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ABSTRACT

A study was done of the effects of school practices and curriculum offerings on eighth graders nationally. The study used data from the National Education Longitudinal Study of 1988, a survey of 24,600 eighth graders in 1,035 public and independent schools as well as the Hopkins Enhancement Survey of school practices. The results reveal that in many schools students are not offered real challenges in advanced academic courses and have few opportunities to experience rich instructional approaches that develop higher level skills. However, when these opportunities to learn are extended, students of all levels of ability benefit in higher achievement and more positive attitudes. Other findings include the following: (1) students in homogeneously grouped algebra classes, regardless of the ability level of the class, perform better than do students in heterogeneous algebra classes; (2) heterogeneous grouping in English classes does not disadvantage high-, average-, or low-ability students; (3) opportunities to learn through frequent experiences with high level instructional approaches influence eighth graders' achievements and attitudes; and (4) generally, the results suggest the need for greater equity in access to advanced curriculum offerings and challenging instructional approaches for all students. Included are 11 tables, 1 figure, 2 appendixes with 2 tables, and 30 references. (JB)

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OPPORTUNITIES TO LEARN

Effects on Eighth Graders Of Curriculum Offerings And Instructional Approaches

Joyce L. Epstein

Douglas J. Mac Iver

Report No. 34

July 1992

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The Center

The mission of the Center for Research on Effective Schooling for Disadvantaged Students (CDS) is to significantly improve the education of disadvantaged students at each level of schooling through new knowledge and practices produced by thorough scientific study and evaluation. The Center conducts its research in four program areas: The Early and Elementary Education Program, The Middle Grades and High Schools Program, the Language Minority Program, and the School, Family, and Community Connections Program.

The Early and Elementary Education Program

This program is working to develop, evaluate, and disseminate instructional programs capable of bringing disadvantaged students to high levels of achievement, particularly in the fundamental areas of reading, writing, and mathematics. The goal is to expand the range of effective alternatives which schools may use under Chapter 1 and other compensatory education funding and to study issues of direct relevance to federal, state, and local policy on education of disadvantaged students.

The Middle Grades and High Schools Program

This program is conducting research syntheses, survey analyses, and field studies in middle and high schools. The three types of projects move from basic research to useful practice. Syntheses compile and analyze existing knowledge about effective education of disadvantaged students. Survey analyses identify and describe current programs, practices, and trends in middle and high schools, and allow studies of their effects. Field studies are conducted in collaboration with school staffs to develop and evaluate effective programs and practices.

The Language Minority Program

This program represents a collaborative effort. The University of California at Santa Barbara is focusing on the education of Mexican-American students in California and Texas; studies of dropout among children of recent immigrants are being conducted in San Diego and Miami by Johns Hopkins, and evaluations of learning strategies in schools serving Navajo Indians are being conducted by the University of Northern Arizona. The goal of the program is to identify, develop, and evaluate effective programs for disadvantaged Hispanic, American Indian, Southeast Asian, and other language minority children.

The School, Family, and Community Connections Program

This program is focusing on the key connections between schools and families and between schools and communities to build better educational programs for disadvantaged children and youth. Initial work is seeking to provide a research base concerning the most effective ways for schools to interact with and assist parents of disadvantaged students and interact with the community to produce effective community involvement.

Acknowledgments

This report is based on presentations at the annual meeting of the American Educational Research Association, 1991 and at the Society for Research on Adolescence, 1992. The authors appreciate the comments and suggestions of Gayle Dorman and David Stevenson who served as discussants for the presentations of the papers, and John Hollifield for his suggestions and editorial assistance. Authorship is alphabetical and either author may be contacted for information or reprints.

Executive Summary

Data from the NELS:88 Base-Year survey of 24,600 eighth graders in 1035 public, Catholic, other religious, and other private schools, and the Hopkins Enhancement Survey of school practices are used to examine middle grades students' opportunities to learn. There are important differences across schools in the numbers of students who are offered basic, advanced, and exploratory courses. Analyses also disclose influences of sector, grade organization, region, grouping practices, and other school and student characteristics on the frequency of instructional approaches that emphasize drill and practice or higher level skills.

The results reveal that in many schools many students are not offered real challenges in advanced academic courses (such as algebra or advanced math), and have few opportunities to experience rich instructional approaches to develop higher level skills. When these opportunities to learn are extended, however, students at all levels of ability benefit in higher achievement and more positive attitudes from advanced math courses and from rich instruction in math, English, science, and social studies. Several specific results about curriculum and instruction are compelling:

Curriculum. Opportunities to learn in advanced math courses increase students' math achievements and positive attitudes towards math. This result is shown with several indicators of school policies to open or restrict opportunities to take algebra, and individuals' experiences in algebra and high content math courses. Even after controlling for students' ability group membership and prior math grades, eighth graders who take an algebra course achieve significantly better than do similar students who receive high-, medium- or low-content math survey courses.

Students in homogeneously grouped algebra classes, regardless of the ability level of the class, do better than students in heterogeneous algebra classes. High-ability students do better in homogeneously grouped math classes, but this is not true (except for algebra) for students at other ability levels. Heterogeneous grouping in English does not disadvantage high-, average-, or low-ability students. The results support strategies to schedule a mix of homogeneously-grouped math classes and heterogeneously-grouped English classes, unless or until teachers are fully prepared to teach heterogeneous math classes.

Instruction. Opportunities to learn through frequent experiences with high level instructional approaches influence eighth graders' achievements and attitudes. For example, teachers' frequent use of problem solving activities in math results in higher math proficiency scores and less fear of asking questions in math. Similarly, teachers frequent use of editing, rewriting, and the writing process results in higher reading achievement. Teachers' emphases on rich instruction in math, English, and in the four major academic subjects combined, results in higher achievements and more positive attitudes overall. Greater emphasis on drill and practice in instruction in the four subjects negatively affects test scores across subjects.

The results inform current debates about whether the middle grades are presently too hard or too easy for students, whether to push middle grades students ahead with high school courses, whether to provide a "common" curriculum (including advanced courses such as algebra) to all students, whether to emphasize higher level skills for some or for all students, whether teachers are adequately prepared to teach highly heterogeneous classes, and other difficult questions. For example, as instruction is presently organized, students of all abilities benefit from homogeneously-grouped algebra classes. High-ability students benefit from other homogeneously-grouped math classes.

Educators' decisions about course offerings and instructional approaches have important consequences for students' achievements and attitudes. The results point to the need for greater equity in access to advanced curriculum offerings and to rich and challenging instructional approaches for advantaged and disadvantaged students.

Introduction

One of the basic needs of early adolescents is to feel competent (Lipsitz, 1984). In school, the content of the middle grades curriculum and teachers' instructional approaches open or restrict students' opportunities to learn and to feel competent.

Course offerings influence *what* students learn. If courses are not offered, students will not learn the content. For example, more or fewer opportunities to take advanced courses (such as algebra) may affect the number of students who reach advanced levels of math proficiency and may influence students' math attitudes and behaviors. Similarly, if schools offer many students an extra course in reading in addition to their English class, more students may reach advanced levels of reading proficiency and their experiences may affect their attitudes and behaviors in English.

Instructional approaches influence *how* students learn. For example, student achievement and attitudes may be influenced by the degree to which teachers emphasize drill and practice of basic skills, higher level thinking skills, active learning approaches, discussion and expression of ideas, and peer-interaction practices. These approaches not only influence how much students learn in a subject, but also the depth of their knowledge and how they think and feel about a subject.

The direction and size of the influence of course offerings and instructional approaches on middle grades student achievement and attitudes are still open questions. In recent debates about curriculum, some argue that all students should have access to and be required to take a full algebra course (Carnegie Task Force on the Education of Young Adolescents, 1989; Moses, Kamii, Swap, & Howard, 1989). Similar arguments are made about courses for all students in foreign languages, or advanced English such as studies of literature. In discussions about instructional approaches, many argue that U.S. schools need *less* passive drill and practice instruction and seat work, and *more* active learning and higher level thinking skills (Goodlad, 1984; McKnight, 1987; Sizer, 1984).

The debates are not one-sided. In comparative analyses of U. S. and Japanese math instructional approaches, Shaub and Baker (1991) conclude that whole class math instruction (often associated with teachers' lectures and drill and practice activities) helps to explain the greater gains of Japanese vs. U. S. students in math test scores. In other comparisons of U.S. and Japanese students, Miller and Miyake (1991) conclude that the U.S. curriculum fails to introduce higher level thinking in math as early as the Japanese, suggesting that this deficiency is responsible for students' lower scores and lesser gains in math.

In other subjects, such as science, Linn and Songer (1991) conclude that the only hope for students to attain high achievement and deep understanding is through more active work with science concepts and experiments. This is reinforced by Larson and Richards' (1991) finding that many middle grades students often are bored in school, resulting in too few students motivated to work hard or to persist in courses that they consider uninteresting or irrelevant. Eccles, Lord, and Midgley, 1991, discuss the decline of academic motivation of students in the middle grades and give preliminary analyses of contextual variables that may influence differences in achievements and behaviors.

In math and in other subjects, a mix or balance of approaches may be necessary for students to develop depth and breadth in a subject. Drill and practice in math should have some real payoffs for mastery of basic math skills, and applications and problem solving should help students advance to higher levels of math proficiencies. In English, it may be that the only way to learn to write is to write often, edit, and rewrite. A balanced and challenging program in English may require basic communication skills, writing processes, and deeper studies of literature. The appropriate mix of approaches may be particularly important in the middle grades for building students' knowledge and positive attitudes in specific subjects that will support their successful work in high school.

Middle grades educators are debating these issues and making choices about the content of their courses, the extent to which all or some students have access to advanced or engaging work, and the instructional approaches they will use to reform or revitalize their classes. But evidence is scarce about the results of these choices.

In this study we describe middle grades students' opportunities to learn based on courses offered at their schools and the instructional approaches of their teachers in math, English, science, and social studies. Then, we explore school and student characteristics that explain the uses of particular instructional approaches in math, English, science, and social studies. Finally, we examine the effects of different emphases in instructional approaches on student achievement in math and English, and the effects of opportunities to learn algebra and other advanced math on math achievements and attitudes.

Data

In this study we combine data from the National Educational Longitudinal Study of 1988 (NELS:88) and the Hopkins Enhancement Survey of NELS:88 Middle Grades Practices. NELS:88 includes information from a national sample of over 1000 public and private schools in the U.S. that contain grade 8. In addition to basic information on the schools, achievement test scores and surveys were obtained from 24,599 students (Haffner, Ingels, Schneider, Stevenson, and Owings, 1990). Other surveys were administered to these students' teachers and parents.

Because NELS:88 did not include information on middle grades practices, the Hopkins Enhancement Survey (Epstein, McPartland, & Mac Iver, 1988) obtained additional information from the principals on school organization, guidance and advisory periods, rewards and evaluations, curriculum and instructional practices, interdisciplinary teams of teachers, transitions and articulation practices, involvement of parents, and other practices recommended for middle grades reform. Of the original 1036 schools in the NELS:88 spring sample, 1025 still contained grade 8 in the fall of 1988 when the Hopkins Enhancement was conducted. Information was obtained by mail on self-administered questionnaires (822 schools) and by telephone on shorter follow-up interviews (189 schools) for a completion rate of 99% of the eligible schools (Ingles, 1989).

Two sections of the Hopkins Enhancement Survey focused on curriculum and instruction. Principals reported the proportion of students in their schools who take various courses in grades 7 or 8. These reports do not refer to all of the courses offered in school, but to particular curricular investments including *basic* subjects such as two full years of science and an extra course in reading concurrent with English; *advanced* courses such as a full year of algebra and a full high school equivalent foreign language course; and *exploratory* or mini-courses. Principals also estimated how often a typical teacher —not the best nor the weakest teacher —in math, English, science, and social studies used various instructional approaches that emphasized drill and practice or higher level skills.

In this paper we draw from the NELS:88 *school component* for information on sector (public, Catholic, other religious, private secular), location (urbanicity, region), and percent minority in the school population; from the NELS:88 *student component* for information on family poverty level, test scores, proficiencies and attitudes in specific subjects; and from the *Hopkins Enhancement Survey* for information on the grade organization of the school, grouping strategies, average ability of students in the school, percent professional or managerial families, course offerings and inclusivity, instructional approaches, and other characteristics.

NELS:88 is, by design, a survey of the school-related experiences and accomplishments of a national representative sample of eighth grade students in public and private schools in the U. S. The data encourage examinations of whether and how students are affected by the curriculum and instruction that they are allowed to experience. Therefore, most of the analyses are conducted at the student level.

Variation in Course Offerings

Basic Courses (Reading and Science)

Reading. Schools that offer a separate reading course are investing extra school time for students to catch up, master, or expand their basic reading skills, comprehension, and/or exposure to and appreciation for literature. Table 1 shows that most schools in all sectors offer reading to most (over 50%) of their students in grades 7 or 8. An extra reading course is particularly prominent for most or all students in Catholic schools, many of which are K-8 organizations that continue reading as a course for students through grade 8 as part of a regular elementary school curriculum.

Table 1 about here

Schools that do not offer a separate reading course to any students (20% of all schools) may be making choices between reading and other electives. These schools may operate on a six-period day and may be restricted in how many courses they can offer in addition to math, English, science, and social studies. About 15% of all schools offer reading as a separate course to a small subset (10% - 25%) of students. Some middle grades educators may consider developmental reading skills essential only for those having difficulty in reading, offering remedial reading classes or pull-out classes only to those who need extra help (Mac Iver, 1991; Mac Iver and Epstein, 1991).

We will examine how these different investments in time for reading for few or many students affect student success in reading achievement and attitudes or behaviors in their English courses in the middle grades.

Science. Two years of science in grades 7 and 8 are offered to most students by most schools. Like other basic subjects —English, math, and social studies —most schools require students to take science every year in the middle grades. A small but notable proportion of schools (10-12%) do not offer any students two years of science in these grades. These include mostly other religious schools (which may set curricular requirements to match their educational philosophies or to include other required subjects) and private secular schools (which may include some magnet programs in subjects other than science).

Differences in science programs in the middle grades probably have more to do with different instructional approaches (e.g., hands-on laboratory activities) as discussed below, than with access to basic science courses.

Advanced Courses (Algebra and Foreign Language)

Algebra. Principals reported whether they offer a full year of algebra and how many students take that course. More than one-third of all middle grades schools (including almost one-half of all Catholic schools) do not offer algebra as a full course to *any* students in grades 7 or 8. Schools vary greatly in whether algebra is offered to the top 10%, top quarter, or more students. Over one-third of all private secular schools offer algebra to 50% or more of their students. These schools are twice as likely as the average school to offer algebra to most of their students.

Schools that offer algebra to many students take the position that giving eighth graders a head start in advanced math should help them in high school and establish them squarely in a college preparatory program. Some schools are joining a recent push to provide algebra to educationally disadvantaged students, even if they are struggling with arithmetic, to help them become more motivated as math learners and recognize their potential to take advanced math in high school (Moses et al., 1989).

Schools that do not offer algebra to any students or to only the top few take the position that a strong, traditional program in middle grades math or an innovative approach to a broad math survey course will give students the basics in computation and problem-solving skills . The rationale is that with an introduction to pre-algebra and pre-geometry, most students should feel successful and confident enough in math to succeed in algebra and other advanced math in high school. Or they may be taking the position that most of their students would be incapable of benefiting from algebra or likely to fail.

Foreign Language. Foreign language is a more selective or exclusive subject than algebra and is offered by few schools to few students. Most schools —over 70% —do not offer the high school equivalent of one full year of foreign language to *any* students. About 15% offer the subject to one-half or more students, and an equal number of schools offer foreign language to a select few, from 10% to 25% of their students (usually as an elective, sometimes during the period when other students are in reading).

Some private secular schools diverge dramatically from this pattern—more than half (58%) offer a full foreign language course to half or more of their students. In these schools that "prep" students for the college track in high school, foreign language courses clearly are viewed as giving students a head start.

Schools that offer a full year of high school equivalent foreign language take the view that their students are ready for and will benefit from deep explorations in a foreign language, and the schools may structure the activity so that students can earn credits toward the high school foreign language requirement. Schools that do not offer advanced foreign language may be restricted by their schedules to the basic courses and electives (e.g., home economics, typing, computers, industrial arts) or may believe that foreign language in the middle grades is best offered as an exploratory or elective course that allows students to identify their interests and test their skills in one or more language to prepare for taking a full course in high school.

Other Electives

Exploratory/mini courses. Schools are in two camps about offering mini-courses in the middle grades. Nearly half(46%) offer exploratory electives to one-half, most, or all of their students; just about as many (43%) offer mini-courses to none. More public schools (44%) than Catholic schools (29%) offer mini-courses to most of their seventh or eighth graders.

Schools that adopt this practice usually take the position that middle grades students will benefit from a wide range of opportunities to identify and develop diverse skills and talents. Schools that reject the practice usually have fixed six-period days (which they are unwilling to change) with no room for courses beyond the basic requirements and traditional electives, or they may view mini-courses as a frivolous use of time.

Summary of Course Offerings

There are five distinct patterns across sectors for the five course offerings in Table 1. Just about *all* schools offer most students science; *more than half* of the schools offer more than half of their students reading as an extra, separate subject along with English; *nearly half* of the schools offer exploratory courses to nearly half the students; *fewer than one fifth* of the schools offer algebra to one half or more students, and fewer than one fifth of the eighth graders take such a course; *fewest of all* schools offer full-year high-school-equivalent foreign language courses to students, and most schools do not offer full foreign language courses to any students.

Schools across sectors differ, but schools within sector differ as much or more. Overall, there is great variation in middle grades students' opportunities to learn basic, advanced, and exploratory subjects.

Catholic schools offer the basic courses of science and reading to *more* students than schools in the other sectors, on average, and offer advanced courses and other electives such as algebra, foreign language, and exploratory courses to *fewer* students than do other schools. Private secular schools stand out for offering more students algebra and foreign language than do other schools.

The variation in whether middle grades schools in the U. S. offer few or many students basic reading and science, advanced math and foreign language, and exploratory and mini-courses reflects unresolved debates about whether the middle grades are presently too difficult or too easy for students, whether to push students ahead with high school courses, whether to provide a "common" curriculum to all students regardless of their initial abilities in major academic subjects, whether and how to use the exploratory age of early adolescence to allow students to explore and construct knowledge, and other difficult questions.

What has been missing from the strong opinions that are heatedly argued on both sides of these debates is evidence of the effects on students of the different investments by schools in these contrasting philosophies of course offerings. Appropriate national data previously were not available to address these questions.

Variation In Instructional Approaches

The press of the decade in the middle grades is for instruction that requires students to be active, not passive, learners; to be thinkers, not memorizers (Linn & Songer, 1991). Numerous observers and researchers note the prevalence of instruction that produces passive students in boring classes (Becker, 1990; Dorman, 1987; Eccles & Midgley, 1989; Epstein & Mac Iver, 1990a; Goodlad, 1984; Larson & Richards, 1991; Lipsitz, 1984; Sizer, 1984). These and others call for more active work, higher level and active thinking, and other instruction to engage and motivate students to learn, produce, and apply knowledge that is important and useful (Carnegie Task Force on the Education of Young Adolescents, 1989).

In an earlier national survey of the middle grades, principals in public schools that contain grade 7 report that their typical teachers of average classes most often emphasize drill and practice activities in basic skills in all subjects —math, English, science, and social studies (Epstein & Mac Iver, 1990a). Other instructional approaches (e.g., writing and editing activities, peer group tutoring and projects, use of calculators and computers) are used much less frequently.

There is also, however, variation among teachers within subjects and important patterns across subjects, with more drill and practice in math, on average, and less in social studies. There are systematic patterns of instruction within and between grade organizations that render grade span an interesting but insufficient determinant of instructional practices (Epstein, 1990; Epstein & Mac Iver, 1990b).

Emphases in instructional approaches are linked to location (principals of rural schools report that their teachers conduct less written work and more drill and practice than do principals of schools in other locations); racial composition (schools with more minority group students conduct more frequent writing and discussion activities); and family socioeconomic status (schools that serve more professional families offer more active, higher level learning opportunities) (Becker, 1990; Mac Iver & Epstein, 1990). The earlier survey reveals that schoolwide emphases on higher level instructional approaches and active learning are still the exceptions to the rule of basic skills instruction in the middle grades in public schools.

In the Hopkins Enhancement Survey, principals in public, Catholic, other religious, and private secular schools that contain grade 8 estimated the frequency with which the average teacher uses drill and practice and other approaches with their average or mixed-ability eighth grade classes in math, English, science, and social studies. Choices of instructional approaches are influenced by features of the schools or characteristics of students. The next analyses address the question: What school or student characteristics determine whether teachers emphasize particular instructional approaches in math, English, science, and social studies average or mixed-ability classes.

Determinants of the Frequency of Use of Varied Instructional Approaches in Math, English, Science, and Social Studies

Tables 2-5 show that pertinent school, community, and student characteristics predict the frequency of schools' uses of drill and practice or higher level instructional practices in math, English, science, and social studies. For example, analyses that statistically control for student characteristics reveal how frequently schools in different sectors with similar students use particular instructional approaches. Because of the large sample size, we emphasize coefficients in tables 2-5 that are significant at or beyond the .01 level. These results tend to be stable and important in analyses that include all schools and in separate analyses of public schools only, the largest group of schools in the sample.

In all analyses, we statistically control for the effects of variables other than our variable of interest, in order to show the independent influence of that variable. For example, with grade span, location of school (region and urbanicity), school features (size of eighth grade enrollment, ability grouping in math, length of math period), characteristics of the student body (% minority, % poverty, % professional families, and average student ability on entry to the school), and other school features statistically controlled, we determine the independent influence of sector on the schools' emphases on particular instructional approaches in math.

Instructional Practices in Math

The instructional practices that we examine in math include (1) drill and practice, (2) creative problem solving, logic, and multiple ways of solving problems, (3) math applications in real-world situations, and (4) use of peer tutoring or cross-grade tutoring.

Sector differences. In Table 2, sector effects and other effects of categorical predictor variables on instructional approaches are expressed in standard score units using delta coefficients. For example, the coefficient of .39 in the last column of the first row of table 2 indicates that after controlling statistically for school and student population characteristics, Catholic schools use peer-tutoring or cross-grade tutoring about two-fifths of a standard deviation more frequently than do public schools. However, Catholic and public schools that serve similar populations do not differ significantly on the other three measures of teachers' instructional approaches in math.

Table 2 shows that non-Catholic religious schools differ most from other schools, with less emphasis on drill and practice *and* less creative problem solving and real world applications, suggesting a weaker math program, on average. Private secular schools place the least emphasis on math applications in real-world situations. The deemphasis on math real-world applications in elite private schools may reflect the expectations in these schools for students to master standard math skills and to move toward advanced math in high school and college.

Table 2 about here

Appendix A shows the crosstabulation of instructional practice by sector. Schools in different sectors tend to serve very different student populations. Whereas the first three rows of Table 2 describe the unique effects of sector after controlling for differences in student population, Appendix A shows the "raw" differences that result from the combined influence of sector and other important variables that are confounded with sector.

The appendix table confirms earlier findings that middle grades schools in all sectors emphasize drill and practice in math more than in any other subject, but raw sector differences are not trivial. About 70% of principals in Catholic schools and private secular schools compared to 54% of principals in other religious schools report that their teachers emphasize drill and practice activities in math daily. Over half (55%) of the secular private schools emphasize problem solving *daily,* compared to the greater *weekly* emphases in other schools. Most other patterns in Appendix A are similar to those found in Table 2 with the full set of controls.

Grade span differences. Rows 4-8 of Table 2 show the independent influence of grade span on teachers' math instruction after controlling for all other variables in the model, including sector. K-8 schools tend to use more drill and practice and more peer or cross-grade tutoring than other middle grades schools. K-12 schools more frequently emphasize creative problem solving in math than do other schools. Still, with all other characteristics controlled, grade span is neither a strong nor consistent explanatory variable for understanding the emphases of typical teachers in their math instructional approaches.

Characteristics of students. Using the full set of controls described above, including sector and grade span, we find some important independent effects of students' background characteristics on teachers' math instructional practices. These effects and all others based on continuous measures are expressed as Betas (standardized regression coefficients), which indicate the expected change in the dependent variable in standard deviation units associated with an increase of one standard deviation in the value of the predictor.

The data in the bottom panel of Table 2 confirm earlier findings that schools serving more professional or managerial families and schools serving more minority students use significantly more creative problem-solving activities than do other schools. Also, schools serving large percentages of students living below the poverty line are significantly more likely than others to emphasize math in real-world situations and peer tutoring in math. These schools, with more students behind grade level in skills, may be reaching out for a variety of methods to increase students' math competencies, including approaches recommended to increase students' positive attitudes about math as a useful subject.

Becker (1990) reported greater use of problem-solving instruction in schools with many minority group students as a surprising result that contradicted conventional wisdom that minority students are in schools that overemphasize drill and practice. With these data, we suggest that the earlier finding is not an anomaly. Rather, quite different schools —schools serving students whose professional families expect them to have the most advanced education and schools concerned that the racial or economic composition of their schools should not be limiting factors in students' opportunities to learn —may purposely use a variety of math instructional approaches to help students increase their math skills and motivation.

Other explanatory variables in math. There are other independent influences —region, grouping, and length of class period —on the frequency of teachers' uses of particular instructional approaches in average math classes.

Region. After all other variables are accounted for, schools in the south report significantly more use of drill and practice, problem solving, and peer tutoring activities in math than schools in other regions. Schools in the south may be actively working to increase their math instruction and varied methods of teaching math to help students attain basic and advanced skills to raise math test scores, which tend to lag behind those of students in other regions. Schools in the west report significantly more use of peer tutoring than all other schools. The unusually high rate of peer tutoring in the west may indicate a regional investment in staff development in methods of peer interaction, such as cooperative learning.

Grouping. Schools that assign students by ability to homogeneous math classes use more drill and practice and less peer tutoring than do other schools. Peer tutoring is more likely to occur in heterogeneous classes where stronger students may assist those who need extra help in learning skills. Peer tutoring may provide a novel way of conducting the drill and practice activities that are more traditionally taught by the teacher in homogeneous groups. Grouping practices do not significantly affect the frequencies with which teachers use creative problem solving or math applications.

Length of class period. The longer the class period in math, the more frequent the use of problem solving and real-world applications, with the latter approach significantly different in longer class periods. Applications and thinking skills take more time to teach and to explore, and therefore can be added to students' experiences when more class time is available.

Instructional Practices in English

The instructional practices that we examine in English include (1) drill and practice; (2) content and ideas in literature; (3) written compositions or reports; (4) editing and rewriting; and (5) oral presentations.

Sector differences. There are interesting patterns by sector in the average teachers' uses of instructional practices in English. As shown in Table 3, when the schools are equal in other ways, Catholic schools are more likely than public or other religious schools to emphasize drill and practice in language arts skills, and significantly less likely than public schools to have students write or edit compositions. Public schools are significantly more likely than schools in all other sectors to use the writing process with average students. The "writing process" —consisting of prewriting, writing, editing, and rewriting —has become a prominent reform in the middle grades in public schools (Epstein & Salinas, 1992).

Table 3 about here

After accounting for other school and student characteristics, there is more emphasis in English classes in public and Catholic schools on teaching content and ideas in literature, and on making oral presentations than in other religious or private secular schools. Overall, public schools tend to use a greater variety of high-level instructional practices in English more frequently than do schools in other sectors when serving similar students.

The second panel of Appendix A shows the crosstabulation of English instructional practices by sector. Several non-trivial "raw" differences between sectors result from the combined influence of sector and other important variables that are confounded with sector. For example, more than half of the Catholic and private secular schools offer drill and practice of language basics skills *daily*, compared to one-fourth to one-third of schools in other sectors. Daily experiences in literature in 24% of the Catholic schools indicate a strength of their programs compared to 15% or fewer of schools in other sectors. The writing/editing approach is prominent in some private schools, but not in religion-affiliated schools. Other patterns (e.g., the less frequent use of oral presentations in other religious and private secular schools) parallel the findings of the controlled analyses in Table 3.

Grade span differences. Using the same statistical controls described for grade span differences in math, we find few significant differences in English instruction due to grade span. The 7-12 schools tend to emphasize drill and practice in language basics, whereas K-12 schools are the most frequent users of the writing process and teaching literature to eighth graders. The K-12 schools are, however, an unusual sample —small in number, and including disproportionately large numbers of private and non-Catholic religious schools that have disproportionately small numbers of students. As in math, grade span is not a key determinant of teachers' uses of particular English instructional practices.

Characteristics of students and English instruction. In analyses using the full set of statistical controls described above, schools serving two types of families report significantly different English instructional approaches. Schools serving more professional/managerial or white-collar families use writing and editing practices and provide experiences with literature significantly more often than schools serving other communities. In contrast, schools serving more economically disadvantaged students use significantly more drill and practice and more oral presentations than other schools.

The picture that emerges for English instruction in schools serving students from families who live in poverty is one of heavy emphasis on basic skills and on oral presentations that may produce rather boring classes with students listening (or not) to each others' reports. Larson and Richards (1991) report that eighth grade students are even more bored in school listening to each other than listening to a teacher. The overall picture is that schools serving students from professional and managerial families have stronger and more balanced programs of English instruction than schools serving students from less advantaged families.

Other explanatory variables in English. As in math, region, grouping, and length of class period independently influence teachers' uses of particular instructional approaches in English.

Region. Schools in the northeast and urban schools use significantly more writing and editing activities than do other schools, suggesting that there may be different emphases on the implementation and dissemination of writing process programs in these areas.

Grouping. Grouping practices in English do not affect the frequency of most instructional approaches. The exception is that schools that group students homogeneously by ability report more frequent drill and practice in English. This tendency was also true in math, suggesting that there may be some connections at the middle level between schools that use traditional grouping practices of tracking students by ability between classes and the use of traditional instructional approaches that include drill and practice in math, English, and social studies (see table 5). Earlier studies of elementary students have shown that teachers' instructional practices were linked to their resegregation and grouping strategies (Epstein, 1985).

Length of class period. The length of the class period is an important influence on schools' frequency of writing compositions, oral presentations, and drill and practice in English. The longer the time to work in English, the more often activities of all types can be scheduled or mixed within periods.

Instructional Practices in Science

The instructional practices that we examine in science include (1) drill and pracice; (2) scientific methods; (3) hands-on laboratory research; and (4) computers and technology.

Sector differences. Table 4 shows that when schools serve similar students, private secular schools more frequently use drill and practice in science than do other schools. With students who are similar to those in private schools, public schools more frequently report using *hands-on* laboratory activities. Other religious schools offer significantly fewer experiences than other schools in all active learning or advanced science approaches.

Table 4 about here

Appendix A shows the raw marginals of instructional practices in science by sector because, overall, the schools do not serve similar students. Principals of private secular schools report stronger science program instruction overall. More of these schools (over 50%) have daily drill, daily or weekly emphases on science methods and hands-on activities, and experiences weekly or most weeks with computers or technology to teach science.

Although they lead the others, even elite private schools use computers or video technology for science instruction relatively infrequently. Computer and video technology has not yet become a regular instructional tool in science classes in U. S. middle grades schools. Many schools, from 20% of the private schools to 40% of non-Catholic religious schools, rarely or never use technologically guided or enriched instruction with science classes of average or typical students. Fewer than 1% of any middle grades schools use technology *daily* for science instruction.

Grade span differences. K-8 schools tend to use more drill and practice activities in science than do schools for early adolescents, and significantly less hands-on activities than 6-8 schools. K-8 schools also have less computer or video instruction than other grade organizations. K-8 schools, usually housed in elementary buildings, usually have less lab space and equipment than middle grades schools for early adolescents.

The 7-12 schools report more frequent emphasis on drill and practice work than other grade organizations. These schools tend to have less innovative programs, overall, for students in the middle grades (Epstein and Mac Iver, 1990a) and may save advanced science equipment and experiences for the high school students who are part of the same schools. Here, the K-8 schools, compared to 6-8 middle schools that serve similar students, have more traditional or less innovative science instruction.

Characteristics of students. The strongest and most stable pattern in science shows that schools serving more professional and managerial families use significantly more advanced science instruction (less drill and practice, more emphasis on the scientific method, more frequent laboratory work, more computer-based instruction) than schools serving students from less advantaged families. Schools serving students from families living in poverty have significantly more drill and practice and less frequent laboratory research than schools with more advantaged students.

Although the schools serving poor communities also offer computer or video science instruction, it may be in connection with drill and practice work or basic films, rather than with simulations or advanced thinking in science. Thus, in science as in English, schools show apparent inequities in opportunities to learn, offering fewer higher level, challenging instructional approaches for economically disadvantaged students.

Other explanatory variables in science

Region. Unlike in math and English, region less consistently influences instructional approaches in science. Schools in the south use drill and practice activities in science more frequently than schools in other regions. Schools in the west use technology more than schools in other regions, and schools in the north central region emphasize hands-on laboratory experiences more than other schools.

Grouping. Our analyses of grouping practices show that more homogeneous grouping leads to more laboratory research and computer- or technology-based instruction. Teachers may find it easier to organize these methods for students with similar abilities, or may use the methods mainly with more advantaged students, as reported above. Ironically, lab work is one aspect of science that can be effectively organized for heterogeneous classes by having teams or small groups of students of different abilities work together to conduct experiments, surveys, or observations. The practices linked to grouping strategies may be explained by teachers' comfort and experience with different methods, or lack of experience in using innovative or advanced practices in heterogeneous groups. Teachers may need training in using methods of group work with heterogeneous classes.

Size of Class. Larger class size influences the use of more frequent drill and practice in science, but not the use of other instructional practices. Size of class has not been important in explaining math or English instructional approaches, and is an inconsistent influence on science instructional methods.

Instructional Practices in Social Studies

The instructional practices that we examine in social studies include (1) drill and practice on names, dates, and facts; (2) discussions controversial issues in history and current events; (3) group projects
(4) written compositions in social studies; and (5) being historians.

Sector differences. Table 5 examines instructional approaches in social studies using the same statistical controls as in the analyses of the other three subjects. Schools do not differ significantly across sector in their uses of drill and practice activities in social studies, although the tendency is for religious and private secular schools to include more drill and practice than public schools.

When schools are equivalent in student and school characteristics, other religious schools differ consistently from public schools and most other schools in providing significantly less group work, discussion of controversial issues, students working as historians, and writing in social studies. Public schools report the greatest use of writing across the curriculum, an extension and confirmation of their emphasis on the writing process (i.e.,writing, editing, rewriting) reported in English.

Table 5 about here

Public schools —which tend to have more diverse groups of students who need to learn to understand and appreciate each other —are significantly more likely than other religious and private secular schools to use project and group work in social studies. Other studies show that there is less homogeneous grouping of students in public schools in social studies than in any other subject (Epstein and Mac Iver, 1990a).

The table in Appendix A shows that, overall, schools place less emphasis on drill and practice in social studies than in other subjects. Across sectors in schools that do not serve similar students, the appendix table reveals that elite private secular schools lead the others in the frequency of discussions of controversial issues. Teachers may be less concerned about neutrality on difficult topics in private secular schools compared to teachers in public or religious schools. Of all approaches in all of the subjects we explored, the least used is asking students to act as historians —only about five percent of students in the middle grades experience this opportunity at least weekly. Other religious schools use this approach least of all.

Grade span differences. There are no consistent patterns in the frequency of social studies practices by grade span of school. A minor exception is that K-12 schools in this sample more frequently emphasize both drill and practice and writing compositions than do schools with other grade organizations. Overall, grade span is not an important explanatory variable for social studies instructional practices for early adolescent students in U. S. middle grades schools.

Characteristics of students and social studies instruction. The richness of social studies instruction is clearly greatest in schools serving more advantaged families. With all other variables statistically controlled, schools serving a large proportion of professional and managerial families are much more likely than any other type of school to require students to write compositions frequently and are more likely than the average school to have students work on group projects, discuss controversial issues, or conduct hands-on historical research by collecting oral histories, conducting interviews, and studying archives.

In contrast, schools whose student body is composed primarily of students living in poverty emphasize drill and practice of historical names, dates, and facts more than do other schools. Nevertheless, schools serving poor students are also more likely than the average school to include group work, discussion of controversial issues, and opportunities to learn by working as junior historians (e.g., as in programs modeled after the Foxfire approach, Wiggington, 1989).

Thus, the biggest losers in opportunities for active "minds-on" learning in social studies may be students attending schools that serve populations that are neither especially advantaged nor especially disadvantaged. Social studies programs in these lower-middle class schools are less adventurous than those of both advantaged and disadvantaged schools.

Other explanatory variables in social studies

Region. While the patterns are not consistent, schools in the northeast tend to have more varied instructional methods, with greater frequency of using drill and practice than schools in the west, more group work than schools in the south, more discussion of controversial issues than schools in the north central region. These patterns however, seem isolated and hard to explain. One consistent pattern is the higher use of writing across the curriculum in the northeast than in other regions, repeating and confirming the emphasis in this region on the writing process in English.

Grouping. More homogeneous classes are more likely to use the difficult or advanced methods of students acting as historians. This may be linked to the use of this method with more able students.

Length of class period. Group projects are more frequent in longer class periods, along with more drill and practice. As in math, instructional approaches that require sequences of work, such as group projects, are more likely to be used by teachers who have more time to allocate.

Summary of Instructional Approaches

These data are informative, even enlightening, but not definitive on *why* schools invest in certain instructional practices in math, English, science, and social studies. The percent of variance explained in these analyses across subjects is relatively low, ranging from 4% to 22%. We need to incorporate other factors —such as teachers' individual talents, staff development, district and school decisions about curriculum and instruction, and other unmeasured factors (particularly other characteristics and needs of students) —to fully understand the frequency with which typical teachers of typical classes use various instructional approaches.

Nevertheless, there are some consistent and intriguing patterns across subjects, and consistencies in other analyses of public schools only, that are important for understanding instructional approaches and directions for reform in the middle grades. In this section, we do not repeat the findings reported for specific subjects, but look across subjects for the patterns that may inform research and practice.

Sector. Overall, two patterns stand out in tables 2-5 that report instructional opportunities offered by schools when they serve similar students: the lack of innovation of instruction in other religious schools, and significantly greater use of varied instructional practices in public schools in math, English, science, and social studies. First, in all subjects, other religious schools have significantly lower frequencies of use of instructional approaches in 14 of the 18 practices explored. Second, public schools show significantly more frequent use of 26 of the 54 practices across subjects, while other sectors are significantly higher on 5 of the 54 practices.

There are few strong or significant differences in schools' uses of drill and practice across sectors, but a clear difference in the public schools' emphases on writing and the writing process in English and social studies.

Public schools are most different from Catholic schools in significantly less frequent use of peer tutoring in math, less frequent drill and practice in English, but more frequent writing and editing, more hands-on science work, and more writing in social studies.

Public schools are most different from private secular schools serving similar students in more emphasis on real-world applications in math, more emphasis on writing, literature, and oral presentations in English, less drill and practice but more lab work in science, and more writing and group work in social studies.

Non-Catholic religious schools tend to use fewer and less frequent instructional approaches in all subjects than schools in any sector. When serving similar students, public, Catholic, and private schools differ on occasional approaches across subjects, but the data suggest that there are important strengths in public school programs that often go unnoticed in typical, uncontrolled analyses across sectors. In some ways, for similar students, public middle grades schools in the U. S. may be more innovative and responsive to early adolescents' characteristics and needs than schools that maintain more traditional programs for middle grades students.

Student characteristics. In all subjects, students from advantaged families are offered the richest instructional approaches. Schools serving students from economically disadvantaged families living in poverty are making special efforts to reach students with varied instructional approaches, but may be short changing students in the instructional methods they choose. In math, schools serving students from poor families more frequently use peer tutoring and real-world applications, if not to advance math thinking, at least to engage students in math. This may or may not compensate for emphases on math problem solving offered advantaged students, but may help to promote positive attitudes and staying power in math.

In English, schools serving students from poor families more frequently use drill and practice in language basics and more frequently engage students in oral presentations. These emphases may not compensate for more writing, editing, and literature offered to advantaged students.

In science, schools serving poor families use more drill and practice and more computer or video instruction, but less hands-on laboratory work, if not to advance thinking, at least to provide basic skills. But significantly less lab work in these schools may reflect the financial inability of the community to provide laboratory classrooms, equipment, and rich instructional approaches.

In social studies, schools serving poor families stress drill and practice, group work, and discussions of controversial topics, if not to advance thinking, at least to engage students in their work and make it relevant to topics of the day. This may not compensate for the emphasis on writing across the curriculum in social studies offered to more advantaged students.

Family wealth or socioeconomic status—more than sector, grade organization, region, racial composition of school, or other variables measured—consistently influences the richness of instruction in the middle grades. The results suggest that there should be less concern in policy and practice about whether a school is public, religious, or private, or organized in a particular grade span, and more concern about the design and equity of curriculum offerings and instructional approaches for advantaged and disadvantaged students.

Region. Regional differences are difficult to explain because they tend to reflect different state leadership in education, staff development investments, per pupil expenditures, and other policies. We have controlled for different family characteristics, but may be under-controlling on unmeasured differences of students, families, schools, and districts across regions.

In these analyses we see more frequent emphases on drill and practice and problem solving in math and social studies in the south, more frequent use of writing in English and social studies in the northeast, and more use of peer tutoring in math in the west. These differences may reflect efforts in the south to improve math scores, which typically have been lower than in other regions, and different investments in staff development in the writing process in the northeast and cooperative learning in the west.

The controlled analyses in tables 2-5 ask how frequently schools in different sectors use various instructional approaches with *similar* populations of students. The fact is, however, that the students in public, Catholic, private, and other religious schools are not similar. Religious and secular private schools have entrance requirements, selection procedures, rejection capacities, and extra costs for families that bring different students to these schools than those who attend public schools, on average.

The table in Appendix A shows the patterns of frequency of instructional approaches across sectors for the students who attend the schools. As in our previous study (Epstein and Mac Iver, 1990a), the most daily drill and practice occurs in math and the least drill and practice occurs in social studies in schools in all sectors. Catholic schools and private secular schools are high in daily use of drill and practice in all subjects, but tend to balance the traditional drills with high daily or weekly offerings of instruction that demands high level thinking and skills.

Even more than between sector, there are dramatic within-sector differences in the types of instructional approaches students experience, on average. That is, large percentages of public schools differ in their emphases and uses of the various instructional approaches, as do Catholic, other religious, and private schools.

If principals report that their typical teachers use an instructional approach *daily or weekly,* we assume that students regularly engage in those learning opportunities. If teachers use a particular approach *most weeks, monthly, or rarely,* we assume that students are less likely to experience those learning opportunities. Eighth grades students' experiences and learning opportunities in their common subject classes vary greatly in U.S. middle grades schools. This variation permits analyses of how different investments and emphases in instruction contribute to individual students' learning and development in the middle grades. We next examine how decisions about instructional methods for advantaged and disadvantaged students affect students' learning, attitudes, and behaviors in school.

Effects on Student Achievements and Behaviors

In addition to understanding the diversity in opportunities to learn that are offered to students in the curriculum and instruction of middle grades schools in the U. S., we need to know whether educators' choices of instructional approaches and course offerings have important consequences for student learning and development. Because there are dramatic differences between schools in course offerings in math and English, we focus on whether instructional approaches in math and English and whether course offerings in algebra and reading have measurable effects on students' achievements, attitudes, or classroom behaviors in these subjects.

Effects of instruction emphasizing math problem solving

Table 6 presents analyses in public schools only of effects of teachers' emphases on math problem solving on students' math proficiencies and fear of asking questions in math. The students in these analyses are non-handicapped students who reported that they take "regular" math in a middle track or mixed-ability class. This sample was selected to best match the principals' reports of typical teachers' instructional practices. Excluded are students described by their teachers or parents as having serious handicaps that interfere with their school performance, and students with limited English proficiency reported by teachers as deriving little benefit from instruction in English.

We limit these analyses to students in public schools for two reasons. First, these analyses follow up the results of our earlier studies of principals' reports of instructional approaches that did not include data from students (Becker, 1990; Epstein & Mac Iver, 1990a; Mac Iver & Epstein, 1990). Second, because the principals' reports refer to practices of typical teachers of average classes, we limit analyses to students in public schools to place some control on which teachers are "typical" and which students are "average," as average students in selective schools may be quite different from those in public schools.

Table 6 about here

With other potentially influential variables statistically controlled, including students' success in math as measured by their report card grades through the middle grades, teachers' frequent use of problem-solving activities in math results in <u>higher</u> math proficiency scores and <u>less fear</u> of asking questions in math. This highly controlled model provides significant and persistent evidence of the importance of frequent instruction in problem solving for public school students' high math achievement and motivation to participate by asking questions in math class.

Similar analyses that included students from all sectors yielded near-identical effects of creative problem solving on math proficiency and fear of asking questions, and tests of sector-by-problem solving interactions show that the effects do not differ significantly across sectors.

Other effects on math proficiency

Students' math proficiencies also are explained by other school and student characteristics. Not surprisingly, students with high report card grades in math across the middle school years have higher levels of math proficiency than other students, as do students from families with high socioeconomic status. With all other variables in table 6 taken into account, females and African American students have significantly lower math proficiency scores than white and Asian American students. Students also have significantly lower proficiency scores in schools serving high percentages of minority students and families who qualify for free lunch. Students in the south have lower proficiency scores than students in other regions. Students in 6-8 middle schools, K-8, 7-8, and 7-12 schools in the sample have equivalent math proficiencies. In this sample, 7-9 and K-12 students have higher math scores, with other variables controlled, but neither effect reaches the preferred .01 level of significance.

Math proficiency and fear of asking questions in math do not necessarily covary. Students who are feeling slightly over-challenged, for example, may be more reluctant to ask questions but still reach higher proficiency levels than less challenged students.

Other effects on fear of asking questions

Students' fear of asking questions in math class (or, conversely, students' confidence in participating and asking questions) also is affected by other variables in the model. Not surprisingly, students with high report card grades in math are less afraid to ask questions. Indeed, participation in class often is part of students' grades, and so those confident enough to ask questions and participate in other ways are more likely to earn higher grades.

Males are less afraid to ask questions in math than females. Whites are less afraid to ask questions in math than other groups except African American students. It may be that African American students express high self-confidence in school, despite their lower math grades compared to other students (Simmons, Black, & Zhou, 1991). Or, they may be encouraged by their teachers to ask questions. Asian-American, Hispanic-American, and Native American students may be more afraid to ask questions in math class if they have difficulty with English.

Students in K-8 schools and 7-12 schools have less fear of asking questions than do students in middle schools, junior high schools, or 7-8 schools, although the effects are not strong. In other analyses (see Table 2), K-8 classes tend to use significantly more peer tutoring in math than other grade organizations. This may explain why K-8 students have less fear of asking questions overall, if a portion of the questions are asked of other students. These effects and the effects of grade span on math proficiency need to be revisited to establish their persistence in other samples and, if consistent, to examine the reasons for them.

Students in the north central and southern regions express significantly more fear of asking questions in math than do students in the northeast or west. These regional differences are relatively large, after all other variables are accounted for. They are not immediately explainable. Stereotypes come to mind about bold Easterners and laid-back Californians who might be more comfortable challenging teachers or initiating discussions than polite or reticent southern or stoic midwestern students.

But such stereotypes simply reflect the need for better explanatory variables. More likely, the regional patterns have something to do with teachers' methods, texts, or other materials for teaching problem solving; or with students' skill levels (e.g. southern students have lower proficiency scores and may be less ready, on average, to ask questions about math processes or meanings). Public schools in the West (in other analyses) —like K-8 schools —use significantly more peer tutoring in math than other schools, so students' less fear of asking questions again may be because some are asked of other students.

Our most important findings are that, after school and student characteristics are statistically controlled, students do better in math and have more motivation to ask questions to advance their understanding of math when their teachers more frequently use problem solving approaches in math instruction. Though highly significant, the size of the effects are modest —indeed, dwarfed —by the importance of race, ethnicity, family background, and past success in math. Nevertheless, the persistent significant effects of instructional approaches emphasizing problem solving on higher achievement and more positive math behavior are particularly important for their potential long term influence across the school years.

The results reinforce an early estimate by Rock and Pollack (1990), who found in uncontrolled analyses of the students in the NELS:88 sample that students whose teachers report that they emphasize problem solving skills in math have higher math proficiency scores than students whose teachers report that they do not emphasize these skills. In this study, with stringent controls, and using principals' reports of the work of typical teachers with typical classes, we affirm the significance of this teaching approach.

Effects of instruction emphasizing writing and editing in English

Similar analyses were conducted to determine the effects of rich instructional approaches in English on students' reading achievement and fear of asking questions in English class. The same background and contextual variables were statistically controlled as in Table 6.

We found that students whose teachers more frequently ask them to edit, rewrite, and resubmit compositions have higher reading achievement ($\beta = .05$, $p < .001$). Also, students whose teachers frequently teach content and ideas in works of literature are significantly less afraid to ask questions in English ($\beta = -.03$, $p < .05$).

The effects are small and less consistent than in math, perhaps because of a lower correspondence between classroom content in writing and reading literature and the achievement items in a standardized reading test. Nevertheless, the results strengthen the general conclusion that instruction that promotes higher level thinking in English classes will improve students' reading achievement and help them be less fearful of asking questions in English, and might have even stronger effects on tests of higher order skills in English/language arts.

Effects of rich instruction vs. drill and practice in the four major academic subjects

Table 7 shows the effects of the sum of students' opportunities for rich or active instruction (called "rich instruction" for short) vs. drill and practice across all four major academic subjects (math, English, social studies, and science) on students' average achievement and attitudes in those subjects combined. The question is whether an emphasis on drill and practice or on rich instruction across the curriculum promotes higher achievement and more positive behaviors and attitudes toward school.

Eighteen items measured the frequency of typical teachers' instructional approaches in math, English, science, and social studies. When these items were factor analyzed using principal-axis factor extraction and Oblimin rotation, two expected factors emerged — a drill and practice factor, and a rich instruction factor. The two factors are modestly positively correlated (R=.38), indicating that drill and practice and rich instruction are not incompatible, but rather are used in tandem in many schools. In most subjects, most teachers' provide instruction in both basic skills and higher level skills, but teachers and schools emphasize the two factors to different degrees.

We created two unit-weighted composites to measure the use of rich instruction and drill and practice. Items with significant loadings on both factors were included only on the composite representing the factor on which they had the highest loading. Because 4 of the 18 items loaded on both factors and because the two factors were positively correlated, the effects of each composite on student outcomes were tested while statistically holding constant the other composite.

Because the factors describe instructional methods in average or mixed ability classes, the analyses of achievements, behaviors, and attitudes are based on data only from students in average or mixed-ability classes for all of their subjects —English, math, science and social studies.

The first column of Table 7 reports the effects of rich instruction and drill and practice on students' standardized NELS:88 test scores averaged across the four subjects after all control variables are statistically accounted for. Teachers' emphases on rich instruction across the curriculum results in a small but significant and positive effect on average test scores in the major subjects ($ß = + .06$; $p < 001$). By contrast, an emphasis on drill and practice results in a similarly persistent negative effect on average test scores across subjects ($ß= - .04$; $p < .001$).

Table 7 about here

More frequent opportunities to learn through higher level instructional methods in the four subjects also is predictive of students' reports of significantly less fear of asking questions in their academic classes ($ß= -.05$; $p < 001$). An emphasis on drill and practice is significantly associated with students' greater boredom at school, lower rates of homework completion, and less confidence that school work will be useful in the future. The results, although small, are consistent and significant even after controlling 21 student background variables and school characteristics, including prior abilities from report card marks in all subjects through the middle grades.

Effects of offering algebra courses

Effects of offering a full-year course to none, some, most. We reported in Table 1 that schools vary greatly in whether they offer a full algebra course to none, some, many, or most of their middle grades students. Table 8 reports the effects of public schools' offering a full year of algebra to larger proportions of students on two indicators of a successful program in mathematics: a) the percent of eighth-graders who display proficiency at all three levels of math problems included on the achievement test (level 1 problems require simple arithmetic operations on whole numbers; level 2 problems require simple operations with decimals, fractions, and roots; and level 3 problems require conceptual understanding and the development of a solution strategy), and b) the percent of eighth-graders who report a strong liking for mathematics (i.e., who "strongly agree" with the statement, " I usually look forward to math class"). These effects are estimated while imposing stringent statistical controls for other characteristics of these public schools and their student populations.

The effects are statistically and educationally significant. A standard deviation increase in the percent of students offered algebra is predictive of almost one-fifth of a standard deviation increase in the percent of 8th graders who reach the highest level of mathematics proficiency tested, and of almost one-sixth of a standard deviation increase in the percent of students who display a strong liking for their math class. For example, as applied to the data, the results in Table 8 indicate that schools that offer a full year of algebra to at least 75% of their eighth-graders should expect 9.4% more of their eighth graders to reach a high level of math proficiency and 5.5% more to strongly like math, compared to otherwise similar schools that do not offer eighth graders a full algebra course. The results suggest that if schools open rather than restrict the challenge to take algebra in the middle grades, they help more students develop high math proficiencies and positive attitudes in math.

Table 8 about here

Effects of attending algebra or other advanced math classes at least once a week. Our school-level analyses suggest that by providing greater student access to algebra, schools can boost the proportion of students who do better in math and are more positive about attending math class. If so, there also should be evidence of benefits of taking algebra at the individual level. Students who attend an algebra class should reach higher proficiency in math and be "turned on" to math class more than similar students who do not have algebra.

About 35% of the eighth graders in the NELS:88 sample report that they attend algebra (or other advanced math) at least once a week. These algebra classes reported by the students may or may not have an exclusive focus on algebra, may not meet every day for a full year, or may not offer high-school equivalent content, but they do offer students access to algebra or other "elite" or advanced knowledge in mathematics.

Table 9 reports logistic regression analyses that address the question of whether attending such classes influences the probability of students' mastery and liking of math, after accounting for their past math success in school and other relevant student and school characteristics. The results confirm that when individual students attend algebra, their probability of displaying strong proficiency and liking for mathematics is significantly increased.

Similarly, Table 10 summarizes multiple regression analyses of the effects of attending algebra on other important continuous outcome measures including students' math achievement test standardized scores, fear of asking questions in math class, and perceptions of future usefulness of math in their lives. The delta coefficient of .62 in the first column of Table 10 indicates that eighth graders who report that they attend an algebra or advanced math course at least once a week attain standardized math test scores that are three-fifths of a standard deviation higher than the scores of similar students who do not attend such a course.

Tables 9 and 10 about here

Most students are not "often afraid to ask questions" in math. Students who report that they attend algebra or advanced math classes are somewhat more afraid to ask questions than are other students. They may be more hesitant to ask questions if the class is moving along quickly and they feel they are expected to keep up with other advanced students. On the other hand, students who experience algebra or advanced math classes are more likely than other students to agree that "math will be useful in my future." Thus, results of analyses of the effects of offering a full-year of algebra to more students (Table 8), and the students' own reports that they attend an algebra or advanced math class at least once a week (Table 9), converge to show that students benefit in skills and attitudes if they take advanced math.

Effects of course content in math

In this section we use teachers' detailed reports concerning the content of eighth graders' math courses to clarify the effects of course content on students' achievements. For these analyses, cluster analytic techniques are applied to classify eighth-grade courses based on the topics teachers report that they cover in math. Then, we examine the effects on students of their experiences in algebra classes, high content, medium content, and low-content math courses.

The NELS:88 teacher questionnaire was administered to selected eighth grade teachers of the students in the base year sample. In a random half of the schools, the mathematics teacher of each of the sampled students described the content of the math course in which the student was enrolled by indicating the emphasis placed on the following ten topics: algebra (formulas and equations), geometry, integers, problem solving, common fractions, ratio and proportion, percent, measurement, and probability and statistics. For each topic, an "emphasis score" was created: a major topic was assigned a score of "3"; a minor or review topic was assigned a score of "2"; and if the topic was not covered at all, it received a "1."

An iterative partitioning method (multiple runs of Quick Cluster in SPSSX) was used to cluster students into four groups based on the emphases of their math courses. This method involves (1) identifying four students with the most discrepant patterns of scores on the ten math topics and using their scores to define four initial cluster "centroids;" (2) assigning each student in the sample to one of the four clusters, closest to his or her pattern of scores on the ten math topics, as indicated by the squared Euclidian distance from the centroids; (3) updating the cluster centroids based on each newly assigned student; and (4) repeating steps 2 and 3 until the cluster solution stabilizes. The mean emphasis scores in the four final clusters are reported in Appendix B.

The Algebra Cluster. According to the mathematics teachers, algebra and the related advanced topics of integers and problem solving were the only topics emphasized in the mathematics courses of the 8th-graders classified in this cluster. These students represent 26% of the nation's eighth graders in public schools (not including students with handicaps or limited proficiency in English).

This group of students — identified by teachers as receiving an algebra-focused course — is significantly smaller than the group of students (35%) who report attending "ALGEBRA or (other advanced math) at least once a week." The discrepancy in the apparent group size of 8th-graders receiving algebra is largely due to positive responses on the self-report item by some students who attend survey courses that contain some algebra or pre-algebra units. Conversely, the teacher-identified group of "algebra-takers" is significantly larger than the group of students who receive a full-year course equivalent to a high school algebra course (under 20% of all public school 8th-graders) according to principals' estimates of course enrollments at the school level.

The High-Content Survey Cluster. According to teachers, about 48% of the students attend a broad survey course that places heavy emphasis on 8 of the 10 topics, including several of the "high content" areas (e.g., integers, problem solving, geometry, algebra). Because of the breadth of coverage of these courses, the depth of coverage of algebra is clearly less than in the algebra cluster.

The Medium-Content and Low-Content Clusters. About 10% and 16% of the students attend medium-content and low-content mathematics courses, respectively. These two clusters are similar in their heavy emphasis on common fractions, decimal fractions, and percents. However, teachers of courses in the medium-content cluster also place more emphasis than in the low-content cluster on integers as a major topic and on introductory algebra problems as a minor topic.

Effects of math course content on student achievement in classes with students who have high, average, or low prior achievement in math. Several questions need to be asked about the effects of different courses on student achievement: Does having an algebra-focused course in grade 8 increase students' mathematics achievement, or do students benefit as much from a broad survey course that includes algebra as one major topic among many? Does the ability group level of a class influence how much students benefit from an algebra course compared to other math classes? These questions were addressed in a series of analyses summarized in Table 11 and Figure 1.

Table 11 and Figure 1 about here

The same 21 control variables used in previous analyses were included in the multiple regression models summarized in Table 11. These variables explain 36% of the variance in students' math achievement. Adding information from the cluster analyses on the content of the math class increases the percent of variance explained to 44%. Students who attend an algebra course achieve over one-half of a standard deviation higher on the NELS:88 mathematics test than do students who attend a high-content survey course; almost three-fourths of a standard deviation higher than students in the medium content cluster; and almost one standard deviation higher than students in the low-content cluster. These analyses control for students' past success or ability in math as indicated by report card marks through the middle grades.

Because cluster membership is associated with students' ability group levels, (that is, classes grouped by ability will be placed in high, medium, and low content courses), the final model in Table 11 adds a dummy variable for the achievement level of each student's class as an additional control on ability. Even after controlling for students' ability group membership, the content of the course still has a large and educationally significant effect on math achievement scores. As before, eighth graders who take an algebra course achieve significantly better than do similar students who receive high-, medium- or low-content math survey courses.

To test whether the benefits of receiving an algebra course are equally great for students in all ability groups, the final model in Table 11 was reestimated after adding course content-by-track level interaction terms. The significant interaction (ΔF (9,5724)=5.17, $p<.0001$) is depicted in Figure 1. The interaction reaches significance because the effect of course content on achievement differs for students in heterogeneous classes compared to homogeneous, ability-grouped classes. Whereas students in homogeneous ability-grouped classes benefit more from high content (algebra or survey) courses than from low content courses, students in heterogeneous classrooms do not show significantly higher achievement in the high content courses.

Figure 1 reports the average math achievement test score for students in algebra, high content, medium content, and low content clusters, according to whether the students in the class are high, average, low, or heterogeneous in ability, as reported by the teachers. There are several important patterns.

First, there is an "algebra" effect in homogeneously grouped classrooms. Students in high-, average-, and low-ability classrooms do better in math achievement if they are in an algebra course than similar students in survey courses; and also do better in high content survey than in medium or low content courses. For example, students in low-ability algebra classrooms achieve scores about 1/5 of a standard deviation higher than students in low-ability high content survey classrooms, and considerably higher than students in low-ability medium content or low-content classrooms. Similarly, students in high-ability algebra classrooms achieve scores over 1/3 of a standard deviation higher than students in high-ability high content survey classrooms, and substantially higher than students in medium content or low-content survey classrooms.

There are, of course, relatively few low-ability algebra classes and few high-ability low content courses, making the estimates of the students' achievement scores in these groups less stable. But the patterns are clear and consistent in suggesting that homogeneously grouped students benefit from receiving an algebra course compared to less challenging math courses.

Second, there is a "track level" effect. Within each type of course, students in homogeneously grouped high-ability classes score much higher than students in average-ability, low-ability, or heterogeneous classrooms. Students in average-ability and heterogeneous classrooms do somewhat better than students in low-ability classes in all types of courses.

If the heterogeneous algebra classes in this sample were working well, there should be a mean level of achievement in these classes that at least equals that found in homogeneously grouped average-ability classrooms. Not only do heterogeneous algebra classes perform almost one-fourth of a standard deviation below this level, they even fail to out-perform heterogeneous low content survey courses. This finding raises questions of whether students of all ability levels perform less well in these heterogeneous algebra courses or whether some students (e.g., high-ability students) were achieving as well in heterogeneous as in homogeneous algebra classes.

Therefore, in separate analyses we estimated the adjusted mean achievement of students in heterogeneous math classes separately for students with high ability (i.e., students with high past grades in math), average ability, and low ability. These estimates are reported in Figure 1b. Compared with 1a, the new figure shows that students in heterogeneous algebra classes perform less well than do students of similar ability in homogeneously-grouped algebra classes. The results suggest that teachers may be at a loss about how to teach algebra to highly heterogeneous groups of students.

Further, eighth grade teachers may find it difficult to offer high-ability students an appropriate level of challenge in heterogeneous math classes regardless of the topics of the courses. High-ability students in Figures 1a and 1b achieved at lower levels in heterogeneous than in homogeneous classes regardless of the math course content. Students of average- or low-ability do better in homogeneously grouped *algebra* classes, but as well or better in heterogeneously grouped *survey math* classes of high, medium, or low content.

Some will look at the results in Table 11 and Figures 1a and 1b and suggest that the achievement benefits of homogeneous algebra classes over heterogeneous algebra classes are not large enough to warrant a grouping system that labels and separates students in homogeneous math classes. Others may see the same results and decide that homogeneous groups in math have merit, particularly for high-ability students, and particularly when students of all abilities receive high content learning opportunities in the middle grades, as when all students are prepared to take a full algebra course by grade 8. Others may consider the merit of homogeneously grouped classes for math, or for advanced math in particular, but of not separating students by ability in less hierarchically organized subjects (Maryland State Department of Education, 1989).

The results presented here are not definitive in part because of the limits of some measures in this cross-sectional dataset. For example, students' prior ability in math was measured by a self-report of grades in math from "sixth grade up till now." Although such self-reports provide fairly accurate measures of relative differences between students in their past levels of success in math, a more objective measure (e.g., a seventh grade math achievement test) would be preferable.

Nevertheless, the unusual number and quality of other important control variables in these analyses (e.g., teachers' reports of their students' abilities and whether their classes are homogeneously or heterogeneously grouped, teachers' reports of the topics covered in their math courses, and parents' reports of family SES) strengthen confidence in the results. The patterns are large and consistent enough to warrant new studies with better measures.

Educators worry about the dangers for low-group students associated with homogeneously-grouped classes in math and other subjects. However, these dangers may be greatly reduced when homogeneous grouping is not accompanied by a "dumbed-down" curriculum for those in the lower groups. In grade 8 in algebra, for example, the novelty of the challenge of the course and its meaning for students as an advanced "elite" math class may compensate low-group students for the potential danger of being assigned to a low group. Teachers may find instructing these classes to be more satisfying than teaching a remedial, low-content course, and thus may prepare more, provide better instruction, and have higher expectations for their students than is found in the typical low-group math class. Whether similar advantages of homogeneously grouped and challenging (not dumbed-down) courses may appear in other subjects remains to be studied. Also, there are still pedagogical, ethical, and moral questions about grouping practices that deserve reasoned debate and research-based information.

Nevertheless, the data suggest that middle grades students of high ability are placed at a serious disadvantage in heterogeneous mathematics classes *as they are presently taught*. Students of high ability do better in high ability classes of all types of math; students of low ability do better in homogeneously grouped classes in algebra, perhaps because the motivation is high in these classes, or because the teaching is stronger and compensates for the homogeneity of the class. In all other classes, heterogeneous classes are as productive as homogeneously grouped classes for average and low-ability students.

Teachers with classrooms containing students who differ widely in achievement presently may not know how to make these heterogeneous classes work well. Teachers of homogeneous average and low-ability students also face serious problems in how they motivate and instruct students in math.

Effects of offering high-, medium-, and low-content English courses and separate reading courses on reading achievement

We also wanted to know if different investments in reading and English affect students' reading proficiencies. English teachers' reports of emphases on literature, grammar, composition, reading, spelling, study skills, and number of books students were required to read were clustered using the same procedures as for math. Four clusters revealed courses that differed in content. High-content courses emphasized composition, literature, and high numbers of books required for student reading; medium-content courses emphasized composition and grammar, but not literature; and low-content courses either emphasized basic skills and some literature or grammar and little else. All courses included some emphases on grammar.

We found that reading achievement test scores were highest in the high content cluster, but the effects disappeared when controls were imposed for the ability of the class. That is, students high in reading ability to start were placed in homogeneous high ability classes. Using the ability of the class as a proxy for earlier reading achievement shows that the students were not dramatically enriched, beyond their initial abilities, by the high content courses.

The results indicate that heterogeneous grouping in English did not disadvantage high, average, or low ability students. Combined with the earlier results in math, this finding supports strategies to schedule a mix of homogeneously grouped math classes and heterogeneously grouped English classes. This mix is more in keeping with recommendations to limit homogeneous grouping to no more than half the school day in order to assure that students are not labeled and placed in classes with the same students all day and for all subjects (Maryland State Department of Education, 1989).

On the other hand, the lack of grouping and course content effects in English may be due to the outcome measure used here. The reading achievement test of NELS is not an English language arts or writing test, so the content of the courses that emphasized the writing process and editing and rewriting work was not well-matched with the content of the test, making it less likely that an advanced course would show its benefits for students. An English and writing test would be better suited to picking up the benefits of the high content courses in English.

A multiple regression analysis was conducted to determine whether the percent of students who receive a reading course in addition to English was predictive of the percent of students who reach high reading proficiency in the same way that the percent of students who take algebra is linked to the percent of students reaching high math proficiency. It was not (($\beta = .04$; $p=.15$).

Typical reading instruction in the middle grades is often more of the same type of instruction that students receive in the elementary grades, with little adjustment of the curriculum and instructional processes to meet the needs or tap the interests of early adolescents (Stevens, 1991). Too often, middle grades reading courses emphasize instruction in isolated skills and the content is unrelated to what students read in other subjects. Perhaps as a result, schools that offer a separate reading course to middle grades students do not necessarily develop a greater proportion of proficient readers than do otherwise similar schools that do not offer such a course. It may also be that some schools give extra reading classes only to students who need remedial instruction, thereby limiting the connection between the extra class and high reading proficiency.

Discussion

These analyses suggest that educators' decisions about course offerings and instructional approaches have important consequences for students' achievements and attitudes. The significant effects we report are small, but not surprisingly so. The survey measures include gross estimates of school practices and single item indicators of student attitudes or behaviors. Nevertheless, the direction of the effects are clear and consistent across subjects. The confirmatory patterns strengthen the conclusion that curriculum and instruction which require higher level skills benefit students' achievements and behaviors. Despite some weaknesses, the data are the best available measures of middle grades students' achievements and attitudes, and provide patterned and consistent information for discussion and debate among educators about course offerings and instructional strategies. The data and results inform several questions that were raised at the outset:

Are the middle grades too hard or too easy for students? Is the work challenging enough for all students? The data on course offerings and instructional approaches reveal that in many schools many students are not offered real challenges in academic courses and have few opportunities to develop higher level skills. Schoolwork may be too easy for many, if not most, students in the middle grades.

Should students be " pushed ahead" with high school equivalent courses (such as a full course in algebra, or a full high school equivalent course in foreign language)? The jury is out on this question until we can determine the consequences of middle grades experiences on students' progress and success through high school. Nevertheless, the present data on algebra courses suggest that, on average, early opportunities to push ahead with math are beneficial, not harmful. Students benefit in skills and in math attitudes (e.g., liking math class) if their schools offer greater access to algebra.

Whether courses are offered to few or many students is of interest in the abstract, but must be considered as part of a larger set of questions about what courses to offer, to whom, and when (at what grade level). These analyses suggest that some benefits result from offering more students algebra, and that the benefits occur for students at all ability levels when they take algebra, even more than for high content survey courses. The patterns of results are persistent and consistent enough to be taken seriously. Although they are not overwhelming enough to overpower all other educational considerations, they are strong enough to contribute to the debate.

A related question is: *Does algebra in grade 8 really matter?* If students *do not* take a full year of algebra in grade 8, they still can easily and successfully complete a full sequence of advanced math in four years of high school that includes algebra, geometry, trigonometry, and calculus. Most colleges require three years of math; some two, few four. But these data suggest that even low-ability students have significantly higher test scores if they take a full algebra course in grade 8.

There are related issues. If algebra is offered to many in grade 8, then higher content also must be offered in regular math and pre-algebra courses in grades 6 and 7 in order to prepare eighth graders for advanced work. It also may produce higher student interest and self-confidence in math. Even if an eighth grade algebra course is not credited as a full equivalent of a high school algebra course, it may reduce students' fear of math in high school and produce greater success when they take the high school course. This question should be addressed with longitudinal data when it is available in the NELS first followup survey of these students in grade 10.

Similar issues have been raised by educators' suggestions that all middle grades students should read Shakespeare because it shows them that they can handle it; that students feel proud and competent when they carry and read a copy of Romeo and Juliet; and that reading a classic will help them to approach difficult work in high school with greater confidence. The same explanation —students feel proud of themselves and are motivated to learn math when they carry and work from a "real" algebra book —is offered as one reason for offering algebra early, even to students who never liked nor excelled in regular arithmetic. Thus, students may be motivated by the messages they receive from the school when advanced work is offered and expected, whether in algebra, Shakespeare, or other options.

If "push ahead" means "challenge to think and work hard," the results of these analyses suggest that students generally benefit in skills and behavior in math and English from higher level math instruction and more demanding reading and writing activities. In current U.S. middle grades schools, fewer problems are caused by "pushing ahead" than by "holding back."

Should all students be given a "common" curriculum that includes such courses as algebra and literature, and common instruction such as problem solving and the writing process? About 90% of the principals report that they presently offer a "common" curriculum to their middle grades students. But Table 1 and similar data in an earlier survey (Epstein & Mac Iver, 1990a) suggest that when principals say "common," they may mean that all students have *math*, not that all students have *algebra*, or that all students have reading, but not necessarily literature.

For example, most students take math in the middle grades every year (Haffner, 1990), but not many students are in algebra or advanced math. Our estimates from different respondents range from principals' reports that about 18% of the students take a full-year, high school equivalent algebra course; to teachers' reports that about 26% take high-content courses with heavy emphasis on algebra; to students' reports that about 34% take some algebra at least once a week. The different reporters indicate that from one-fifth to one-third of the eighth graders in the U.S. have some exposure to and experience with algebra. This is far fewer students than in Japan, for example, where many more students are offered advanced math by or before grade eight (McKnight, 1987; Miller and Miyake, 1991). The differences in curriculum are so clear that in one international study of math proficiency the only fair comparison was between U.S. eighth graders and Japanese seventh graders (Shaub and Baker, 1991).

Importantly, in all analyses —the principals' reports of school offerings, the teachers' reports of high content in their courses, or the students' reports of at least weekly contact with high content math —there is evidence that higher content courses have positive effects on student achievement.

There is another aspect of the question of common curricula that needs to be discussed. If one accepts as fact that middle grades students are highly diverse in their skills and starting abilities (based on levels of mastery attained in the elementary grades, personal interests, and goals), then it may be highly unresponsive to ignore individual needs, and hard to justify giving everyone the same course or courses whether or not they are ready to successfully meet the same requirements.

A more defensible position is to consider alternate paths to common goals (Carnegie Task Force on the Education of Young Adolescents, 1989). It also is important to consider alternative programs to develop equally important skills and talents. We need more and deeper inquiries into what a "common" curriculum is; how different definitions of "common" affect the progress and success of students at all levels of ability; how uncommon instructional approaches may be needed to help all students master a common curriculum; and how much uncommon curriculum should be offered to develop diverse, important talents.

Do teachers' choices of instructional approaches influence student success? The analyses suggest that the answer to this question is "yes." Problem solving in math and emphasis on writing and literature in English independently affect students' achievements and behaviors in these subjects. The results of the analyses of rich instruction vs. drill and practice across four subjects reinforce the conclusion that students benefit from instruction that demands higher level thinking. Indeed, whether or not the curriculum is common, it may be that the types of instructional approaches should be common to the extent that all students should be engaged in active learning, higher order thinking, advanced equipment and technology, and responsibility for their work. Students who learn at slower rates require even more innovative and challenging approaches (Epstein and Salinas, 1992).

Conclusion

The core — the substance — of any school is its curriculum and instruction. No matter what else is improved in the name of school reform or restructuring, if the curriculum and instruction are not challenging, students' will not learn as much as they could. In the middle grades, where long lists of recommendations guide school improvement, curriculum and instructional reform often are postponed. Schools tend to work first on mechanical changes that are immediately visible, such as creating teams of teachers, establishing a 7- or 8-period day, or scheduling a teacher-group advisory period to discuss students' concerns and development. These are important but insufficient reforms for increasing the success of early adolescents. Curriculum and instructional revisions take longer than these mechanical changes, but are necessary to help more students become competent and confident learners. Educators need to think deeply about the choices they make, debate the issues and consequences, and work to improve their courses and instructional approaches for all students.

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Table 1

Percent of Schools Providing Course Offerings in Selected Subjects During 7th and 8th Grades

	All Schools N=987	Public Schools n=596	Catholic Schools n=170	Other Religious n=185	Private Secular n=36
Reading (a course separate from but concurrent with English) to:					
No Students	19%	18%	11%	32%	26%
About 10% of school's students	9	11	4	4	12
About 25% of school's students	6	8	1	2	9
50% or more of school's students	66	63	84	62	53
Science (two full years) to:					
No Students	5%	3%	1%	12%	10%
About 10% of school's students	1	1	0	0	0
About 25% of school's students	0	0	0	0	0
50% or more of school's students	93	96	99	84	90
Algebra (a full year) to:					
No students	36%	33%	47%	35%	45%
About 10% of school's students	26	31	21	22	2
About 25% of school's students	20	24	12	14	18
50% or more of school's students	17	12	20	29	36
Foreign Language (a full year) to:					
No Students	70%	67%	82%	72%	34%
About 10% of school's students	9	11	7	6	8
About 25% of school's students	7	8	2	8	1
50% or more of school's students	14	14	9	14	58
Mini-Courses on a variety of topics to:					
No Students	43	38%	50%	51%	44%
About 10% of school's students	7	6	10	6	1
About 25% of school's students	4	3	2	10	2
50% or more of school's students	46	44	29	28	31

Table 2

Effects of School Characteristics on the Frequency of Using Selected Instructional Practices in MATHEMATICS with Average or Mixed-Ability Classes (N=833 Schools)

	Drill and practice in math computations		Emphasize creative problem solving, logic and multiple ways of solving problems		Emphasize math applications in real-world situations		Organize peer tutoring or cross-grade tutoring	
	Delta	Beta	Delta	Beta	Delta	Beta	Delta	Beta
Type of School vs Public Schools:								
1) Catholic	.11		-.13		-.07		.39**	
2) Other Religious	-.24*		-.63***		-.38**		.27*	
3) Private Secular	.26		-.20		-.68**		.07	
Grade Organization vs. Middle Schools:								
4) 7 - 8	-.17		.01		-.09		-.04	
5) 7 - 9	.05		-.03		.08		02	
6) 7 - 12	.24		.00		.01		-.03	
7) K - 8	.27*		.18		.18		.28*	
8) K - 12	.07		.39**		.17		-.07	
Length of Class Periods:								
9) Minutes per 8th-grade class		-.02		.08		.10**		.02
Size:								
10) Number of 8th-graders enrolled		.01		-.08		.02		.03
Between-Class Ability Grouping:								
11) 8th-graders are assigned to homogeneous math classes	.18*		-.13		.07		-.17*	
Urbanicity of School vs. Urban Schools								
12) Suburban	.18		.14		-.15		-.03	
13) Rural	-.07		.04		-.30**		.14	
Region vs. Northeast:								
14) Northcentral	.03		.14		.04		.05	
15) West	.02		.01		.14		.61***	
16) South	.30*		.27*		.16		.26*	
Characteristics of School's Students:								
17) % minority		-.07		.12**		-.09*		.01
18) % living in poverty		.08		.08		.21***		.21***
19) Average ability upon entry		-.04		.06		.06		.10*
20) % From professional or managerial families		-.03		.28***		.19***		-.01
Adjusted R^2	04		.11		.06		.13	

* $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

Table 3
Effects of School Characteristics on the Frequency of Using Selected Instructional Practices in ENGLISH with Average or Mixed-Ability Classes (N=823 Schools)

	Drill and practice on language basics		Teach content and ideas in works of literature		Have students write composition or reports		Have students edit and re-write compositions		Have students make oral presentations	
	Delta	Beta	Delta	Beta	Delta	Beta	Delta	Beta	Delta	Beta
Type of School vs Public Schools:										
1) Catholic	.45***		-.06		-.58***		-.41***		.01	
2) Other Religious	-.01		-.36**		-.91***		-1.11***		-.64***	
3) Private Secular	.38		-.75***		-1.00***		-.75***		-.43*	
Grade Organization vs. Middle Schools:										
4) 7 - 8	-.21		-.20		.05		-.02		-.16	
5) 7 - 9	-.11		-.25		-.19		-.21		-.08	
6) 7 - 12	.38**		-.04		-.01		-.14		-.14	
7) K - 8	.07		.07		.23*		.06		.18	
8) K - 12	.22		.45**		.65***		.33*		.00	
Length of Class Periods:										
9) Minutes per 8th-grade class		.08*		.02		.13***		.07		.08*
Size:										
10) Number of 8th-graders enrolled		-.08		.06		-.03		-.02		-.01
Between-Class Ability Grouping:										
11) 8th-graders are assigned to homogeneous English classes	.19*		.05		.02		.11		.11	
Urbanicity of School vs. Urban Schools										
12) Suburban	.04		-.19*		-.42***		-.22**		.05	
13) Rural	-.22*		-.12		-.41***		-.39***		-.11	
Region vs. Northeast:										
14) Northcentral	.01		.22*		-.25**		-.26**		.05	
15) West	-.15		.03		-.15		-.25*		.30**	
16) South	.04		.03		-.43***		-.36***		-.02	
Characteristics of School's Students:										
17) % minority		.02		.03		.00		-.02		-.11*
18) % Living in poverty		.13**		-.08		.07		.03		.25***
19) Average ability upon entry		-.04		.02		-.06		-.04		.12**
20) % From professional or managerial families		-.01		.27***		.42***		.32***		.09
Adjusted R^2	.10		.09		.19		.18		.09	

* p ≤ .05   **p ≤ .01   ***p ≤ .001

TABLE 4

Effects of School Characteristics on the Frequency of Using Selected Instructional Practices In SCIENCE With Average or Mixed Ability Classes (N=830 Schools)

	Drill & Practice (Science Facts)		Emphasize Scientific Methods		Hands-on Laboratory Research		Use Computer/Video for Science Instruction	
	Delta	Beta	Delta	Beta	Delta	Beta	Delta	Beta
Type of School vs. Public Schools								
1) Catholic	-.07		-.10		-.45***		-.18	
2) Other Religious	.06		-.42***		-.90***		-.36**	
3) Private Secular	.71***		-.01		-.50**		-.01	
Grade Organization vs. Middle Schools								
4) 7 - 8	-.09		-.18		-.23		-.12	
5) 7 - 9	.16		-.14		-.25		-.07	
6) 7 - 12	.53***		.09		-.06		-.12	
7) K - 8	.38**		.03		-.25*		-.35**	
8) K - 12	.21		.23		-.08		-.12	
Length of Class Periods:								
9) Minutes per 8th-grade class		.02		.00		-.08*		-.02
Size:								
10) Number of 8th-graders enrolled		.16**		.07		.06		.02
Between Class Ability Grouping								
11) 8th-graders assigned to homogeneous science classes	.11		.03		.39***		.29***	
Urbanicity of Schools vs. Urban Schools:								
12) Suburban	.23*		.02		.18*		-.26**	
13) Rural	.09		.01		.28**		-.25*	
Region vs. Northeast:								
14) Northcentral	.02		.02		.23*		.16	
15) West	-.23		.10		.00		.30*	
16) South	.33**		.07		.02		-.01	
Characteristics of School's Students:								
17) % minority		-.02		.12**		.03		-.08
18) % living in poverty		.11*		.01		-.09*		.12*
19) Avg. ability upon entry		.10*		.14**		.01		.02
20) % from professional or managerial families		-.11*		.17***		.30***		.17***
Adjusted R^2	.07		.06		.22		.08	

*p ≤ .05 **p ≤ .01 ***p≤ .001

TABLE 5

Effects of School Characteristics on the Frequency of Using Selected Instructional Practices in SOCIAL STUDIES With Average or Mixed Ability Classes (N=831 Schools)

	Drill & Practice (Facts & Dates)		Students Write Compositions in Social Studies		Students Work on Group Projects		Discuss Controversial Issues		Students Act as Historians	
	Delta	Beta	Delta	Beta	Delta	Beta	Delta	Beta	Delta	Beta
Type of School vs. Public Schools:										
1) Catholic	.23		-.38***		-.23		.02		.19	
2) Other Religious	.20		-.77***		-1.03***		-.54***		-.51***	
3) Private Secular	.18		-.73***		-.79***		.34		.11	
Grade Organization vs. Middle Schools:										
4) 7 - 8	-.13		.06		.23		-.30*		-.06	
5) 7 - 9	-.11		-.03		.03		-.14		-.11	
6) 7 - 12	.21		-.03		-.25		-.22		-.24	
7) K - 8	.09		.12		.01		-.03		.12	
8) K - 12	.30*		.44**		.05		-.13		-.10	
Length of Class Periods:										
9) Minutes per 8th-grade class		.08*		-.02		.09*		.03		.05
Size:										
10) Number of 8th-graders enrolled		.10		-.02		-.12*		.00		.04
Between Class Ability Grouping:										
11) 8th-graders assigned to homogeneous social studies classes	.19*		.03		-.03		.03		.32***	
Urbanicity of Schools vs. Urban Schools:										
12) Suburban	.29**		-.07		-.02		-.09		-.07	
13) Rural	.36***		-.26*		-.28**		-.33**		.00	
Region vs. Northeast:										
14) Northcentral	-.05		-.36***		-.01		-.25*		.14	
15) West	-.54***		-.32***		.15		-.01		.12	
16) South	.20		-.24*		-.22*		-.01		.01	
Characteristics of School's Students:										
17) % minority		.09*		.01		-.07		-.04		.02
18) % living in poverty		.14***		.07		.11**		.12**		.10*
19) Avg. ability upon entry		.07		-.03		.09*		.02		.11**
20) % from professional or managerial families		.08		.35***		.15**		.17***		.10*
Adjusted R^2	.10		.15		.12		.10		.08	

*p ≤ .05 **p ≤ .01 ***p ≤ .001

Table 6

Estimated Effects of Emphasizing Creative Problem Solving in Math, School Characteristics, and Student Characteristics on Students' Proficiency and Fear of Asking Questions in Math

Predictor	Math Proficiency Score Delta	Math Proficiency Score Beta	Fear of Asking Questions Delta	Fear of Asking Questions Beta
Frequency of emphasizing creative problem-solving, logic, and multiple ways of solving problems in math		.05***		-.04**
School characteristics:				
# of different teachers eighth-graders have during an average week in academic subjects		-.02		-.01
# of 8th-graders enrolled		.01		-.05**
% minority students in school		-.03		.04*
% free lunch students in school		-.09***		-.02
Grade Organization vs. middle schools:				
Junior High (e.g, 7-9)	.09*		.04	
Middle-High Combination (e.g., 7-12)	.03		-.11*	
7-8 School	-.01		-.03	
Elementary-High Combination (e.g, K-12)	.16*		.05	
Elementary-Middle Combination (e.g., K-8)	-.02		-.11*	
Urbanicity of school vs. urban schools:				
Suburban	-.06		-.04	
Rural	.06		-.03	
Region vs. Northeast:				
North central	.09*		.18***	
West	.01		.08	
South	-.10**		.16***	
Student Characteristics:				
Socio-economic status composite		.18***		-.01
Past marks in math on report cards in the middle grades		.20***		-.20***
Female	-.12***		.09***	
Race vs. white students:				
Asian American	.13		.23**	
African American	-.16***		-.10*	
Hispanic American	-.11*		.14**	
Native American	-.20		.20	
Adjusted R^2		.15		.05

Note. Students with handicaps and students who are not proficient in English are excluded. The analyses include only public school eighth-graders who indicate that they attend a regular math class and that their class is an average ability or mixed-ability class; minimum pairwise n = 5594.

*$p \leq .05$ **$p \leq .01$ ***$p \leq .001$

Table 7

Estimated Effects (Betas) of Rich Instruction and Drill & Practice in the Major Academic Subjects on Students' Mean Achievement Test Scores, Attitudes, and Behaviors

Predictor	Achievement	Afraid to Ask Questions	Noncompletion of Homework	Boredom	Future Utility of Subjects
Emphasis on Rich Instruction	.06***	-.05***	.00	-.01	.03
Emphasis on Drill & Practice	-.04***	.03	.04*	.06**	-.04*
R^2	.34	.05	.08	.03	.06

Note. Table entries are beta coefficients. The analyses include only public school eighth-graders who are in average or mixed-ability classes for the major academic subjects. Students with handicaps and and students who are not proficient in English are excluded. The analyses statistically hold constant the same school characteristics and student characteristics as in Table 6 except that students' average past marks *across subjects* in the middle grades replaces students' average past marks *in math* as a control variable.

$^{***}p \leq .001$ $^{**}p \leq .01$ $^{*}p < .05$.

Table 8

Estimated Effects of the Percentage of Middle Grades Students Taking Algebra, School Characteristics, and Student Characteristics on the Percentages of Students With High Scores on Measures of Mathematics Proficiency and Liking of Mathematics Class (N = 742 Public Schools)

Predictor	% Students Proficient in Math At All 3 Levels[a]		% Students Strongly Agreeing That "I Usually Look Forward to Math Class"	
	Delta	Beta	Delta	Beta
% middle grades students who take a full year of algebra		.18***		.15***
Grade Organization vs. Middle Schools:				
7 – 8	.09		.16	
7 – 9	.10		-.02	
7 – 12	-.19		-.04	
K – 8	-.06		.02	
K – 12	.01		-.22	
Length of Class Periods: Minutes per 8th-grade class		-.05		-.04
Size: Number of 8th-graders enrolled		-.02		-.03
Between-Class Ability Grouping: 8th-graders assigned to homogeneous math classes	.23***		.07	
Urbanicity of School vs. Urban Schools				
Suburban	.06		.11	
Rural	.02		.04	
Region vs. Northeast:				
Northcentral	.18*		-.08	
West	.07		-.32**	
South	-.15		-.05	
Characteristics of School's Students:				
% minority		-.04		.35***
% living in poverty		-.11**		.14**
Average ability upon entry		.29***		.00
% from professional or managerial families		.19***		-.09*
Adjusted R^2		.43		.20

[a] level 1 — simple arithmetical operations on whole numbers; level 2 — simple operations with decimals, fractions, and roots; level 3 — simple problem solving, requiring conceptual understanding and/or development of a solution strategy.

Table 9

Logistic Regression Estimates of the Effects of Attending an Algebra Class on Students' Probability of Scoring at the Highest Level of Mathematics Proficiency and of Displaying a Strong Liking for Mathematics

Predictor	Probability of High Proficiency (n=8,455 students)	Probability of Strong Liking (n=9,224 students)
Student reports attending "ALGEBRA (or other advanced math)"[a]	1.77***	.22***

Note. Each coefficient indicates the incre_ in the log of the odds associated with attending Algebra. The analyses included only public school eighth-graders. Students with handicaps and students who are not proficient in English were excluded. Logistic regression requires listwise deletion of cases with missing values. Thus, only cases with valid values on all variables included in the analysis were used. As the *n*'s reflect, data on attitudes toward math were available for more cases than were data on mathematics proficiency.

[a]The effects of this variable were estimated after statistically controlling for 21 other variables. The control variables were the same as those used in Table 6.

***$p \leq .001$

Table 10

Estimated Effects (Deltas) of Attending an Algebra Class on Students' Mathematics Achievement and Attitudes

Predictor	Math Standardized Score	Afraid to Ask Ques.	Future Utility
Student reports attending "ALGEBRA (or other advanced math)"[a]	.62***	.07***	.05**
Adjusted R^2	.43	.05	.07

Note. The analyses included only public school eighth-graders. Students with handicaps and and students who are not proficient in English were excluded. Pairwise deletion of cases with missing values was used; minimum pairwise $n = 10{,}339$.

[a]The effects of this variable were estimated after statistically controlling for 21 other variables. The control variables were the same as those used in Table 6.

$**p \leq .01$ $***p \leq .001$

Table 11

Estimated Effects (Deltas) of Course Content and Track Level on Students' Mathematics Achievement Test Standardized Scores

Predictor	Variables in the regression equation: 21 controls[a]	Add Course Content (Cluster)	Add Control for Track Level (Ach. level of class)
Cluster vs. Algebra Cluster:			
High Content Survey	—	-.54***	-.23***
Medium Content	—	-.73***	-.44***
Low Content	—	-.88***	-.41***
Achievement Level of Class (Compared to School's Average 8th-Grader) vs. Low Ach. level:			
High ach. level	—	—	.90***
Average ach. level	—	—	.30***
Widely differing ach. levels	—	—	.23***
Adjusted R^2	.36	.44	.52

Note. The analyses included only public school eighth-graders. Students with serious handicaps and students who are not proficient in English are excluded. Teacher descriptions of the course content and track level of students' mathematics courses were obtained for a random half of the students. The minimum pairwise n for the analyses reported in this table is 5,943.

[a] The 21 control variables were the same as those used in Table 6.

$***p \leq .001$ $**p \leq .01$

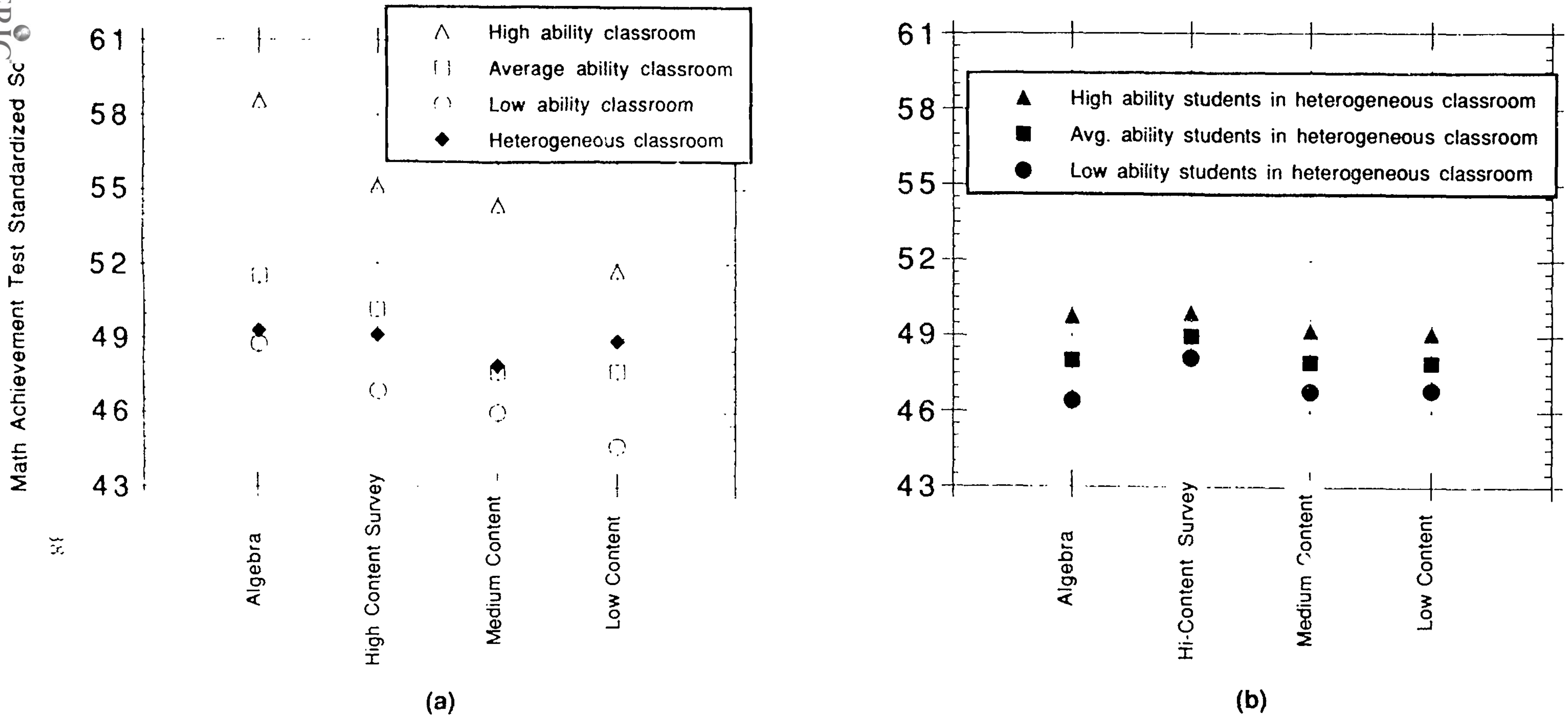

Figure 1. ***(a) Adjusted mean math achievement in homogeneous and heterogeneous classrooms by course content and track ability level. (b) Adjusted mean achievement in heterogenous classrooms by course content and student ability level.***

Appendices A and B

Appendix A: Instructional Approaches by Typical Teachers of Average or Mixed-Ability Eighth-Grade Classes (Rounded to the nearest %)

	Public Schools n=596	Catholic Schools n=170	Other Religious n=185	Private Secular n=36	All Schools N=987
How Often the Typical MATH Teacher Uses These Approaches					
Drill and Practice in Computation:					
Daily	64%	71%	54%	70%	64%
Weekly	22	19	27	20	22
Most Weeks	12	7	11	8	11
Monthly	1	3	6	1	2
Rarely or Never	1	0	2	2	1
Emphasize Creative Problem Solving:					
Daily	23%	32%	11%	55%	24%
Weekly	44	37	42	22	41
Most Weeks	25	30	40	23	29
Monthly	4	1	8	0	4
Rarely or Never	3	1	0	0	2
Emphasize Applications in Real World:					
Daily	22%	24%	17%	18%	21%
Weekly	41	40	39	25	40
Most Weeks	27	29	37	47	30
Monthly	6	5	0	8	5
Rarely or Never	4	2	7	1	4
Peer or Cross-Grade Tutoring:					
Daily	8%	15%	19%	1%	11%
Weekly	10	13	17	11	12
Most Weeks	20	24	8	19	18
Monthly	13	17	6	16	13
Rarely or Never	50	32	51	53	47
How Often the Typical ENGLISH Teacher Uses These Approaches					
Drill and Practice on Language Basics:					
Daily	30%	56%	24%	57%	34%
Weekly	45	36	67	25	47
Most Weeks	22	6	4	17	16
Monthly	2	1	5	1	3
Rarely or Never	0	0	0	0	0
Teach Content and Ideas in Works of Literature:					
Daily	14%	24%	10%	13%	15%
Weekly	28	36	45	37	33
Most Weeks	40	26	25	36	35
Monthly	14	10	16	1	14
Rarely or Never	4	4	5	13	4

	Public Schools	Catholic Schools	Other Religious	Private Secular	All Schools
Have Students Write Compositions or Reports:					
Daily	4%	2%	2%	0%	3%
Weekly	33	39	33	59	35
Most Weeks	45	30	25	16	37
Monthly	17	25	30	25	21
Rarely or Never	2	4	10	0	4
Have Students Edit, Rewrite, and Resubmit Compositions:					
Daily	4%	0%	0%	2%	3%
Weekly	28	34	19	47	28
Most Weeks	40	40	26	18	36
Monthly	20	22	29	33	23
Rarely or Never	7	4	27	1	10
Have Students Make Oral Presentations:					
Daily	2%	0%	0%	0%	1%
Weekly	10	9	9	6	9
Most Weeks	30	42	13	12	28
Monthly	47	44	50	73	48
Rarely or Never	11	4	28	9	13
How Often the Typical SCIENCE Teacher Uses These Approaches					
Drill and Practice on Science Facts:					
Daily	35%	35%	31%	51%	35%
Weekly	40	28	41	42	38
Most Weeks	21	29	20	5	21
Monthly	3	2	8	0	4
Rarely or Never	1	6	0	2	2
Emphasize Scientific Methods of Discovery:					
Daily	18%	28%	16%	29%	20%
Weekly	44	26	40	53	40
Most Weeks	30	35	23	17	29
Monthly	6	9	15	2	8
Rarely or Never	2	3	7	0	3
Hands-on Laboratory Research:					
Daily	4%	3%	3%	6%	3%
Weekly	37	29	23	43	33
Most Weeks	35	27	17	19	29
Monthly	15	24	26	20	19
Rarely or Never	10	17	32	12	16

	Public Schools	Catholic Schools	Other Religious	Private Secular	All Schools
Use Computer or Video for Science Instruction:					
Daily	1%	1%	0%	0%	1%
Weekly	17	9	9	21	14
Most Weeks	29	19	28	34	27
Monthly	27	37	24	25	28
Rarely or Never	27	35	40	20	30
How Often the Typical SOCIAL STUDIES Teacher Uses These Approaches					
Drill and Practice on Names, Dates, and Facts:					
Daily	19%	23%	9%	29%	18%
Weekly	36	31	46	22	36
Most Weeks	31	28	33	45	31
Monthly	10	11	5	1	9
Rarely or Never	6	8	7	3	6
Discuss Controversial Issues in History & Current Events:					
Daily	17%	21%	11%	50%	18%
Weekly	40	46	34	29	40
Most Weeks	29	28	31	19	29
Monthly	12	2	13	2	10
Rarely or Never	3	2	11	1	4
Have Students Work on Group Projects:					
Daily	2%	0%	0%	0%	1%
Weekly	21	23	2	9	17
Most Weeks	29	33	29	27	30
Monthly	37	37	35	53	37
Rarely or Never	12	6	34	10	15
Have Students Write Compositions in Social Studies:					
Daily	0%	0%	0%	1%	0%
Weekly	19	26	17	27	20
Most Weeks	30	22	14	24	25
Monthly	37	33	39	36	37
Rarely or Never	15	19	30	12	18
Have Students BE Historians:					
Daily	0%	3%	0%	0%	1%
Weekly	5	7	0	4	4
Most Weeks	14	15	5	20	13
Monthly	32	34	24	38	31
Rarely or Never	49	41	71	39	52

Note. Chi square tests for all instructional approaches are significant at or beyond the .001 level indicating differences in the percents of teachers using these practices in public, Catholic, other religious, and private schools.

Appendix B

Mean Emphasis on Each of Ten Topics in Four Different Types of 8th-Grade Math Courses

Topic	Algebra Cluster *n* = 1596	High Content Survey Cluster *n* = 2959	Medium Content Cluster *n* = 628	Low Content Cluster *n* = 979
Algebra (formulas and equations)	**2.9**	**2.7**	*2.3*	1.7
Integers	**2.8**	**2.9**	**2.8**	2.0
Problem-solving	**2.8**	**2.8**	2.3	*2.6*
Geometry	2.1	**2.8**	2.0	2.2
Measurement	1.8	*2.6*	2.1	2.3
Probability and statistics	1.7	2.3	1.8	1.4
Ratio and proportion	2.2	**2.9**	*2.4*	*2.6*
Percent	2.2	**3.0**	**2.7**	**2.8**
Decimal fractions	1.9	**2.8**	**2.7**	**2.9**
Common fractions	1.9	**2.8**	**2.8**	**3.0**

Note. These analyses include only public school eighth-graders. Students with serious handicaps that interfere with school performance and students who are not proficient in English are excluded. Teacher descriptions of students' math courses were obtained for a random half of the students in the NELS:88 base-year sample.

Emphasis scores indicating **heavy emphasis** are printed in **boldface**, those indicating *moderate emphasis* are printed in *italics*, those indicating minor emphasis are printed in regular type, and those indicating little or no emphasis are printed in small type.