Promoting cooperative learnin*g. Cambridge, MA: Brookline Press.

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ANNOTATED BIBLIOGRAPHY OF SELECTED REFERENCES

The studies selected for the annotated bibliography are representative of the four variations of peer tutoring found in the search of the literature plus an evaluation of federally funded programs.

Fuchs, L. S., Fuchs, D., & Karns, K. (2001). Enhancing kindergartners' mathematical development: Effects of peer-assisted learning strategies. *Elementary School Journal, 101*(5), 495–510.

This study examined whether kindergartners could be effective as peer tutors in twice weekly sessions in mathematics. Kindergarten students were taught how to alternately serve as tutor and tutee in paired sessions. Tutoring sessions were monitored to ensure that tutoring occurred as intended. Students at all achievement levels benefited. Teachers judged the treatments to be feasible and effective.

Ginsburg-Block, M., & Fantuzzo, J. (1997). Reciprocal peer tutoring: An analysis of teacher and student interactions as a function of training and experience. *School Psychology Quarterly, 12*(2), 134–149.

This study examined whether reciprocal peer tutoring for at-risk, fourth- and fifth-grade students in mathematics would improve achievement. Students were randomly assigned to peer tutoring or a control experience in which students were not paired. Those in peer tutoring conducted two 45-minute sessions each week for 10 weeks. Peer tutors were carefully trained in the roles. Those in peer tutoring outperformed the control group and also demonstrated higher rates of on-task behaviors.

Greenwood, C. R., Delquardi, J. C., & Hall, V. (1989). Longitudinal effects of classwide peer tutoring. *Journal of Educational Psychology, 81*(3), 371–83.

The researchers conducted a longitudinal study of the effects of Classwide Peer Tutoring (CWPT) on low-SES elementary school students' achievement. Classwide peer Tutoring involves pairs of students alternately assuming the role of tutor and tutee. A low-SES control group received traditional classroom instruction, as did a high-SES comparison group. CWPT was successively introduced in three subject areas: spelling, mathematics, and reading culminating in a planned use of 90 minutes per day. The low-SES treatment group outperformed the low-SES control group, as did the high-SES comparison group. Attrition was a problem over the four years of the study with the low-SS group losing the largest number of students.

Mathes, P. G., & Babyak, A. E. (2001). The effects of literacy strategies for first-grade readers with and without additional mini-skills lessons. *Learning Disabilities: Research & Practice, 16*(1), 28–44.

This study sought to examine whether first-grade, Peer-Assisted Literacy Strategies (PALS) would be effective for children of different achievement levels in naturally constituted regular classrooms. Children were paired to practice aspects of phonics and share reading and reflection on text for 30 minutes three times a week. As an additional support, teachers provided mini-lessons on the same material. First-grade PALS was effective in enhancing reading performance of low-achieving students. The addition of mini-lessons enhanced the results but teachers resisted implementing them.

Pringle, B., Anderson, L. M., Rubenstein, M. C., & Russo, A. W. W. (1993). *Peer tutoring and mentoring services for disadvantaged secondary school students: An evaluation of the Secondary Schools Basic Skills Demonstration Assistance Program*. Washington, DC: ERIC.

This report is an evaluation of the federally funded Secondary Schools Basic Skills Demonstration Assistance Program. The program funded 31 one-year grants to explore innovative ways of helping disadvantaged secondary students attain proficiency in basic and more advanced skills. Data from 13 grantees were used in the report. Findings suggest that peer tutoring and mentoring can be useful in addressing the needs of disadvantaged secondary students. Eight programs showed modest positive effects on academic achievement. However, the wide variance in both implementation factors and outcome measures limits the useable data from the programs.

CHAPTER 7

COMPUTER-ASSISTED INSTRUCTION

Motoko Akiba

Computer-assisted instruction (CAI) has been identified as an effective strategy to improve the achievement of at-risk students. With the advancement of technology, the use of computers in schools has rapidly increased over the last 20 years. Statistics show that by 1996, 70 percent of fourth graders and 50 percent of eighth and eleventh graders were using a computer at school at least once a week, while less than 20 percent did so 20 years ago (U.S. Department of Education, 2002). Accordingly, the use of technology to improve student learning has become one of the major emphases in the current education reform as expressed in the No Child Left Behind Act of 2001.

Researchers have argued that CAI has the potential to alter the nature of teaching from the traditional, teacher-centered model to a more student-centered instruction approach which especially benefits students at risk (Waxman & Huang, 1996; Waxman, Padron, & Arnold, 2001). Given the current reform focus on low achievers in high-poverty schools and the promise of CAI to improve the achievement of this population, synthesizing the effectiveness of CAI based on the available empirical studies can provide important information for policymakers and educators.

This chapter presents the results from a synthesis of 21 empirical studies published since 1985 that examine the effects of CAI on the achievement of at-risk students. The concept of computer-assisted instruction is defined, the methods used to conduct the meta-analysis are described, the results of the analysis are reported, and a discussion of the findings from selected studies that examined the special features of CAI is provided. Finally, policy implications and suggestions for future studies on the effects of CAI for at-risk students are presented.

BACKGROUND

Benefits of CAI in terms of the achievement of at-risk students have been discussed in many studies (e.g., Waxman et al., 2001; Hessemer, 1986; Cantrell, 1993). These researchers suggest that the following characteristics of CAI contribute to the learning of at-risk students:

- CAI is non-judgmental and motivational.
- CAI gives frequent and immediate feedback.
- CAI can individualize learning through designs to meet students' needs.
- CAI allows for more student autonomy.
- CAI provides a multi-sensory learning environment (images, sounds, and symbols).

Research suggests that teachers in high-poverty schools tend to use teacher-dominated whole-class instruction approaches more often than do teachers in middle-class schools (Devillar & Faltis, 1991). Researchers have observed that CAI changes teacher-dominated classroom interactions to student-centered ones (Swan & Mitrani, 1993, Waxman & Huang, 1996), and that it enables teachers to individualize instruction (Sandholtz, Rnagstaff, & Dwyer, 1992). In addition, CAI motivates students to be actively engaged in learning tasks (Worthen, Vanduzen, & Sailor, 1994). Furthermore, CAI may be especially effective for kinesthetic learners because of its capacity to provide multi-sensory learning environments. It can connect student classroom learning to real-life situations through the use of images, sounds, and symbols (Kozma & Croninger, 1992; Means & Olson, 1994; Poirot & Canales, 1993).

Although many studies have examined the effects of CAI on the performance of low-achieving students, there is no recently published meta-analysis of the effects of CAI on this population. The two syntheses that have examined the effects of CAI on beginning readers included both low and high achievers (Blok, Oostdam, Otter, & Overmaat, 2002) and students with learning disabilities (Hall, Hughes, & Filbert, 2000). This chapter provides additional information for policymakers and educators by systematically summarizing CAI effects on at-risk students through a meta-analysis.

Computer-assisted instruction (CAI) is generally defined as a process in which a computer is used to present instructional material, monitor the progress of learning, and select additional teaching materials in view of a learners' present level of performance (Kestner, 1989; Hessemer, 1986). This synthesis considers only CAI that is designed to assist K–12 low achievers or students at risk, during the regular school day. CAI programs implemented with primarily special education students and high achievers were not examined. In the studies reviewed, students worked individually or in pairs/groups using a computer program that guided their learning. The teacher's role varied depending on the nature of the computer software — some software programs required teachers' input to facilitate the instruction, whereas others required only a minimal role such as troubleshooting.

METHODOLOGY

Selection/Exclusion of Studies

Using the selection criteria described in Chapter 1, a total of 25 studies were examined. Of these, three studies were excluded because the effects of CAI could not be separated from the effects of the larger program that included CAI, and one study was excluded because it dealt with computer-assisted testing, rather than instruction. All of the remaining 21 studies employed quantitative methods to examine the effects of CAI. Of these, 17 studies provided enough statistical information to compute effect sizes, making it possible to conduct a meta-analysis. The four studies that did not provide sufficient information (Francis, 1990; Koza, 1989; Swarm, 1991; Tanner, 1987) were excluded from the analysis.

Meta-analysis

Meta-analysis is a research method that examines the results of a number of studies in order to determine the average effect of a given intervention and identify moderating. Only studies that utilize

quantitative methods can be included in a meta-analysis factors (see Chapter 1 and Appendix B for details).

First, effect sizes were computed for each study, and then an overall effect size across the 17 studies was computed. Then, moderating factors were examined in order to understand how they interact with interventions to influence the effect size observed. For example, subject area is one such factor, and the effect size of CAI use in mathematics may be larger than the CAI use in literacy.

Based on past research and on the information available from the sample of studies, we examined research quality and three program characteristics: subject area (e.g. math, literacy), grade level, and the nature of computer-assisted instruction.

It is important to understand whether and how effect sizes of CAI are influenced by the quality of the study. If effect sizes differ as a function of the study quality, it is wise to pay more attention to the effect sizes presented in high-quality studies.

The association between the effect of CAI and the program characteristics of subject area, grade level, and the nature of CAI is important information for policymakers and practitioners. For example, if CAI in mathematics is more effective than in literacy, and if CAI is more effective for elementary school students than for middle school students, policymakers and practitioners might first implement CAI in mathematics in elementary schools.

Researchers have debated the differences between problem-solving-oriented CAI and skill-oriented CAI in improving the achievement of at-risk students (Emihovich & Miller, 1988; Wepner, 1991). Whether the effectiveness of CAI differs depending on the nature of CAI and, if so, how it differs are other important issues for policymakers to consider.

META-ANALYSIS RESULTS

Description of the Selected Studies

Table 7.1 describes the characteristics of the 17 studies selected for the meta-analysis. The publication year ranged from 1986 to 2002. There were only a few recent studies that met the selection criteria. The table shows that all of the studies examined at-risk students, though these students were defined differently across the studies. The grade level of students involved in the studies ranged from 1st grade to 12th grade. Most studies employed pretest and posttest comparisons between treatment and control/comparison groups. Two studies conducted only posttest comparisons, and two other studies reported pretest and posttest differences without control or comparison group. Outcome measures were mathematics test scores and literacy test scores that included reading, vocabulary, writing, listening, and language. The last column in the table indicates the direction of the study results.

Table 7.1. Characteristics of the Studies Examining the Effects of Computer-Assisted Instruction on the Achievement of At-Risk Students

Author(s) &Year	Treatment Size	Grade	Student Description	Type of Comparison	Subject Matter	Results[a]
Adams (1986)	45	7, 8	Below grade level	2 grps. pre-post random	reading	Even
Bailey (1991)	21	9	Between 1st and 30th national percentile	2 grps. pre-post random	math	All positive
Dellario (1987)	95	9	Enrolled in a basic skill curriculum	2 grps. pre-post matched	reading, math	All positive
Dungan (1990)	121	4–6	Below the 50th percentile	2 grps. pre-post matched	reading, math	Even
Emihovich & Miller (1988)	4	1	Low-achieving African American students	3 grps. post random	math, vocabulary language	Even
Kestner (1989)	60	7, 8	Chapter 1 remedial math program students	3 grps. pre-post matched	math	All positive
Kitabchi (1987)	23	5	African American students in an inner-city school	3 grps pre-post non-random	reading, math	All positive
Kochinski (1986)	20	10–12 yr olds	One year or more below grade level	2 grps. pre-post random	reading	Even
Ligas (2002)	99	6-8	At-risk students	2 grps. Pre-post non-random	reading	All positive
Mickens (1991)	50	9–12	At-risk minority students	2 grps. pre-post random	Math	All positive
Moore (1988)	61	7, 8	Students in remedial math classes	4 grps. pre-post non-random	math	All positive
Ramey (1991)	138	2–5	Given compensatory education	2 grps. pre-post non-random	reading, math	Even
Sinkis (1993)	824	2–6	Chapter 1 students	2 grps. pre-post non-random	reading, math	All positive
Stegemann (1986)	47	4	Under-achievers	3 grps. pre-post random	math	Even
Weller, Carpenter, & Holmes (1998)	63	5	Low-achievers	2 grps. pre-post random	reading, math	Mostly positive
Wepner (1991)	34	8	At-risk students	2 grps. post random	reading, writing	Even
Willingsky & Green (1990)	19	7–9	Potential candidates for remedial programs	3 grps. pre-post non-random	reading, writing	Even

[a] The number of comparisons that were all positive, mostly positive, even, mostly negative, or all negative from Cooper , Charlton, Valentine, and Muhlenbruck (2000).

Overall Effect Size

Effect sizes for the 26 independent samples from 17 studies were computed. The effect sizes varied from -.12 to 1.36. The overall effect size was .37, which can be translated into a percentile

difference of 14 points between the average achievement of the treatment group and the control group. In other words, the average students who received CAI scored 14 percentile points higher than the average students who did not receive CAI. It was found that the effect size could vary from .30 to .44. Because the effect size is greater than zero, it is assumed to have a significantly positive effect. These results demonstrate that CAI is an effective strategy that significantly increases the achievement of at-risk students.

Moderators of CAI Effects

The influence of research quality and three program characteristics of grade level, subject area, and the nature of CAI was examined. The sample size, the presence of pretest and control groups, sampling methods (random or non-random), alignment between research questions and study design, program implementer qualifications, and the reliability of the measurement of key variables were considered in determining the quality of studies. Study quality was coded as low or high.

The subject areas in which computer-assisted instruction was conducted were mathematics, reading/vocabulary, writing, listening, and language arts. Due to the small number of studies that reported results relative to writing, listening, and language arts, these areas were combined with reading/vocabulary to create an inclusive category, "literacy." Mean effect sizes were compared between the CAI programs on math and literacy.

Grade levels were coded as lower elementary (first grade and second grade), upper elementary (third grade to fifth grade), middle school (sixth grade to eighth grade), and high school (ninth grade to 12th grade). When the samples' grade levels spanned multiple grade bands, the mean grade level was used to determine the coding.

The nature of CAI was determined by reviewing the descriptions of the CAI programs in terms of whether they focus on drill and practice, project and problem solving, or both.

T-test statistics were used to analyze the effects of moderating factors with two categories, and *F*-test statistics were used to analyze the effects of moderating factors with three or more categories. The mean effect sizes for high- and low-quality studies did not significantly differ. The results for program characteristics are presented in Table 7.2.

Regarding the program characteristics, 48 out of 61 achievement outcomes involved CAI effects on students in upper elementary grades (3–5) or middle school grades (6–8). Nine achievement outcomes involved CAI effects on lower elementary grade students (1–2), and only four involved CAI effects on high school students (9–12). The effect sizes by grade level varied from .20 to .62, with the highest mean effect on high school students and the lowest mean effect on middle school students. The mean CAI effect size for lower elementary grade students (.59) was similar to that for high school students (.62), followed by the mean effect on upper elementary grade students (.31). Due to the small sample size and large standard deviation, the differences between these means were not statistically significant, but the numerical mean differences by grade level may merit attention.

Table 7.2. Moderators of Effect Sizes: Computer-Assisted Instruction

Program Characteristic (N = 61)[a]	Categories of Characteristic	N[b]	Mean (SD)	*t/F*	Probability
Grade Level	Lower elementary (1–2)	9	.59 (.56)	*F*=1.25	.302
	Upper elementary (3–5)	27	.31 (.70)		
	Middle school (6–8)	21	.20 (.46)		
	High school (9–12)	4	.62 (.28)		
Subject Area	Mathematics	25	.57 (.74)	*t*=2.78	.007
	Literacy	35	.16 (.40)		
Type of CAI	Drill/practice	19	.13 (.47)	*F*=1.53	.229
	Project/problem solving	25	.32 (.48)		
	Mixed	4	.51 (.15)		

[a] N is the total number of achievement outcomes across all studies.
[b] The analysis was conducted treating achievement outcomes as a unit.

Twenty-five comparisons were made to examine the effects of CAI in mathematics, and 35 comparisons were made to examine the effects of CAI in literacy. One study combined the effects of CAI in mathematics and literacy, preventing the examination of CAI effects separately. The mean effect size for CAI in mathematics was .57, as compared to a mean effect size of .16 in literacy. The difference between these effect sizes was statistically significant. Based on these results, CAI in math improves achievement among at-risk students more effectively than does CAI in literacy.

Forty-eight of 61 comparisons were accompanied with explanations on the type of the CAI implemented. Nineteen comparisons examined the effects of CAI focused on drill and practice; 25 comparisons examined the effects of CAI focused on project and problem solving. Four comparisons on CAI programs included both drill/practice and project/problem solving elements. The mean effect size was the largest for the mixed program (.51), followed by project/problem solving (.32) and drill/practice (.13). However, these differences were not statistically significant.

THE EFFECTS OF SPECIAL CHARACTERISTICS RELATED TO CAI

The Role of Teachers

Most of the studies did not provide information on how the teacher was involved in CAI. Given the fact that the role of teachers mediating between students and computers is a crucial influence on students' learning experiences, it is worth focusing on the findings from the few studies that examined the role of teachers involved in CAI.

Kestner (1989) compared the effects of CAI with two different conditions: (1) computer-managed components of instruction that involves teacher decisions about what software is presented to students, and (2) a computer management system that diagnoses and prescribes software for individual students. Kestner found that the group of seventh and eighth graders who had teacher input on the assignments of

software topics showed higher achievement gains in mathematics than did the group of seventh and eighth graders without teacher input.

Moore (1988) examined the interaction between teachers' personalities and CAI on the achievement of seventh- and eighth-grade remedial math students. Teachers' personalities were rated as having positive affect or negative affect based on self-nomination and through interviews with their colleagues. CAI was found most effective when taught by teachers who had generally positive affect — those who frequently praised students and had high expectations for their students.

The role of tutors may also influence student learning through CAI in ways similar to the role of teachers. Kitabchi (1987) examined the effects of Apple Classroom of Tomorrow (ACOT) involving 10 tutors who served as both peer tutors and academic role models to reinforce the learning processes of African American students in an inner-city school. The study revealed that the students who participated in ACOT achieved higher in vocabulary, reading, language, and mathematics than the students who did not participate in ACOT.

In summary, these studies found positive effects of teachers and tutors involved in CAI on the achievement of at-risk students, especially when their interactions with students are positive. However, only the work by Kestner compared matched treatment and control groups; the other studies selected their samples non-randomly. Therefore, the positive effects of teachers' role in mediating students' learning through computers should be viewed with caution.

The Nature of CAI with Special Characteristics

Although 48 achievement outcomes were examined to determine whether the type of CAI (drill/practice vs project/problem solving) had different effects on student achievement, most studies did not provide detailed information on the nature of the CAI that was implemented. Three studies reported special characteristics of CAI that targeted at-risk students. Willingsky and Green (1990) examined the effects of using desktop publishing software to enable students to cooperatively plan, write, layout, and produce a teen magazine. This desktop publishing program was created to provide an opportunity for low achievers to see themselves for the first time as writers working on an important project that would improve their attitudes toward writing. Despite the promising features of the desktop publishing software, no significant effect on improving remedial students' achievement in writing and reading as compared to the control group was found.

Two of the studies examined the analyzed the effects of CAI designed for culturally diverse students. Emihovich and Miller (1988) examined the effects of Logo software, which is sensitive to the learning styles of African American students. Logo software gives students freedom to make discoveries on their own, promotes learning through social and cultural contexts, and encourages considerable verbal communications between students and teachers. The researchers found that first-grade African American students scored higher in mathematics than did first-grade White students under the Logo condition, while White students outperformed African American students in the traditional instruction condition without CAI.

Wepner (1991) also examined the effects on reading and writing achievement of a software package that deals with the real-life issues of African American and Hispanic students as compared with the effects of a skill-focused software. No statistically significant differences were found in reading and writing achievement between the group using real-life-focused software and the group using skill-focused software.

The findings from these three studies on the effects of CAI specifically designed for at-risk students are mixed. In addition, the quality of these studies is questionable due to their lack of control. More high-quality research is needed before conclusions can be made about the effects of special features of CAI for this population of students.

SUMMARY OF FINDINGS ACROSS STUDIES OF COMPUTER-ASSISTED INSTRUCTION

Based on the overall effect size from the meta-analysis of .37, CAI has a significantly positive effect on improving the achievement of at-risk students. This effect size is higher than the effect size of .19 computed in a previous meta-analysis of CAI involving beginning readers (including both high and low achievers) in the United States and abroad (Blok et al., 2002). This substantial difference in effect sizes may indicate that the effect of CAI is more positive for at-risk students in the United States than for high- and middle-level achievers outside of the United States.

The analysis of moderating factors revealed that CAI for at-risk students is more effective in mathematics than in literacy. This is a new finding because previous syntheses focused on a single subject area, and thus did not compare the effect sizes across different subject areas (see Blok et al., 2000; Hall et al., 2000). The stronger effects of CAI in math may be explained by the fact that CAI can provide a rich visual learning environment, such as simulations, which is especially important for mathematical understanding. The variations in other study characteristics did not result in significantly different effect sizes.

Close examination of four studies that addressed the roles of teachers/tutors and three that examined special nature of CAI for at-risk students revealed interesting findings. The four studies reported positive effects of teachers/tutors' involvement in CAI in improving student achievement. One study found that the personalities of teachers affect student learning; at-risk students benefit more from affective teachers in learning through CAI than from non-affective teachers. The three studies that examined the nature of CAI yielded mixed results regarding the effects of CAI targeted for at-risk students. Only one study found significant effects of culturally sensitive CAI for African American students; the other two studies found no effects of their CAI program targeted to at-risk students. More high-quality studies are needed before conclusions can be drawn about the effects of teachers'/tutors' roles and the special features of CAI programs for at-risk students.

Although this synthesis provides new and important information for policymakers and educators, the findings need to be interpreted with caution due to design and methodological limitations. First, the number of studies included in the analysis was small, and a larger set of studies might produce different results. Second, it cannot be assumed that only the subject area makes a difference in the effectiveness of CAI for at-risk students. The range of factors examined in this meta-analysis was limited since the studies

lacked detailed information about many contextual and moderating factors that might influence the observed effect sizes. For example, the amount and nature of interaction among students might make a difference in the effect sizes. Also, different groups of at-risk students might benefit differently from CAI depending on their gender and ethnicity.

It is likely that more studies on the effectiveness of CAI will be conducted in the future as technology's use and value in education increases. These studies should address factors such as student characteristics, learning contexts, the nature of the CAI, and types of interactions between students and teachers. For policymakers and practitioners to learn from these studies and implement CAI based on research results, it is important that researchers report the details of effective CAI programs, the contexts in which they work, and the characteristics of the students involved. More qualitative studies that provide rich contexts of CAI programs would also benefit the field, combined with well-designed quantitative program evaluations. These studies could provide more evidence of the benefits of CAI for at-risk students.

A Final Word to Practitioners

Computer-assisted instruction has the potential to deliver student-centered instruction and to provide supportive learning environments for at-risk students. The results of our meta-analysis of 17 studies revealed that computer-assisted instruction significantly improves the achievement of at-risk students in mathematics and literacy. Its effects were especially strong in mathematics. CAI can be used to improve the achievement of at-risk students at all grade levels. Finally, both drill/practice-based CAI and project/problem-solving-based CAI were found to be effective in improving the achievement of at-risk students.

For information on implementation of CAI and other technology-based instruction, practitioners should consult Roblyer and Edwards (2000) and Sandholtz, Ringstaff, and Dwyer (1997).

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This annotated bibliography provides additional information on several research studies included in the chapter on CAI. The following studies were selected because they provided detailed information on the CAI programs.

Kestner, M. K. (1989). A comparative study involving the administration of computer- managed instruction in a remedial mathematics program. *Dissertation Abstracts International, 51*(03A), 0774.

Kestner compared the effects of CAI on 113 Chapter 1 remedial math program students with two different conditions: (1) computer-managed components of instruction that involved teacher decisions about what software to present to students, and (2) a computer management system that diagnoses and prescribes software for individual students. After a one-semester implementation, the author found that the group of seventh and eighth graders who had teacher input on the assignments of software topics showed higher achievement gains in mathematics than the group of seventh and eighth graders without teacher input.

Moore, B. M. (1988). Achievement in basic math skills for low performing students: A study of teachers' affect and CAI. *Journal of Experimental Education, 57*(1), 38–44.

This study examined the interaction between teachers' personalities and CAI on the achievement of 117 seventh- and eighth-grade remedial math students. Teachers' personalities were rated as having positive affect or negative affect based on self-nomination and through interviews with their colleagues. Based on the comparison of CAI effects taught by the teachers with positive and negative affects, the author found that CAI improved math achievement of remedial students most effectively when taught by teachers with affective natures — those who frequently praised students and felt satisfaction from seeing their students master various skills and develop responsibility for doing homework.

Kitabchi, G. (1987, November). *Evaluation of the Apple classroom of tomorrow*. Paper presented at the sixteenth annual meeting of the Mid-South Educational Research Association, Mobile, AL.

Kitabchi examined the effects of Apple Classroom of Tomorrow (ACOT) involving 10 tutors who served as both peer tutors and academic role models to reinforce the learning processes of 50 African American students (fifth graders) in an inner-city school. ACOT was conducted as a joint project of the

Memphis City Schools and Apply Computer, Inc. The author found after one semester of implementation that the students who participated in ACOT achieved higher in vocabulary, reading, language and math than did the students who did not participate in ACOT after one semester of implementation.

Sinkis, D. M. (1993). A comparison of Chapter One student achievement with and without computer-assisted instruction (Chapter One students, at risk). *Dissertation Abstracts International, 54*(2A), 0422.

This study examined the impact of the JOSTENS Integrated Learning System (ILS) on the achievement of 800 Chapter 1 students (grade 2 to 6). JOSTENS ILS structures CAI programs and presents students with lessons appropriate to their own ability level of learning. It stresses problem solving and real-life applications of skills students mastered. The students in the treatment group received JOSTEN ILS and traditional classroom instruction, whereas the students in the control group received only traditional classroom instruction. One year of implementation indicated that the students who were exposed to the JOSTENS ILS achieved significantly higher in mathematics computation, mathematics problem solving, comprehension, and reading vocabulary than did the students who did not receive any CAI.

Emihovich, C., & Miller, G.E. (1988). Effects of Logo and CAI on black first graders' achievement, reflectivity, and self-esteem. *Elementary School Journal, 88*(5), 473–487.

Emihovich and Miller examined the effects of Logo software, which is sensitive to the learning styles of African American students. Logo software gives students freedom to make discoveries on their own, promotes learning through social and cultural contexts, and enhances considerable verbal communications between students and teachers. 16 first-grade African American students and 20 first-grade white students participated in the program under one of the three conditions: (1) Logo treatment, (2) traditional CAI focusing on mathematical skills and principles, and (3) traditional instruction without CAI. The researchers found that African American students scored higher in math than white students under the Logo condition, while white students outperformed African American students in traditional instruction without CAI.

CHAPTER 8

SUMMARY AND CONCLUSIONS

Zoe Barley and Patricia A. Lauer

This chapter provides a summary of findings and an overall conclusion about research on six strategies to assist low-achieving students during the school day. Results and conclusions should be considered in light of the methods employed, particularly the criteria for inclusion of research studies. Thus, conclusions discussed here are limited to the studies synthesized.

FINDINGS ACROSS THE SIX STRATEGIES

Given the parameters of our literature search and study goals, the 118 studies synthesized in this document are representative of the research on strategies to assist low-achieving students during the school day. There are positive findings for the effects of each strategy on the performance of low-achieving students but in varying degrees, and with the exception of Peer Tutoring and Computer-Assisted Instruction, only a minority of the studies were coded as having high quality.

The following describes the general results of the synthesis for each strategy, and Table 8.1 provides a summary.

1. *General Instruction* — Studies of instruction based on a constructivist approach (e.g., emphasis on meaning and understanding) found positive effects on student achievement. Studies of instruction based on a behaviorist approach (e.g., emphasis on practice and direct instruction) were of a lower research quality than the constructivist studies and produced mixed findings. The total number of studies on General Instruction was too small to support general conclusions.

2. *Cognitively Oriented Instruction* — Studies of cognitive strategy instruction in reading, mathematics, and oral and written language found positive effects on student achievement and included studies coded as having high quality. These findings related to achievement should be considered in light of implementation findings. In particular, some studies found that it is important to provide opportunities for students to practice cognitive strategies, such as summarizing information. In addition, involving peers can help support students' use of cognitive strategies.

3. *Grouping Structures* — The set of studies of heterogeneous student groupings (e.g., cooperative learning), which include high-quality studies, found positive effects on student achievement. Investigators suggested the need for rigorous implementation and teacher training in this type of instructional grouping. Compared to studies of heterogeneous grouping, there was less research support for the use of ability grouping. Furthermore, studies of ability grouping were of lower quality.

4. *Tutoring* — In support of recent meta-analyses of tutoring, studies revealed positive effects on student achievement of tutoring by professionals, students, and adult volunteers, with some high-quality studies in the latter subcategory. Diagnostic-prescriptive interactions with tutees and the need for tutor training are factors that support implementation.

5. *Peer Tutoring* — Findings from studies of peer tutoring in varied formats generally indicated improved student achievement in basic skills. There were two high-quality longitudinal studies in this set of related research. These findings should be considered in light of implementation findings, in particular those related to classroom logistics and the need to train both teachers and students in peer tutoring procedures.

6. *Computer-Assisted Instruction* — Studies of CAI provided sufficient quantitative information for a meta-analysis. A majority of these studies were coded as high quality. Results indicate a positive effect of computer-assisted instruction on student achievement, which was greater for mathematics instruction than for language arts instruction.

Table 8.1. Summary of Research Synthesis

Strategy	Type	Number of High-Quality Studies	Selected Implementation Considerations[a]	Synthesis Results on Positive Effects of Strategy on Student Achievement
General Instruction	Approach	4	Balance of direct instruction and authentic learning	Inconclusive
Cognitively Oriented Instruction	Approach	4	Student practice Student interaction Teacher modeling	Preliminary
Grouping Structures	Intervention	4	Heterogeneous groups Teacher training Student instructions	Preliminary
Tutoring	Intervention	5	Tutor training Program monitoring	Preliminary
Peer Tutoring	Intervention	13	Structured tasks Teacher monitoring Participant training	Preliminary
Computer-Assisted Instruction	Intervention	10	Subject matter	Conclusive

[a] Other implementation issues are described in the individual chapters on each strategy.

RESEARCH QUALITY AND CONTENT

Studies coded as high quality met the criteria for research validity based on standards for quantitative and qualitative research. Of the 118 studies synthesized, 40 studies (34 percent) were coded as high quality. Thirteen of the high-quality studies addressed Peer Tutoring, and 10 addressed Computer-Assisted Instruction. The small number of high-quality studies on four of the six strategies demonstrates

the need for more rigorous research designs, larger sample sizes, and more complete reporting of research procedures in studies of strategy effectiveness.

Two of the strategies examined in this synthesis are approaches — General Instruction and Cognitively Oriented Instruction — and the other four strategies are interventions. As explained in Chapter 1, approaches are conceptually more general and theoretically based, while interventions are more specific and applied. Studies of the two approaches were less specific than the studies of the four interventions. In addition, studies of interventions tended to emphasize basic skills. It may be that the specificity of basic interventions makes it easier for researchers to study them as compared to general approaches. If so, more research is needed to identify implementation details of general approaches to instruction so that their effects on student achievement can be tested and practitioners can have clearer guidelines for implementation.

In addition, there is a need for a cumulative body of research on interventions in which studies systematically build on previous findings to extend results to different conditions, such as different student grade levels and variations in subject matter. The research studies on peer tutoring constitute an example of how researchers can connect their studies in ways that make the findings more informative. The varying research designs and their lack of connection to prior research make it difficult to give general recommendations to practitioners about strategy effectiveness.

Overall Conclusion

As indicated in Chapter 1, this research synthesis addresses the following research question: What are effective strategies that can be used to assist low-achieving students? Results indicate that approaches using cognitively oriented instruction and interventions using heterogeneous student groupings, tutoring of students by adults and peers, and computer-assisted instruction can be effective strategies in improving the performance of low-achieving students and students who are at risk for low achievement. Although deriving guidance on strategy implementation is not a goal of this document, implementation issues emerged in the analyses of study findings. Practitioners, in particular, should be aware of the influences of these factors on overall strategy effectiveness and should consult the resources suggested at the end of each chapter for guidance.

Finally, this synthesis was limited to studies of strategies that target low-achieving students and that are implemented in regular classrooms during the school day. There are other studies that examine classroom strategies designed to raise student achievement but that do not examine differential effects for low achievers. For example, Marzano's (1998) meta-analysis identified nine instructional strategies (including cooperative learning, examined in Chapter 4 of the current synthesis) that improve achievement of the general population of K–12 students (see also Marzano, Pickering, & Pollock, 2001). It is possible that strategies found to work for all students might also work for the subgroup of low-achieving or at-risk students. However, such inferences require empirical confirmation through research studies designed to compare the effects of a strategy on high- versus low-achieving students. Such research could provide much-needed information on the most effective ways to implement instructional strategies that can help all students to learn.

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APPENDIX A

STRATEGIES TO ASSIST LOW-ACHIEVING STUDENTS — CODING GUIDE

Study Number _____ *Coder* _____

MCREL SYNTHESIS: 2002

Strategies to Assist Low-Achieving Students – Coding Guide

Codes: NA = Not Applicable M=Missing

Author(s): _____

Title: _____ Report Year _____

Source: ☐ Journal _____

☐ Dissertation ☐ ERIC report ☐ ERIC eval ☐ other _____

Quality Index: Quantitative _____ Qualitative _____

Information for Table *(complete after coding):* Sample size _____ Grade or age _____

Student characteristics _____ Type of comparison _____

Outcome measure _____ Direction of results* _____

*The number of independent samples revealing comparisons that were all positive (ap), mostly positive (mp), even (e) mostly negative (mn), and all negative (an)

1. PROGRAM/INTERVENTION INFORMATION

1.01 Determination of low-performing or at-risk:

_____

1.02 School context: % FRL _____ % LEP _____ %M _____ % F _____

% Caucasian _____ % African American _____ % Latino _____

% Native American _____ % Asian _____ %Other _____

1.03 Goals within intervention strategy (optional as an aid to grouping within category)

_____

1.04 Assignment of teachers to treatments:

☐ Self-selected ☐ Random ☐ Non-random ☐ Missing

1.05 Program Implementer Qualifications: ☐ Yes ☐ No

1.06 Avg. Daily Exposure _____hrs. Avg Weekly Exposure _____hrs. Tot # Weeks _____

1.07 Subjects:

☐ Math ☐ Reading ☐ Writing ☐ Science ☐ Other _____

1.08 Nature of Intervention: _____

_____

_____

2. RESEARCH DESIGN

Student Sample Characteristics:

2.01 ☐ Random

☐ Purposive

☐ Population

☐ Other _____

2.02 ☐ Control Group(s) *describe* _____

2.03 ☐ Comparison Group(s) *describe* _____

2.04 Tot N in study _____

2.04a N in Treatment Group _____

2.04b N in Control Group(s) _____

2.04c N in Comparison Group(s) _____

2.05 Treatment Group Attrition _____% Control/Comparison Group Attrition _____%

2.06 Grade levels in study _____

2.07 %Female _____ % Male _____

2.08 % Caucasian_____ %Afrcn Amer_____ % Latino _____ %Native Amer _____

%Asian ___ %Other ___

Predominant Methodology (the methodology on which conclusions are based):

2.09 ☐ Quantitative, quasi-experimental:

☐ One-group posttest only

☐ One-group pretest-posttest

☐ Nonequivalent groups posttest only

☐ Nonequivalent groups pretest-posttest

☐ Other _____

Characteristics used for equating or matching groups:

_____

_____

2.10 ☐ Quantitative, experimental *(randomized trials)*:

☐ posttest only

☐ pretest-posttest

☐ Other _____

2.11 ☐ Qualitative (*can check more than one*)

☐ Case study

☐ Action research/Field Study

☐ Grounded theory

☐ Ethnography

☐ Other _____

2.12 ☐ Secondary methods *(describe)* _____

_____

_____

_____

3. QUANTITATIVE ANALYSIS

Outcome Measure Analysis

3.01a Measure: _____

Reliability reported: ☐ Yes ☐ No

If yes, type of reliability measure_____ Result of measure_____

Treatment Group	*Control/Comparison group*
Pretest mean _____ sd _____	Pretest mean _____ sd _____
Posttest mean _____ sd _____	Posttest mean _____ sd _____
Unit of analysis: ☐ student ☐ class	Direction of effect ☐ positive ☐ negative

Effect size _____

Test statistic(s) _____

3.01b Measure: _____

Reliability reported: ☐ Yes ☐ No

If yes, type of reliability measure_____ Result of measure_____

Treatment Group	*Control/Comparison group*
Pretest mean _____ sd _____	Pretest mean _____ sd _____
Posttest mean _____ sd _____	Posttest mean _____ sd _____
Unit of analysis: ☐ student ☐ class	Direction of effect ☐ positive ☐ negative

Effect size _____

Test statistic(s) _____

3.01c Measure: _____

Reliability reported: ☐ Yes ☐ No

If yes, type of reliability measure_____ Result of measure_____

Treatment Group *Control group*

Pretest mean _____ sd _____ Pretest mean _____ sd _____

Posttest mean _____ sd _____ Posttest mean _____ sd _____

Unit of analysis: ☐ student ☐ class Direction of effect ☐ positive ☐ negative

Effect size _____

Test statistic(s) _____

3.01d Measure: _____

Reliability reported: ☐ Yes ☐ No

If yes, type of reliability measure_____ Result of measure_____

Treatment Group *Control group*

Pretest mean _____ sd _____ Pretest mean _____ sd _____

Posttest mean _____ sd _____ Posttest mean _____ sd _____

Unit of analysis: ☐ student ☐ class Direction of effect ☐ positive ☐ negative

Effect size _____

Test statistic(s) _____

3.01e Measure: _____

Reliability reported: ☐ Yes ☐ No

If yes, type of reliability measure_____ Result of measure_____

Treatment Group *Control group*

Pretest mean _____ sd _____ Pretest mean _____ sd _____

Posttest mean _____ sd _____ Posttest mean _____ sd _____

Unit of analysis: ☐ student ☐ class Direction of effect ☐ positive ☐ negative

Effect size _____

Test statistic(s _____

3.02 Potential for Quantitative Synthesis _____

_____

_____

3.03 Findings/Conclusions

What are the relevant findings/conclusions from this study that support the synthesis?:

_____

_____

3.04 Quality of Quantitative Research

3.04a Is the information provided thorough enough for us to *determine the presence of threats* to validity?

☐ Yes ☐ No

If no, go to Quality Index 3.06 and code as "missing."

3.04b Does the study represent a careful effort to eliminate threats *to internal validity*?

Have the following threats been appropriately addressed and/or negated?

☐ Yes ☐ No

- *events that may confound treatment* (history, maturation, mortality, selection bias)
- use of *potentially flawed measures* and/or measuring techniques (pretest and posttest design, use of different measures in pretest and posttest, comparing gains of students performing on widely desperate levels, measurement error)
- unwanted control group treatment or influence
- the *study design* does not thoroughly target the research questions

3.04c. Does the study represent a careful effort to eliminate threats to *external validity*?
Have the following threats been appropriately addressed and/or negated?

☐ Yes ☐ No

- *interaction* of treatment and subject selection or educational setting

3.04d. Does the study represent a careful effort to eliminate threats to *construct validity*?

Have the following threats been appropriately addressed and/or negated?

☐ Yes ☐ No

- *inadequate design of variables* (definition, single measure for cause/effect)
- *anticipation and apprehension* (subject or researcher knowledge of hypothesis potentially influenced outcome)
- fidelity of implementation

3.04e. Does the study represent a careful effort to eliminate threats to *statistical conclusion validity*?

Have the following threats been appropriately addressed and/or negated?

☐ Yes ☐ No

- adequate *sample size* to support effect (power!)
- *violated assumptions* of statistical tests
- appropriateness of *statistical methods*
- *regression to the mean* (particularly important for our studies' low achievers)

statistical vs. practical significance

3.05 Total "yes"_____ Total "no"_____

3.06 **QUALITY INDEX:**

☐ Missing
☐ Low
☐ Medium
☐ High *(enter index on first page)*

4. QUALITATIVE DESIGNS

4.01 Purpose of qualitative approach:

☐ Theory building
☐ Interpretive/descriptive
☐ Other _____

4.02 Data collection methods used:

☐ Nonparticipant observations
☐ Participant observations
☐ Focus groups
☐ Interviews
☐ Document review
☐ Questionnaires
☐ Other_____

4.03 Data Analysis:

☐ Content analysis
☐ Constant comparative method
☐ Inductive
☐ Other_____

4.04 Findings/Conclusions:

What are the relevant findings/conclusions from this study that support the synthesis:

_____

_____

4.05 Quality of Qualitative Research:

Confirmability/Objectivity (the ability for others to examine all data sources and processes to assure that the findings are grounded in the data)

4.05a Were any of the following used in the study?
☐ Yes (indicate which ones below) ☐ No

☐ Member checking
☐ Audit trail
☐ Expert/Peer review

4.05b Did the researcher control for researcher effects?
☐ Yes (indicate how below) ☐ No

☐ Used unobtrusive measures
☐ Disclosed purpose of study and intentions to informants

☐ Included variety of informants
☐ Triangulated data

Dependability/Reliability
(the use of sufficient methods and techniques to assure that the study's results can be trusted)

4.05c Are the research questions clear, and are the features of the study design congruent with them?
☐ Yes ☐ No

4.05d Were data collected across the full range of appropriate settings, time, respondents, and so on suggested by the research questions?
☐ Yes ☐ No

4.05e Are basic paradigms and analytic constructs clearly specified?
☐ Yes ☐ No

Credibility/Internal Validity
(the findings are credible to the reader and the researcher has used techniques to ensure the credibility of findings)

4.05f Are multiple sources of evidence and/or data collection methods used to produce converging conclusions?
☐ Yes ☐ No

If not, is there a coherent explanation for this?
☐ Yes ☐ No

4.05g Were any of the following conducted?
☐ Yes (indicate which ones below) ☐ No

☐ Search for disconfirming evidence
☐ Generation of rival hypotheses/explanations
☐ Negative case analysis
☐ Other _____

4.05h Do the presented data and measures reflect the constructs or categories of prior or emerging theory?
☐ Yes ☐ No

Transferability/External Validity
(the provision of sufficient "thick description" to enable the reader to decide whether the concepts or themes can be transferred to another setting)

4.05i Are the characteristics of the original sample of persons, settings, processes (etc) fully described enough for readers to assess the potential transferability, appropriateness for their own settings?
☐ Yes ☐ No

4.05j Does the researcher define the scope and the boundaries of reasonable generalization from the study?
☐ Yes ☐ No

4.05k Total "yes"_____ Total "no"_____

QUALITY INDEX:

☐ Low
☐ Medium
☐ High *(enter index on first page)*

APPENDIX B

META-ANALYSIS METHODS

Since all 17 studies examined the effects of CAI by the comparison of achievement score between treatment and control groups, we computed the d-index of the effect size (Cooper 1998; Hedges & Olkin, 1985). The overall effect size was computed by subtracting the effect size at the time of the pretest from the effect size at the time of the posttest in order to accurately estimate the effect size of CAI (see Blok et al., 2002). The pooled standard deviation was used to reflect the different standard errors and sample sizes between the treatment and the comparison groups (Hedges & Olkin,1985). For the studies without pre-test scores, the effect size from the posttest was used as the overall effect size. Five studies provided t values or F values without mean scores and/or standard error. T values and F values were converted to d indexes based on the equations presented in Cooper (1998).

In computing the overall effect size, we employed the fixed model (Cooper, 1998). The effect size from each study was weighted by the estimate of sample size based on the general assumption that studies with larger sample sizes produce more reliable estimates of the effect size. Homogeneity analysis was conducted in order to determine whether the effect sizes from the selected studies vary more than expected by sampling error alone. If the result is significant, which means that the effect sizes vary across studies more than expected by the sampling error alone, we should seek the moderating factors that explain the variation across studies. Results of homogeneity analysis indicated that the Q statistics is significant; therefore, we proceeded with further analysis of identifying the moderators of the effect sizes.

The strategy of shifting the unit of analysis (Cooper, 1998) was utilized when we moved from calculating the overall effect size to identifying the moderators of the effect sizes. In computing the overall effect size, we disaggregated each study to an independent sample unit. While some studies report outcomes based on a single sample, other studies report their results for multiple independent samples. For example, a study may report math score gains of fourth and fifth graders separately. In this case, this study provides two independent samples and their outcomes. However, another study may report forty fifth graders' achievement gain in math and reading separately. In this case, the mean effect size from math and reading achievement gains was computed so that this single group of samples has only one effect size. The number of independent samples in a study varied from one to five.

When we examined the relationship between effect sizes and publication characteristics such as publication year and type, we employed each study as the unit of analysis. When we moved to the analysis of identifying moderators related to experimental characteristics, we disaggregated each study to the smallest unit the study could provide. In this way, we identified whether the effect sizes depend on the samples' grade level and/or the subject area. The number of the effect sizes each study provides varied from one to twenty.

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