The Quality of Intellectual Work in Chicago Schools: A Baseline Report

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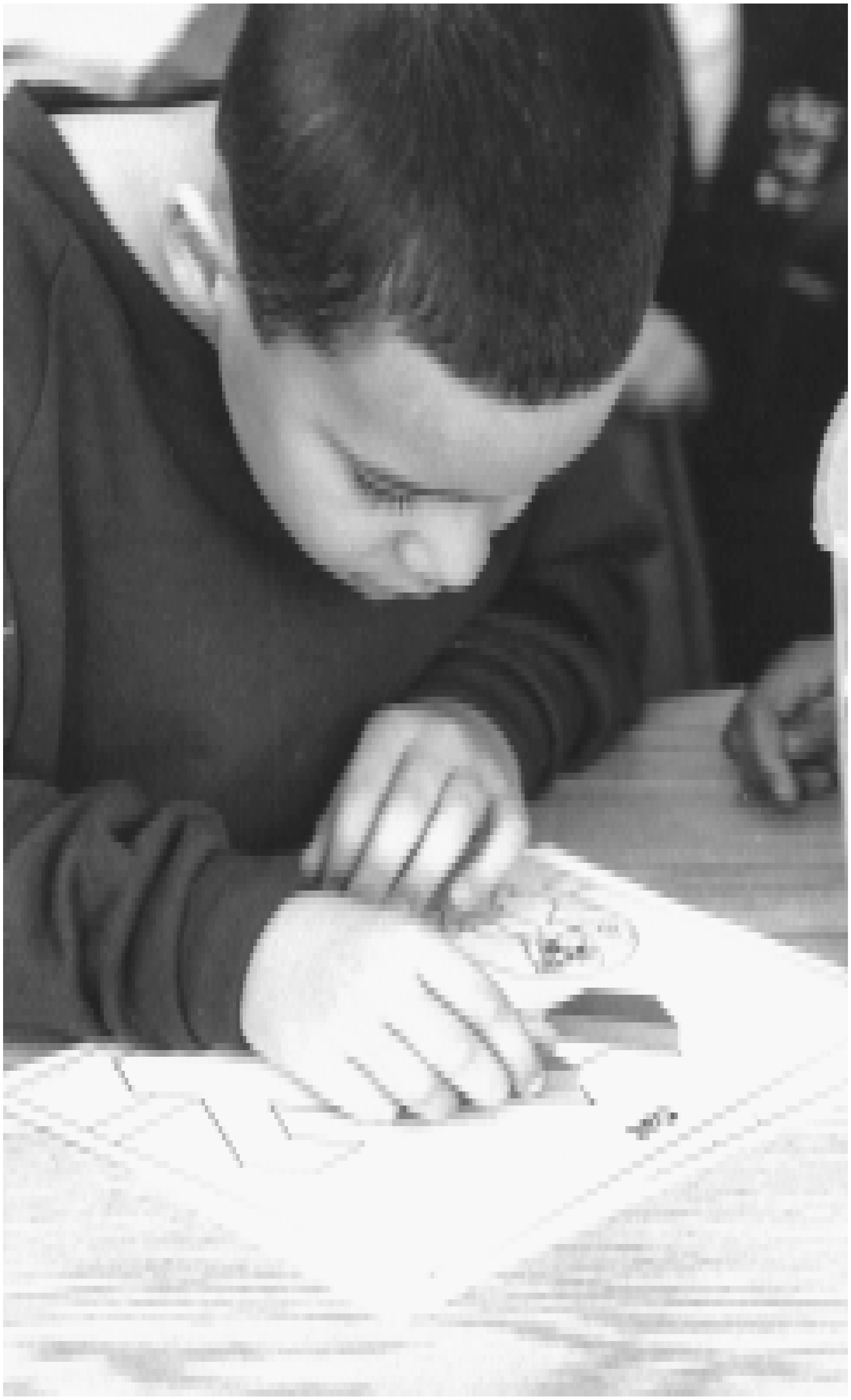

Forward

In 1993 Ambassador Walter Annenberg announced a $500 million challenge grant to support school reform in the nation's largest cities. Chicago parents, teachers, principals, and community leaders submitted a proposal to the National Annenberg Challenge and received a five-year grant of $49.2 million to assist the Chicago public schools. An additional $100 million in matching funds was pledged by local Chicago donors.

The Chicago Annenberg Challenge (the Challenge) was organized to manage and distribute those grant monies. Its mission is to improve student achievement by supporting intensive efforts to reconnect schools to their communities, restructure education, and improve teaching and learning. The Challenge funds school networks and partnerships that seek to create successful, community-based schools that address three critical education issues: school and teacher isolation, school size, and time for learning. Over half of Chicago's public schools may participate in an Annenberg-sponsored improvement effort by the end of the five-year grant period.

This report is part of a first series of reports from the Chicago Annenberg Research Project that will be released in 1998. This series draws from baseline survey, interview, and documentary data collected in late 1996 and 1997, the first full year of Annenberg network funding and the research project's first year of data collection. This series documents and analyzes various "starting points" for the Chicago Challenge. These starting points concern the broader institutional contexts in which the Chicago Challenge was founded and has begun its work, and the conditions of schools and classrooms that the Challenge seeks to improve. These contexts also concern the development of the Challenge as an organization, the establishment and initial function of its networks—the primary organizational mechanism by which the Challenge seeks to promote school improvement—and the resources available to schools that can aid improvement.

Specific reports in this first series focus on: (a) the early history of the Chicago Challenge and its role in the broad context of school reform in Chicago; (b) characteristics of Chicago Challenge networks, with a particular focus on their organization, "theories-of-action," and the roles of their external partners; (c) initial function and accomplishments of Challenge schools and networks; (d) the nature of student learning opportunities found in Chicago Annenberg schools in their first year of participation in the Challenge (this report); (e) social support for student learning and academic press found in these schools during that first year; and (f) opportunities for teacher professional learning and development as a specific resource for school improvement.

A second series of reports will be prepared after the research project has completed a second full round of data collection. This second series will move beyond reports of "starting points" from baseline data and focus on change in Annenberg schools. It will draw on two and one-half years of longitudinal case study data of schools and classrooms and comparative cross-sectional data from 1997 and 1999 teacher, student, and principal surveys. It will document and analyze how schools have developed during their first three years of participation in the Chicago Challenge and how networks may have contributed to that development.

Consistent with other studies conducted by the Consortium on Chicago School Research, this report is designed to promote a broader understanding of how to improve learning in Chicago's schools. The current dominant indicator of student learning in Chicago is scores on the standardized Iowa Tests of Basic Skills (ITBS). The knowledge and skills tested on the ITBS can serve as a foundation, but as explained below, such tests alone are inadequate indicators for the more complex intellectual challenges that are increasingly required for success in work, civic participation, and personal life. This report takes a first look at the extent to which students in Chicago schools gain opportunities to succeed in more complex intellectual work.

Drawing upon the first year of fieldwork supported by the Chicago Annenberg Challenge, the report presents standards for intellectual work to describe the quality of instruction and student performance in Annenberg Challenge schools. It also presents evidence and examples of how teachers' assignments and student performance in writing and mathematics, grades three, six, and eight, fared on these standards in 12 Chicago schools during our initial data collection (spring 1997). The purpose of this study is not to judge the success of the Annenberg initiative or of any school, teacher, or student. Rather, it establishes a baseline of practices in Chicago schools for comparison in subsequent research that will track school improvement between 1997 and 2001.

More generally, the various research studies supported by the Chicago Annenberg Challenge are intended to expand public understanding about the conditions of education in the Chicago Public Schools and the kinds of efforts needed to advance meaningful improvements. This effort to stimulate new avenues of discussion about urban school improvement is an important aspect of Ambassador Annenberg's challenge to the nation's largest cities to extend the educational opportunities provided their citizens.

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SECTION I
Standards for Intellectual Quality

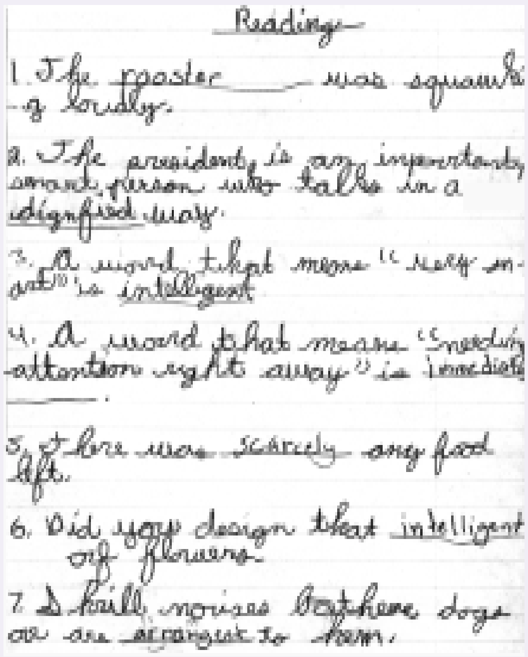
Since the early 1980s, schools in the United States have been subject to persistent public scrutiny and, in some cases, intense pressure to reform. Critics differ in their diagnoses of the most serious problems, but a common complaint is the low level of students' academic achievement. This judgment is often based on standardized test scores that show large proportions of students scoring below a state or national average, or United States students scoring below students from other nations. Because these test scores historically have been very low in Chicago, the Consortium has initiated a separate report series, "Examining School Productivity," that presents in-depth analysis of these trends.[1]

But standardized test scores give only a partial picture of students' intellectual performance. The standardized test score gives a numerical indicator of how a student performed relative to other students, but does not show the specific knowledge or skills the student demonstrated (or failed to demonstrate). The items on such tests usually call for specific memorized information, retrieval of given information (as in reading comprehension questions), or application of routine computational procedures, but rarely do they call for higher level thinking, interpretation, or in-depth conceptual understanding. Finally, because almost all items are to be answered in multiple-choice format, the tests offer no opportunity for students to demonstrate their ability to communicate in prose or other kinds of writing about the subject being tested. Concerns such as these led us to expand our inquiry to additional indicators of the intellectual performance of Chicago's students.

We chose to examine the work that teachers asked students to undertake in the classroom. Teachers' assignments and student work comprise the most direct evidence we can collect about students' opportunities to learn and the competencies they demonstrate. We begin by considering examples of assignments typically given for

Figure 1: Typical Assignment and Student Work Grade 3 Writing

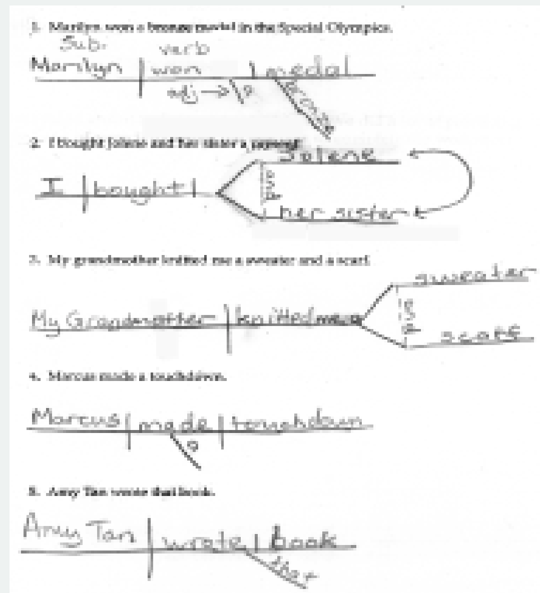
Assignment: "Use vocabulary words to fill in the blanks of the sentences, page 135. You may use definitions."



To complete this assignment correctly, students had to know the meaning of the words, but they did not have to interpret them or compose their own writing. In addition, this student made several errors.

Figure 2: Typical Assignment and Student Work Grade 6 Writing

Assignment: The teacher modeled sentence diagramming on the board, and the class practiced. The teacher explained the parts of speech, then told the students to complete the diagrams for five sentences on a worksheet.



This student completed the diagrams fairly successfully, but the assignment did not call for original or elaborate composition.

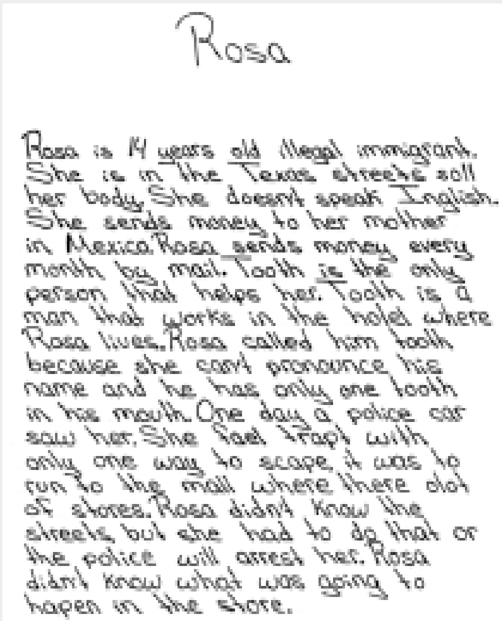
writing and mathematics in grades three, six, and eight, and the work of "average" Chicago students in response to those assignments.[2]

How "good" is the student work in Figures 1 through 6? Is it satisfactory? Is it below or above what should be expected at these grade levels? Reaching agreement on criteria for evaluation can be difficult, as we discuss in more detail later. But for now, suffice it to say that prominent voices on "world class" standards for student performance would probably find these work samples quite troublesome.[3]

For example, the third-grade writing assignment (Figure 1) asked students to insert given words into given sentences, and the student made several errors. The sixth-grade writing assignment (Figure 2) also asked students to insert words into a given format, in this case a sentence diagram. But neither of these assignments asked students to compose their own writing. The eighth-grade writing task (Figure 3) did ask students to compose a book report. However, the student simply summarized information about each character, offered no interpretation of the meaning of the story, and made

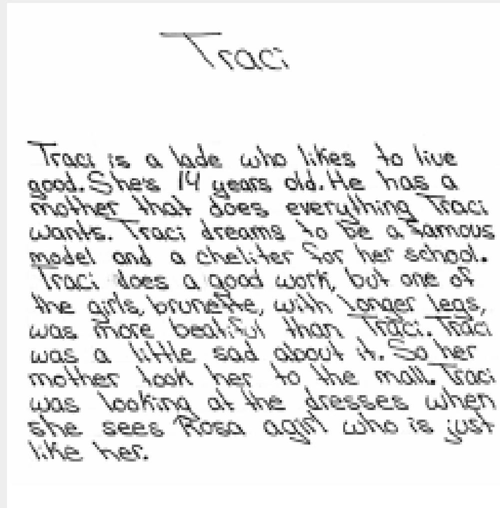
Figure 3: Typical Assignment and Student Work
Grade 8 Writing

Assignment: "Write a book report on the book *Sisters*."



Rosa

Rosa is 14 years old illegal immigrant. She is in the Texas streets sell her body. She doesn't speak English. She sends money to her mother in Mexico. Rosa sends money every month by mail. Tooth is the only person that helps her. Tooth is a man that works in the hotel where Rosa lives. Rosa called him tooth because she can't pronounce his name and he has only one tooth in his mouth. One day a police car saw her. She feel trapt with only one way to scape, it was to run to the mall where there alot of stores. Rosa didn't know the streets, but she had to do that or the police will arrest her. Rosa didn't know what was going to hapen in the store.



Traci

Traci is a lade who likes to live good. She's 14 years old. He has a mother that does everything Traci wants. Traci dreams to be a famous model and a chelider for her school. Traci does a good work, but one of the girls, brunette, with longer legs, was more beatiful than Traci. Traci was a little sad about it. So her mother took her to the mall. Traci was looking at the dresses when she sees Rosa agin who is just like her.

This report included illustrations, a dedication page, and a biography of the authors. The assignment required original composition, but the student provided only a plot summary, with no interpretation or evaluation of the book.

several spelling errors along the way. Even though the sixth- and eighth-grade students completed the assignments successfully, in general, these assignments made no demands for students to use writing as a way of expressing complex thoughts.

Similarly, the mathematics assignments in Figures 4-6 (next page) required either memorization of simple mathematics facts and computational procedures or application of given formulas to a set of almost identical problems. These three students completed the assignments with varying degrees of success–the sixth grader answered only about one-third of the questions correctly, while the third- and eighth-grade students solved all the problems without mistakes. However, none of the assignments challenged students to think about mathematics in more complex ways; for example, by asking them to choose among algorithms for solving different kinds of problems, to solve problems that have several computational steps, or to judge the reasonableness of their answers. On balance, although the student competencies demonstrated in these assignments are important, they are just not sufficient, especially as we look to preparing students for a future workplace and society.

Figure 4: Typical Assignment and Student Work Grade 3 Mathematics

Assignment: "You've already learned your multiplication facts. We are now going to use our facts to learn division. In the first problem, what number when you count by 8s equals 40? (5). Yes, 5 is the answer. So, write the number 5 on top. Complete the rest." (There were 28 problems.)

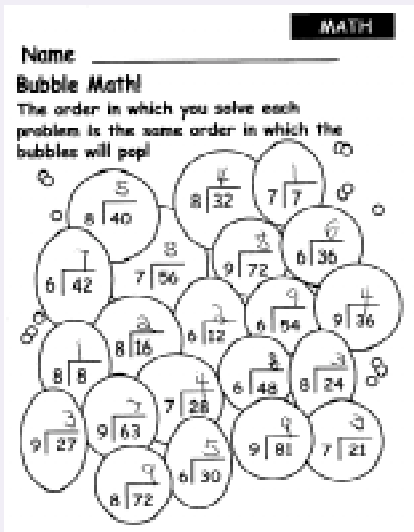
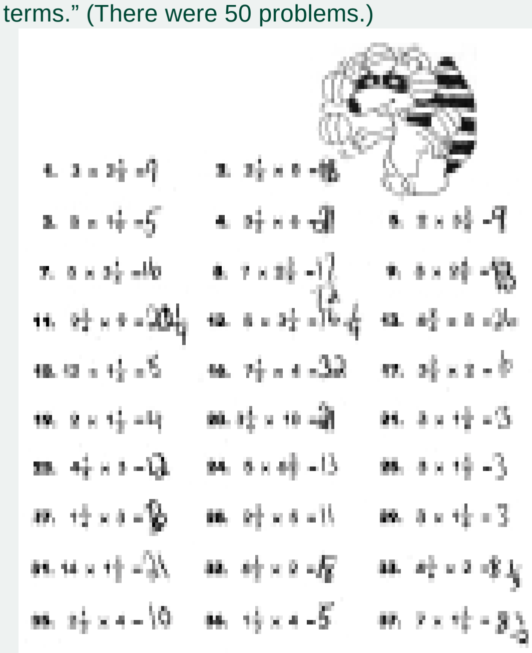


Figure 5: Typical Assignment and Student Work Grade 6 Mathematics

Assignment: "Solve problems on a separate sheet of paper and write your answers on the worksheet. Reduce your answers to the lowest terms." (There were 50 problems.)



Rather than challenging the students by requiring a choice among various algorithms, for example, these assignments each involved a set of almost identical problems. The third grader (Figure 4) solved all the problems without mistakes, but the sixth grader (Figure 5) answered only about one-third of the questions correctly.

Intellectual Work in Contemporary Society: Beyond the Basics

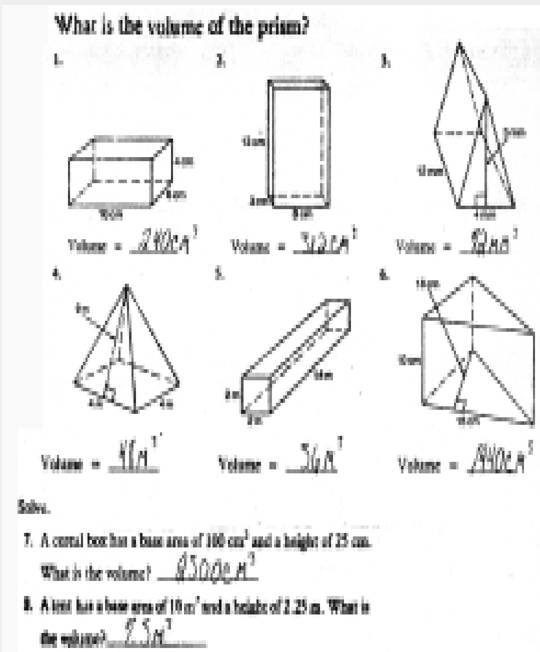
Suppose a group of adults is asked to judge the quality of intellectual work done by students in a specific school. The group visits the school for a few days, with opportunities to observe classroom instruction and examine texts, other instructional materials, the tests given, and students' written and oral work. In deciding whether intellectual quality is high, low, or somewhere in between, what are these observers likely to notice and discuss?

Whether students produce correct answers and follow proper procedures and conventions in writing, speaking, and computing will be a central concern; that is, are students mastering basic knowledge and skills? If all students could demonstrate such competence, this would represent a vast improvement. But it would be only a beginning. As we explain later, productive work, responsible citizenship, and successful management of personal affairs in contemporary and future society is more demanding than giving correct answers and following proper procedures for the work traditionally assigned in school. What additional standards are needed to assess such complex intellectual proficiency?

To identify more ambitious criteria for intellectual work, we considered the kinds of mastery

Figure 6: Typical Assignment and Student Work
Grade 8 Mathematics

Assignment: After a review of 2 pages in the text, students were told to complete the practice sheet.



Like the math examples for third and sixth grade, this eighth-grade worksheet called for computation, but not higher order thinking such as explaining the answers.

demonstrated by successful adults who worked with knowledge; for example, scientists, musicians, childcare workers, construction contractors, health care providers, business entrepreneurs, repair technicians, teachers, lobbyists, and citizen activists. Adults in these diverse endeavors face a common set of intellectual challenges that can serve as guidelines for education that extends beyond the basics to more complex intellectual work.

Consider, for example, an engineer designing a bridge. We do not expect children to design and build real bridges, but understanding the intellectual work of accomplished adults who engage in such endeavors helps to identify characteristics that can serve as general standards for student performance. To complete the bridge design successfully, the engineer relies on the disciplines of engineering, architecture, science, and mathematics. Each field has accumulated bodies of reliable knowledge and procedures for solving routine problems of bridge design. But unique aspects of the context for a specific bridge, such as its length, height, peak points of stress and load, and the impact of possible environmental conditions such as extremes of temperature, wind, ice, snow, and floods as well as the possibility of earthquakes, require the engineer to organize, analyze, and interpret all this background information. In the process, the engineer must construct an understanding of a particular problem, rather than only reproduce established facts. The new design not only shows that the engineer knows the basic facts and can execute diverse skills, but it also reveals an ability to apply them to solve a complex new problem. If the design is completed successfully, it will provide a safe, convenient travel route for many users, it is likely to make an aesthetic statement to viewers, and it will likely be considered a satisfying accomplishment to those who designed it. Such intellectual work yields a product of social and personal significance.

Although the engineer example comes from a profession that requires extended higher education, the intellectual work of more common occupations can be similarly described. The successful auto mechanic, customer service representative, housing contractor, photocopy technician, or childcare worker all use basic knowledge to solve complex problems that require in-depth understanding of issues in a particular context, and the results of their labor have important consequences for others.

Complex intellectual demands also reach beyond the workplace to include participation in civic life and managing personal affairs. Consider a citizen trying to make an informed decision about whether an elected officeholder has done a good enough job to be reelected over the challengers, or how to make a convincing public statement to increase local funding for school security. Consider a single mother of preschool children calculating the costs and benefits of working while paying for child care, and how to choose among child care providers; or a brother and sister, each with young children and spouses, and limited financial resources, trying to decide how to allocate responsibility for the care for their disabled parent. All of this is intellectually demanding work.

The ways in which these adults work with knowledge differ from the ways that students usually work with knowledge in school. These differences suggest criteria for intellectual quality that honor basic knowledge and skills, but also extend beyond them. We define these features below.

Criteria for Authentic Intellectual Work

Compared to the work of students in school, which often seems contrived and superficial, the intellectual accomplishments of adults in diverse fields seem more meaningful and significant. As a shorthand for describing the difference between the intellectual accomplishment of skilled adults and the typical work that students do in school, we refer to the more complex adult accomplishments as "authentic" intellectual work. "Authentic" is used here not to suggest that conventional work by students is unimportant to them and their teachers, or that basic skills and proficiencies are to be devalued, but only to identify some kinds of intellectual work as more complex and socially or personally meaningful than others. More specifically, authentic intellectual work involves original application of knowledge and skills (rather than just routine use of facts and procedures). It also entails disciplined inquiry into the details of a particular problem, and results in a product or presentation that has meaning or value beyond success in school. We summarize these distinctive characteristics of authentic intellectual work as three criteria: construction of knowledge; through the use of disciplined inquiry; to produce discourse, products or performances that have value beyond school.[4]

Construction of knowledge. Skilled adults working in various occupations and participating in civic life face the challenge of applying basic skills and knowledge to complex problems that are often novel or unique. To reach an adequate solution to new problems, the competent adult has to "construct" knowledge, because these problems cannot be solved by routine use of information or skills previously learned. This knowledge that skilled adults create reflects their mastery of a substantial body of basic knowledge (e.g., facts, definitions, generalizations, rules for communication) and skills (e.g., reading, writing, computing, listening, speaking, conducting research, working cooperatively). Often, these basics are taught through drill and repeated practice in identifying the facts, definitions, generalizations, products and performances that others have produced (for example, by matching authors with their works, by correctly labeling rocks or parts of a flower, or by performing numerous computations

Authentic intellectual work involves original application of knowledge and skills.

of a single algorithm). Students may be asked to memorize and then reproduce specific items of knowledge such as lists of spelling words; names of capitals, elements, or geometric figures; or rules of grammar, punctuation and bibliographic citation. However, it is also possible to learn this basic knowledge and skills through activities that involve guided practice in original conversation and writing; repairing and building physical objects; or artistic and musical performances.

The point here is not to eschew the direct teaching of basic knowledge and skills, but rather to emphasize that schools must also help students use these "basics" as they engage in the more complex intellectual tasks they are likely to face beyond school. Students need a foundation of knowledge and skills, but to solve many real world problems, they must apply or extend prior knowledge beyond merely reproducing it; that is, they must construct knowledge effectively.

Disciplined inquiry. Acknowledging the importance of helping students to construct solutions to novel problems does not mean that "anything goes." The mere fact that someone has constructed, rather than reproduced, a solution is no indication that the solution is adequate or valid. Authentic adult intellectual accomplishments entail construction of knowledge guided by disciplined inquiry. By this we mean that: (1) they use a prior knowledge base; (2) they strive for in-depth understanding rather than superficial awareness; and (3) they express their ideas and findings through elaborated communication. Students too are capable of engaging in such intellectual activities when the work is adapted to their current levels of development.[5]

- **Prior knowledge base.** As mentioned above, significant intellectual accomplishments build on prior knowledge that has been accumulated in a field. The knowledge base includes facts, vocabularies, concepts, theories, algorithms, and conventions for the conduct and expression of inquiry. To participate in disciplined inquiry, students need to learn such basic knowledge and skills. Unfortunately, schooling often concentrates almost exclusively on transmission of discipline-based knowledge in fragmented form, with little emphasis on using such knowledge to solve novel problems.

- **In-depth understanding.** Disciplined inquiry tries to develop an in-depth understanding of a problem, rather than only a passing familiarity with or exposure to pieces of knowledge. Prior knowledge is mastered primarily not to become literate about a broad survey of topics, but to facilitate in-depth understanding of specific problems. Such understanding develops as one looks for, imagines, proposes, and tests relationships among pieces of knowledge in order to illuminate a specific problem or issue. In short, in-depth understanding involves construction of knowledge around a reasonably focused topic and can be expressed as a web of interconnected concepts, claims, and evidence on the topic. In contrast, many of the assignments in school ask students to show only superficial awareness of a vast number of seemingly disconnected topics.

- Elaborated communication. Accomplished adults working across a range of fields, such as office managers, artists, repair technicians, journalists, social service and health care providers, and construction contractors, rely upon complex forms of communication both to conduct their work and to present their results. The tools they use—verbal, symbolic, and visual—provide qualifications, nuances, elaborations, details, and analogues woven into extended narratives, explanations, justifications, and dialogue. In contrast, much of the communication demanded in school asks only for brief responses: choosing true or false, selecting from multiple choices, filling in blanks, or writing short sentences (e.g., “Prices increase when demand exceeds supply”). If students are to achieve authentic intellectual accomplishments, they must learn to communicate in more elaborate forms.

Value beyond school. The third criterion signifies the utilitarian, aesthetic, or personal value evident in significant intellectual accomplishments. In contrast, most conventional school achievement is designed only to document the competence of the learner. When adults write letters, news articles, organizational memos, or technical reports; when they speak a foreign language; when they design a house, negotiate an agreement, or devise a budget; or when they create a painting or a piece of music, they try to communicate ideas that have an impact on others beyond the simple demonstration that they are competent. Achievements of this sort have a value that is missing in assignments contrived only for the purpose of assessing knowledge (such as spelling quizzes, laboratory exercises, or typical final exams).

We note that the call for “relevant” or “student-centered” curriculum is, in many cases, a less precise expression of the view that student accomplishments should have value beyond simply indicating school success. Nevertheless, while some people may regard the term “authentic” as synonymous with curriculum that is “relevant,” “student-centered,” or “hands-on,” we do not. Value beyond the school is only one component of authentic intellectual work.

The three criteria—construction of knowledge; through disciplined inquiry; to produce discourse, products and performances that have meaning beyond success in school—form the foundation for standards to assess the intellectual quality of teaching and learning. All three criteria are important. For example, students might confront a complex calculus problem demanding much analytic thought (construction of knowledge and disciplined inquiry), but if its solution has no interest or value beyond proving competence to pass a course, its authenticity is diminished. Or a student may write a letter to the editor, saying she opposes a newly proposed welfare plan. This activity may meet the criteria of constructing knowledge to produce discourse with value beyond school, but if the letter shows only shallow understanding of the issues or contains significant factual errors, it is less authentic because of shortcomings in disciplined inquiry.

Authentic achievement is demanding in its insistence on all three criteria. Any given achievement in school could be high on some criteria but lower on others, and one would not expect most classroom activities to meet all three criteria. For example, repetitive practice, retrieving information, and memorization of facts or rules may be necessary to build knowledge and skills as foundations for authentic performance, or to prepare for tests required for advancement in the current educational system. The point is not to abolish such work in school, but also to provide as much opportunity as possible for students to engage in and become competent in authentic intellectual work.

Why Should Schools Promote Authentic Intellectual Work?

Increasingly, citizens are called upon to exercise complex intellectual capacities in order to make a good living, to participate effectively in civic life, and to successfully manage personal affairs. Failing to help students face these challenges denies them opportunities for economic security, productivity, democratic participation, and personal fulfillment. The changing economy and workplace have escalated the demand for intellectual competence. Studies have shown that more highly educated persons who demonstrate complex intellectual performance have much higher income and lower rates of unemployment.

The changing economy and workplace have escalated the demand for intellectual competence.

In the most successful businesses, frontline workers (not just managers and executives) are increasingly called upon to solve novel problems, and the hiring practices of these firms include assignments in communication (written and oral) and problem-solving that go beyond standardized tests of basic knowledge.[6] According to one study, a person who installs wheels at a Honda plant must also evaluate the quality of the installation and work with other employees in "circles" to solve production problems and improve performance on the assembly line. The circles identify a problem to be solved, work with a variety of data (graphed in diverse formats), decide on a solution, and make a presentation to a panel of department managers. The presentation, which typically includes visual displays, describes the problem addressed, the solution, and the evidence and analysis used to justify the solution.

Similarly, a hiring interview for a service correspondent at Northwestern Mutual Life included the following question:

> "An agent calls and says that we took two monthly payments of $500 each from his client's checking account when we should have only drawn one. The agent is very upset and says that some of his client's checks are going to bounce because of the screwup. He demands to know who made the mistake. How would you respond?"[7]

These workplace examples illustrate demands for construction of knowledge in the solving of novel problems, for disciplined inquiry's emphasis on in-depth understanding of a particular problem, and for elaborated communication to explain the solution. Such increased cognitive demands in the workplace have been summarized by Murnane and Levy (1996) as "The New Basic Skills." The authors conclude that such skills are increasingly necessary for economic success, but that almost half of United States students leave high school without them.

The argument for authentic intellectual work in school does not rest only on cognitive requirements for economic success. The rationale for public investment in and control of education is also grounded in two other major concerns. Writers from Aristotle to Jefferson to Dewey to recent political scientists contend that maintenance and enrichment of democracy require citizens capable not only of basic literacy, but also of exercising principled and reasoned judgment about the increasingly complex issues of community life.[8] Intelligent choices on controversial public issues, decisions about participation in local volunteer organizations, and voting in national elections all require interpretation, evaluation, in-depth understanding, and elaborate communication that extends well beyond traditional tests of knowledge.

Finally, education is valued for its contribution to individual fulfillment in students' personal lives. Consider the intellectual competence required in contemporary society to care for one's family and friends, to be safe and maintain health, to manage one's time and resources, and to develop rewarding hobbies and relationships. Coping with escalating information in each of these areas presents daunting challenges of interpretation, analysis and synthesis to all of us, and requires us to work with elaborate forms of written, oral, and electronic communication.

A case can also be made that participation in authentic intellectual activity is more likely to motivate and sustain students in the hard work that learning requires. Teachers report that authentic work is often more interesting and meaningful to students than repeated drill aimed at disconnected knowledge and skills. Research evidence indicates that students exposed to authentic intellectual challenges are more engaged in their schoolwork than students exposed to more conventional schoolwork.[9]

Defining Standards to Examine Assignments and Student Work

The main empirical questions for this report are, "How often do Chicago students encounter assignments that call for authentic intellectual work, and how often do they demonstrate mastery of such work?" To answer these questions, we collected two types of information. First, we asked teachers to share samples of the assignments they gave to students in the subjects of mathematics and writing. Second, we asked teachers to share students' written responses to these assignments.

Figure 7: Standards for Assignments in Writing and Mathematics

A. Writing

Standard 1. Construction of Knowledge
The assignment asks students to interpret, analyze, synthesize, or evaluate information in writing about a topic, rather than merely to reproduce information.

Standard 2. Disciplined Inquiry: Elaborated Written Communication
The assignment asks students to draw conclusions or make generalizations or arguments and support them through extended writing.

Standard 3. Value Beyond School: Connection to Students' Lives
The assignment asks students to connect the topic to experiences, observations, feelings, or situations significant in their lives.

B. Mathematics

Standard 1. Construction of Knowledge
The assignment asks students to organize and interpret information in addressing a mathematical concept, problem, or issue.

Standard 2. Disciplined Inquiry: Written Mathematical Communication
The assignment asks students to elaborate on their understanding, explanations, or conclusions through extended writing; for example, by explaining a solution path through prose, tables, equations, or diagrams.

Standard 3. Value Beyond School: Connection to Students' Lives
The assignment asks students to address a concept, problem or issue that is similar to one that they have encountered or are likely to encounter in daily life outside of school.

The teachers' assignments indicate the kinds of intellectual demands that teachers make on students, and the students' written work indicates the kind of mastery they achieve. To evaluate assigned tasks and student work in terms of criteria for authentic intellectual work, we translated the general criteria of construction of knowledge, disciplined inquiry, and value beyond school described above into more specific standards presented in Figures 7 and 8.

Figure 7 summarizes the standards used to judge the intellectual quality of assignments in writing and mathematics. These are detailed for each of the three main components of authentic intellectual work. Figure 8 (next page) summarizes the corresponding standards for student work. We note that for student work, these standards are articulated for only two criteria: construction of knowledge and disciplined inquiry. While it is possible to assess teachers' assignments in terms of "value beyond school," making judgments about the meaning or value of each student's performance to an audience beyond school would have required additional student data unavailable to us. In establishing the student standards for disciplined inquiry, writing authorities specified proficiency in grammar, usage, mechanics, and vocabulary. Similarly, mathematics authorities specified understanding of mathematical concepts as part of disciplined inquiry in this field.

Figure 8: Standards for Student Work in Writing and Mathematics

A. Writing

Standard 1. Construction of Knowledge
Student performance demonstrates interpretation, analysis, synthesis, or evaluation in order to construct knowledge, rather than merely to reproduce information.

Standard 2. Disciplined Inquiry: Elaborated Written Communication
Student performance demonstrates an elaborated, coherent account that draws conclusions or makes generalizations or arguments and supports them with examples, summaries, illustrations, details, or reasons.

Standard 3. Disciplined Inquiry: Form and Conventions
Student performance demonstrates proficiency in grammar, usage, mechanics, and vocabulary appropriate to the grade level.

B. Mathematics

Standard 1. Construction of Knowledge: Mathematical Analysis
Student performance demonstrates thinking about mathematical content by using mathematical analysis; that is, going beyond simple recording or reproducing of facts, rules, and definitions or mechanically applying algorithms.

Standard 2. Disciplined Inquiry: Mathematical Concepts
Student performance demonstrates understanding of important mathematical concepts central to the assignment; for example, by representing concepts in different contexts, or making connections to other mathematical concepts, other disciplines, or real world situations.

Standard 3. Disciplined Inquiry: Written Mathematical Communication
The student's performance demonstrates elaboration of his or her understanding, explanations, or conclusions through extended writing; for example, through diagrams, symbolic representations, or prose that presents convincing arguments.

Note that the standards for authenticity of assignments and student work do not attempt to prescribe the precise knowledge, skills, or dispositions that should be included in the curriculum. Reaching agreement on specifically what to teach in each subject and grade requires resolving professional and political disagreements that will occupy schools, districts, states, and professional organizations for years to come. But one virtue of the standards for authentic intellectual work is that they can be applied to the teaching of almost any content at any grade level. By defining the nature of intellectual work necessary for success in vocation, citizenship and personal affairs, the standards provide a common intellectual mission that can bridge otherwise divisive preferences for teaching different disciplines, different content within disciplines, or different groups of students.

Each of the standards for assignments (Figure 7) and student work (Figure 8) was translated into more specific scoring rules; rules for two of the 12 standards are illustrated in Figures 9 and 10.[10] The sidebar on Research Design and Methods (page

Figure 9: Sample Scoring Rules for Writing Assignments: Elaborated Written Communication

4 = Explicit call for generalization AND support. The task asks students, using narrative or expository writing, to draw conclusions or to make generalizations or arguments, AND to substantiate them with examples, summaries, illustrations, details, or reasons.

3 = Call for generalization OR support. The task asks students, using narrative or expository writing, either to draw conclusions or make generalization or arguments, OR to offer examples, summaries, illustrations, details, or reasons, but not both.

2 = Short-answer exercises. The task or its parts can be answered with only one or two sentences, clauses, or phrasal fragments that complete a thought.

1 = Fill-in-the-blank or multiple-choice exercises.

An example of a teacher's task that scored high on this standard is presented below. In this assignment, third-grade students were asked to draw conclusions about how to show caring, and to substantiate them with reasons. They were asked to complete extended writing (i.e., at least six sentences) on this topic and to make sure that adequate support was included (i.e., it made sense to an adult). This task also scored high on the standards of Construction of Knowledge and Connection to Students' Lives.

Example: Grade 3 writing
High-scoring assignment
Elaborated Written Communication

"Write an essay on 'Showing Someone You Care.' Brainstorm words you might use in the essay. Write those words. Use these words in an essay. Write at least 6 sentences. Have a beginning, middle and a conclusion. Indent the first sentence of each paragraph. Spell words correctly, capitalize the first word in each sentence, have finger spaces between words, use correct ending marks, and write neatly. Re-read your essay after completing it, make corrections, re-read to an adult to make sure it makes sense.

Include in your essay whom you care about, give reasons why you care about them and what you can do to show them that you care."

15) explains how we selected teachers' assignments and student work, and how teachers of writing and mathematics from Chicago scored them against each standard, after which the scores were combined to yield an overall score on a zero-to-10 scale. These scale scores were then divided into four categories that represent four levels of intellectual challenge: *no challenge*, *minimal challenge*, *moderate challenge*, and *extensive challenge*. The meaning of these categories will become clearer as we present results below.

Figure 10: Sample Scoring Rules for Student Work: Written Mathematical Communication

Consider the extent to which the student presents a clear and convincing explanation or argument:

Possible indicators of elaborated written communication are diagrams, drawings, or symbolic representations, as well as prose. To score high on this standard, the student must communicate in writing an accurate, clear, and convincing explanation or argument.

4 = Mathematical explanations or arguments are clear, convincing, and accurate, with no significant mathematical errors.

3 = Mathematical explanations or arguments are present. They are reasonably clear and accurate, but less than convincing.

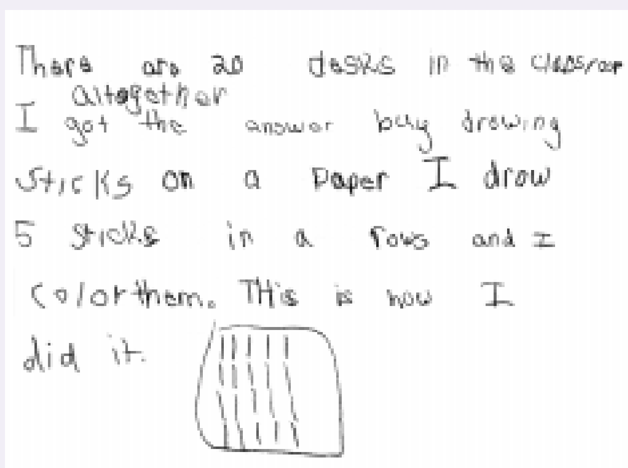
2 = Mathematical explanations, arguments, or representations are present. However, they may not be finished, may omit a significant part of an argument/explanation, or may contain significant mathematical errors. Note: Generally complete, appropriate, and correct work or representations (e.g., a graph, equation, number sentence) should be scored a 2 if no other part of the student's work on the task warrants a higher score.

1 = Mathematical explanations, arguments, or representations are absent or, if present, are seriously incomplete, inappropriate, or incorrect. This may be because the task did not ask for argument or explanation; e.g., fill-in-the-blank or multiple-choice questions, or reproducing a simple definition in words or pictures.

An example of student work that scored high on written mathematical communication appears below.

Example: Grade 3 mathematics
High-scoring assignment
Written Mathematical Communication

Assignment: "There are 4 rows of desks in the classroom. There are 5 desks in each row. How many desks are there all together? Figure out the answer however you like, and write a short paragraph to explain the pathway in your mind that led to this answer."



This third-grade student explained both in prose and through a diagram how he/she concluded that four rows of five desks added up to 20 desks. The mathematical procedures of drawing and counting were communicated in a way that justified the conclusion. The work also scored high (but did not receive the highest possible ratings) on the standards of mathematical analysis and mathematical concepts.

Research Design and Methods

Selecting Assignments and Student Work

During our first semester of research in Annenberg schools, spring 1997, we visited two schools in each of six networks. The networks had received Annenberg implementation grants and were chosen to represent diverse approaches to school reform. For example, one network's major strategy was to focus on improving literacy instruction in the schools, while another's was to coordinate increased support for schools from community resources. Within each network we invited two schools: one that was known to have made recent progress in school improvement, and one with less evidence of progress.

How well do these 12 schools represent Chicago schools in general? We compared this sample with Chicago schools as a whole on the percent of students who are at or above the national norms in math and reading on the Iowa Tests of Basic Skills (ITBS). The Annenberg schools selected in these six networks perform at a somewhat lower level than the rest of the system. While 32 percent of Chicago Public Schools students are at or above national norms on the ITBS in math, only 22 percent of the students in the Annenberg sample reach this level. Reading is similar, with 30 percent of the students in the system scoring at or above the ITBS national norms compared with 21 percent of the students in the Annenberg sample schools. The 12 Annenberg schools also differ from the remaining elementary schools in the system on student racial composition. The Annenberg sample does not include integrated schools (schools with at least a 30 percent white student body) nor any predominately Hispanic schools (schools with over 85 percent Hispanic student body). Although the results presented in this report are based on only a small, select sample of Chicago schools, these schools resemble a broad cross-section of Chicago schools. In subsequent years we will have more complete data from twice as many schools, but these initial results are important as baseline information to guide future studies.

In each school, in order to sample two classes of language arts and two classes of mathematics in grades three, six, and eight, we asked for the help of two teachers in each grade. We asked teachers to provide two "typical" assignments sampled at different times during the semester. We also requested two "challenging" assignments that the teachers considered to give them the best sense of how well their students were learning and understanding a subject or skill at their highest levels. We asked teachers to share the written responses of all students in the class on the two challenging assignments. The time-sampled assignments were collected to provide data on student opportunities to engage in higher level, more cognitively demanding assignments. Teachers were informed of the general purposes of the study to chart the nature of school improvement in the Annenberg Challenge. During this first stage of data collection, teachers were not informed of the more specific criteria on which their assignments and student work would be scored, because the criteria were still being developed. The draft manual used to score assignments and student work has now been distributed to all Annenberg schools so that schools continuing to contribute data to the study have access to the specific scoring criteria.

By the end of school in June 1997, we had received 349 assignments from 74 teachers in 12 schools, with 54 percent of the assignments from language arts and 46 percent from mathematics classes. We received a total of 1,864 pieces of student work in response to the writing assignments and 1,436 pieces of student work in response to the mathematics assignments. But we scored work from no more than 10 students in any class, so the number of student work products evaluated for writing was 965 and the number for mathematics was 727.

Scoring Assignments and Student Work

During summer 1997, we trained teachers from non-participating schools in grades three, six, and eight to score the quality of teachers' assignments and student performance in mathematics and writing according to the standards presented above. The training and scoring of this material took about 3 days for each subject.[11] In both mathematics and writing, the metrics for assignments and student work standards were the same. For assignments, construction of knowledge and connection to students' lives were scored on 3-point scales, and elaborated communication was scored on a 4-point scale. For student writing and mathematical work, all three standards in each subject were scored on 4-point scales, so the highest possible score was 12, the lowest 3.

For both assignments and student work, scores for different grade levels were assigned on the basis of reasonable expectations within the grade level, and it was assumed that within each grade there was no necessary limit on the number of assignments or pieces of student work that could receive the highest ratings. That is, since the scoring scales were not normed from grade three "low" to grade eight "high," there was no reason to expect that overall scores for grade eight would be higher than scores for grade three.

Both teacher assignments and student work were randomly assigned to scorers, and each item was scored independently by two scorers.[12] For teachers' assignments, the two scorers compared their scores, and if they differed, they discussed the matter until they reached agreement on a final score. In scoring student work, the large volume of papers precluded negotiation of differences between scorers. However, if student work scores differed by 2 or more points, a member of the training team assigned a final score.[13]

For both assignments and student work, the indicator of quality was the total score on the three standards. Using Rasch analysis, the scores on the separate standards were combined to construct a scale of authentic intellectual work which we then divided into four categories. At the positive end of the scale are those assignments and student work that reflect *extensive challenge* or *extensive authentic intellectual work* and at the negative end are those assignments and student work that reflect *no challenge* or *no authentic intellectual work*. The two middle categories are *moderate* and *minimal*.

Section II

Analysis of Tasks that Teachers Assign

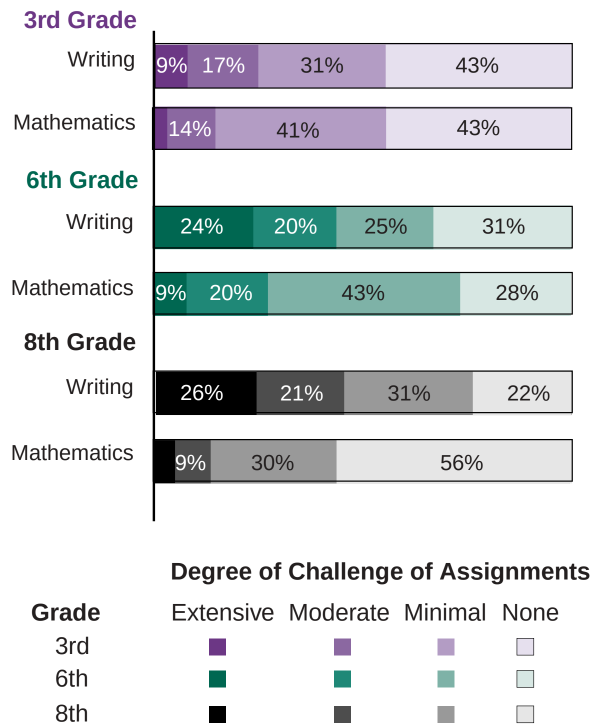
As shown in Figure 11 (next page), writing and mathematics assignments scored about equally at the third grade. For example, in third grade 43 percent of the writing assignments fell into the *no challenge* category. Typically these assignments called for little construction of knowledge, requiring students only to fill in the blank or provide short answers, with minimal opportunity for the students to connect the assignment to their daily lives. In math, the same percentage, 43, of the third-grade assignments provided *no challenge* for the students. Assignments that fell into this category demanded only routine application of algorithms or memorized mathematics facts, did not require any extended communication about the problem, and did not provide students with the opportunity to connect mathematics to their daily lives.

Compared with third grade, sixth and eighth grade tended to show a higher proportion of both writing and mathematics assignments in the top two categories of *moderate* and *extensive challenge;* compared to mathematics, writing assignments made more challenging demands in all three grades. Within mathematics, a higher percentage of grade six assignments fell within the top two categories than assignments from grades three and eight. In writing, a greater percentage of eighth-grade assignments scored in the top two categories, followed by grade six, with grade three making the lowest demands for authentic writing. Nevertheless, across all three grade levels, a majority of the writing and math assignments fell into the lowest two categories, *no challenge* and *minimal challenge*.

As explained in the sidebar on Research Design and Methods, teachers' assignments included those sampled at different times in the semester and also "challenging" assignments that the teachers considered to give them the best sense of how well their students were learning and understanding a subject or skill at their highest levels. We found that assignments selected by teachers as "challenging" scored higher than the time-sampled assignments in both subjects across all grade levels, and this trend was much more pronounced in writing than mathematics. This finding suggests that while students may not typically be exposed to authentic intellectual work, in at least some classrooms students have some opportunity to undertake it.

Figure 11

Writing Assignments Made Higher Demands for Authentic Work



Note: Due to limited space, numbers for 5 percent or less are not shown.

Examples of Typical and High-Scoring Assignments

Figures 1 through 6, which introduced this report, illustrate teachers' typical assignments. They were selected from assignments scoring close to the mean within the most frequently occurring categories in Figure 11. For grade three, the most frequent category was *no challenge* in both subjects; for grade six, *no challenge* in writing and *minimal challenge* in mathematics; for grade eight, *minimal challenge* in writing and *no challenge* in mathematics.

Consider what these typical assignments ask of students, regardless of the quality of the student work that appears. The third-grade writing assignment (Figure 1) asked students to place a list of vocabulary words into a set of given sentences. To complete the assignment correctly, students needed to know the meaning of the words, but they were not asked to interpret or use them in writing. Completion of such a worksheet also has no clear connection to issues in students' lives beyond the classroom. The sixth-grade writing assignment (Figure 2) required knowledge of the rules for sentence construction and the ability to categorize words as subject, verb, etc. This too involved minimal interpretation and no elaborated writing, and completion of such assignments is never required, except in school. The eighth-grade writing assignment (Figure 3), in asking for a book report, had the potential to demand more authentic intellectual work. But by not explicitly asking for interpretation or elaborated writing, or asking students to make a connection between the book and their lives, the assignment implicitly called only for a summary.

The third-grade mathematics assignment (Figure 4) asked students only to fill in numbers. The assignment could be completed by recording numbers students had memorized without analysis or written explanation; students would be unlikely to encounter mathematical questions in this form except in school. The sixth-grade

Figure 12: High Scoring Assignment and Student Work
Grade 3 Writing

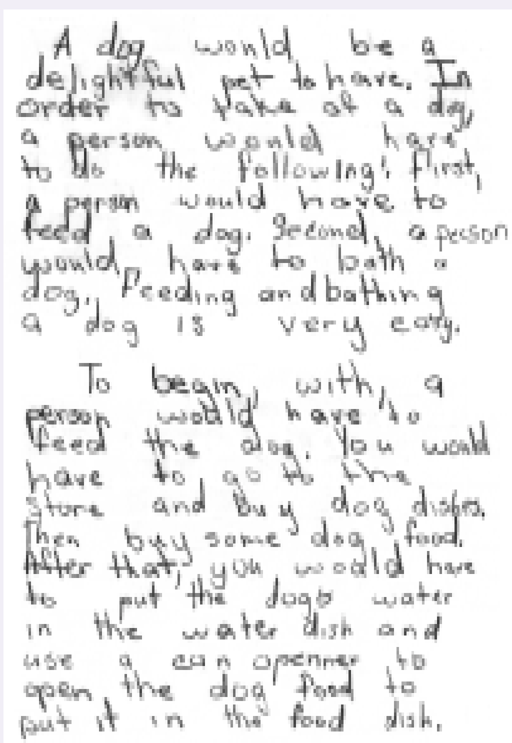
Assignment: Students were told to write four compositions: two persuasive, one expository, and one narrative, according to instructions for each. This example is the expository prompt.

"Your Mom has stated that you may have a pet. However, she wants you to be completely responsible for the pet you select. Your Mom has asked you to write a composition giving step by step details on how you plan on taking care of your particular pet. Write a composition using the following guidelines:

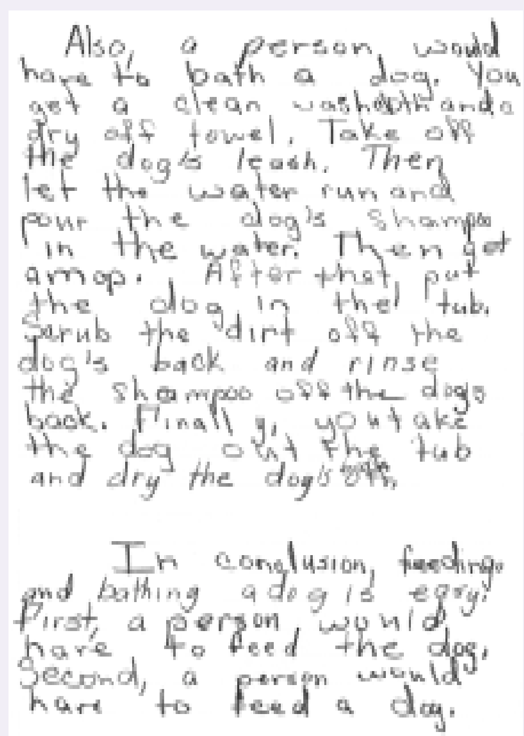
- Choose a pet

- In the beginning of your paper, name the pet you selected. Also, state in your introduction the steps that you will take in caring for your pet. Be sure and explain in detail the steps you will take on caring for your pet in the body paragraphs of your paper.

- Check points to remember:
  Remember what you know about paragraphs.
  Use correct language.
  Check that your sentences have correct punctuation and spelling."


A dog would be a delightful pet to have. In order to take of a dog, a person would have to do the following: First, a person would have to feed a dog. Second, a person would have to bath a dog. Feeding and bathing a dog is very easy.

To begin with, a person would have to feed the dog. You would have to go to the store and buy dog dishes. Then buy some dog food. After that, you would have to put the dogs water in the water dish and use a can openner to open the dog food to put it in the food dish.

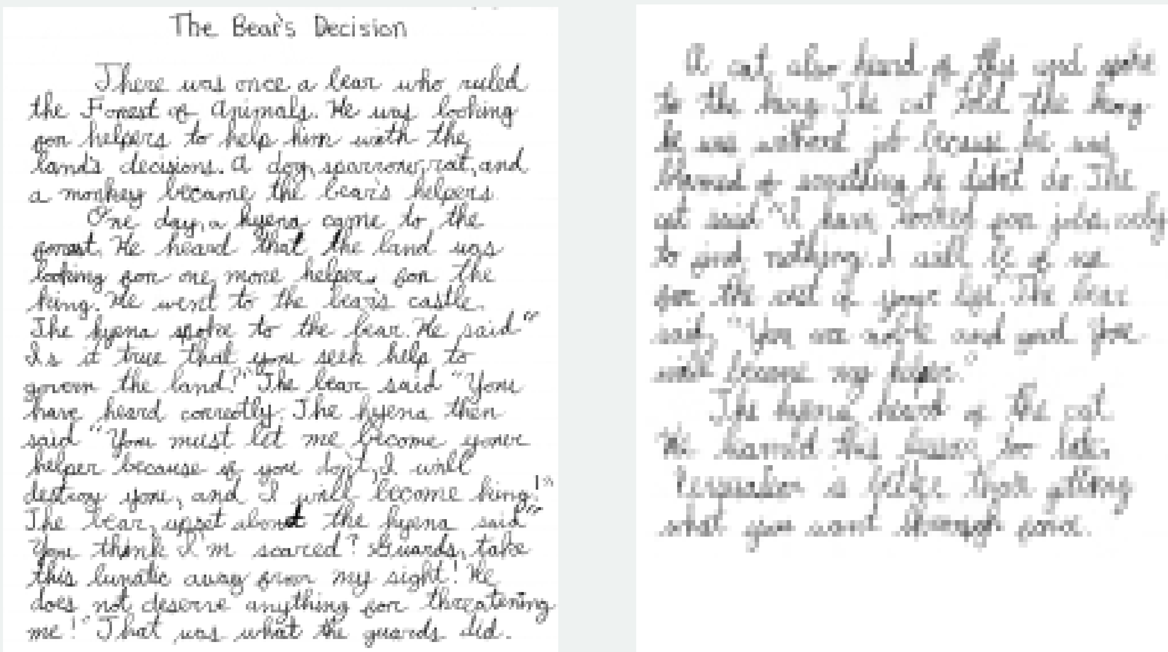

Also, a person would have to bath a dog. You get a clean washcloth and a dry off towel. Take off the dog's leash. Then let the water run and pour the dog's shampoo in the water. Then get a mop. After that, put the dog in the tub. Scrub the dirt off the dog's back and rinse the shampoo off the dogs back. Finally, you take the dog out the tub and dry the dog's off.

In conclusion, feeding and bathing a dog is easy. First, a person would have to feed the dog. Second, a person would have to feed a dog.

This student organized the composition around feeding and bathing a dog, and offered supporting details. Even though there are some mistakes, the writing shows interpretation and synthesis of knowledge, rather than mere reproduction of information.

Figure 13: High Scoring Assignment and Student Work
Grade 6 Writing

Assignment: "Write a fable. Choose two animal characters. Think of some advice that will work as the moral of a fable. Then write a short fable that illustrates the moral. The fable must include conversation (dialogue)."



The Bear's Decision

There was once a bear who ruled the Forest of Animals. He was looking for helpers to help him with the land's decisions. A dog, sparrow, rat, and a monkey became the bear's helpers.

One day, a hyena came to the forest. He heard that the land was looking for one more helper for the king. He went to the bear's castle. The hyena spoke to the bear. He said "Is it true that you seek help to govern the land?" The bear said "You have heard correctly." The hyena then said "You must let me become your helper because if you don't, I will destroy you, and I will become king!" The bear, upset about the hyena said "You think I'm scared? Guards, take this lunatic away from my sight! He does not deserve anything for threatening me!" That was what the guards did.

A cat also heard of this and spoke to the king. The cat told the king he was without job because he was blamed for something he didn't do. The cat said "I have looked for jobs only to find nothing. I will be of use for the rest of your life." The bear said, "You are polite and good. You will become my helper."

The hyena heard of the cat. He learned this lesson too late. Persuasion is better than getting what you want through force.

The plot supports the moral of this fable, and the writing shows interpretation, elaboration, and effective use of conventions of writing.

mathematics assignment (Figure 5) required student knowledge of how to multiply whole and mixed numbers, but the set of highly similar problems could be solved by repeated application of the same algorithm. The assignment called for no analysis or written explanation, and here too, the problems had no connection to an actual mathematics problem that students may encounter outside the classroom. The eighth-grade mathematics assignment (Figure 6) presented students with the formulas and information needed to find the volume of different prisms. The problems could be solved by applying the given algorithms, with minimal analysis, and no elaborated explanations. Although questions 7 and 8 referred to a cereal box and a tent, students would be unlikely to calculate the volume of such objects in cubic centimeters or cubic meters except in a mathematics class.

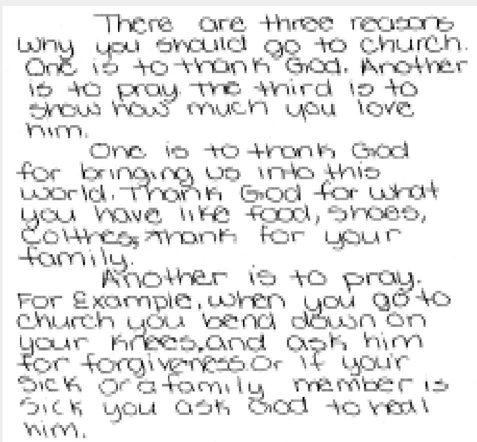
How do these typical assignments compare with less frequent, but more demanding assignments? To illustrate, we selected higher scoring assignments. In writing, some assignments at each grade level scored in the *extensive challenge* category. We selected assignments near the mean score within this category, and for each assignment we chose a representative piece of student work; that is, one that scored near the mean for that assignment. The three writing assignments are shown in Figures 12-14.

Figure 14: High-scoring Assignment and Student Work
Grade 8 Writing

Assignment: "You are going to persuade your classmates to do something. Here's your chance to get your class to do what you tell them. Some ideas might be to convince them to volunteer, to do their homework, to write a letter to someone, or to read a particular book.

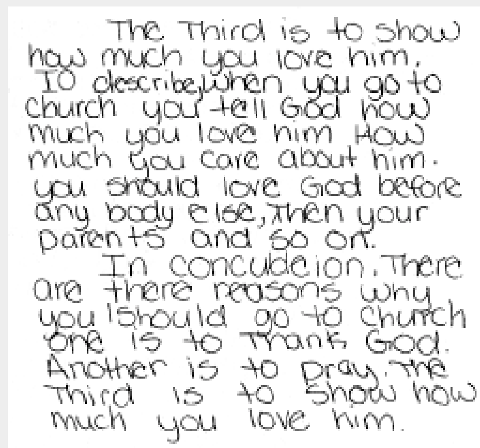
You need three reasons why your classmates should take this action. These reasons must be described in the introduction, presented in detail in the next three paragraphs, and restated in your conclusion. As you move from reason to reason and detail, you need to use transitions.

You will present this speech with a visual. When you begin your speech, grab the audience's attention with a question, a startling fact, or a quote."


There are three reasons why you should go to church. One is to thank God. Another is to pray. the third is to show how much you love him.

One is to thank God for bringing us into this world. Thank God for what you have like food, shoes, Cottres, thank for your family.

Another is to pray. For Example, when you go to church you bend down on your knees, and ask him for forgiveness. Or if your sick or a family member is sick you ask God to heal him.


The Third is to show how much you love him. TO describe, when you go to church you tell God how much you love him How much you care about him. you should love God before any body else, then your parents and so on.

In concudeion, There are there reasons why you should go to church One is to Thank God. Another is to pray. The Third is to show how much you love him.

This essay states three reasons for going to church and supports each with details. Despite some errors in form and conventions of writing, the essay is clear and coherent.

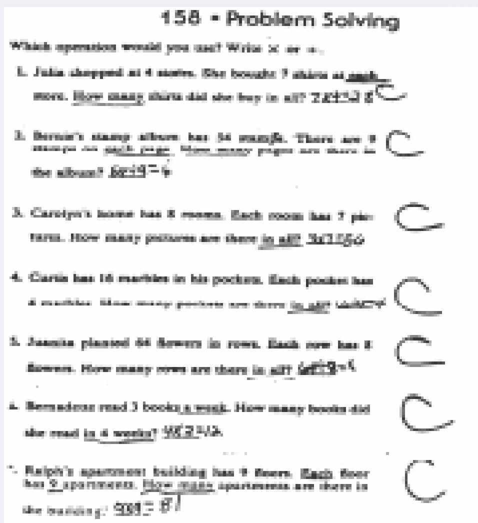
All three assignments asked students to go beyond reproduction of discrete facts or definitions to engage in interpretation, analysis, synthesis, or evaluation of information, and all three required students to draw conclusions or generalizations and to support them in writing. Third graders had to organize information into a comprehensive description of how to care for a pet. Sixth graders had to invent an animal fable that illustrated a moral and tell the story in written dialogue. Eighth graders had to write an argument with several reasons to persuade their classmates to do something. Each of these assignments also asked students to write on a topic clearly connected to their lives beyond the classroom. Compared to the more typical writing assignments (Figures 1, 2, and 3), these assignments required more authentic intellectual work according to our standards.

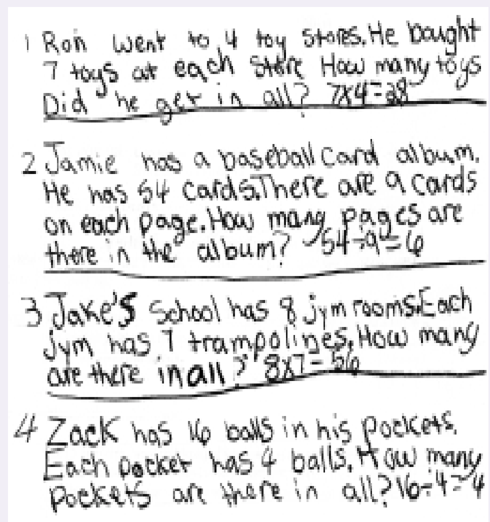
For mathematics, it was more difficult to find high scoring assignments. Only in sixth grade did we find mathematics assignments in the *extensive challenge* category. In third and eighth grade, only a few assignments scored as high as the *moderate challenge* category. For these grades we chose to present here the highest scoring mathematics assignments for which we had samples of student work. These yielded only a *minimum challenge* assignment for grade three

Figure 15: High-scoring Assignment and Student Work
Grade 3 Mathematics

Assignment: "We have been working on looking for clues in word problems all year. Let's take a look at these word problems. Let's read the directions. We know that these problems will be either multiplication or division problems. Read the first problems silently. Look for a clue word or words that will tell you if this is multiplication or division. Do the number problems in the work space. Does this answer make sense? Underline any clue words that helped you decide on dividing or multiplying. Do the rest of the problems in this manner."

After checking the answers and discussing clue words, students were told:
"Write five word problems of your own on a separate sheet of paper for homework. We will read these problems in class tomorrow, looking for clue words. If we hear your clue words and your problems make sense, you will win a prize (sticker)."




1 Ron went to 4 toy stores. He bought 7 toys at each store How many toys Did he get in all? 7X4=28

2 Jamie has a baseball card album. He has 54 cards. There are 9 cards on each page. How many pages are there in the album? 54÷9=6

3 Jake's School has 8 Jym rooms. Each Jym has 7 trampolines. How many are there in all? 8X7=56

4 Zack has 16 balls in his pockets. Each pocket has 4 balls. How many Pockets are there in all? 16÷4=4

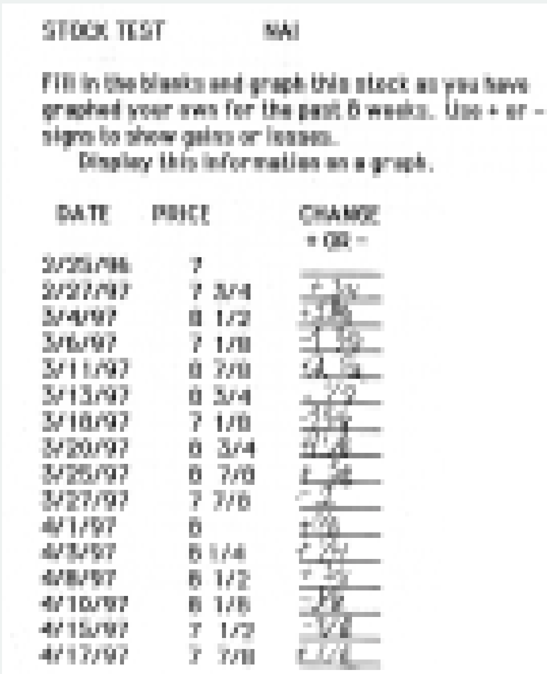
This student decided correctly between multiplication and division, and also wrote and solved original story problems. The assignment required mathematical analysis and some written mathematical communication about mathematics problems beyond school.

and a *moderate challenge* one for grade eight. These "high" scoring illustrations in mathematics appear in Figures 15-17.

All three assignments required some mathematical analysis; that is, mathematical thinking involving more than reproduction of memorized information or repeated use of previously learned algorithms. Third graders (Figure 15) had to organize information to present their own story problems representing multiplication and division, and to consider whether answers made sense; sixth graders (Figure 16) had to organize the tabular information on changes in stock prices and make a graph of it; and eighth graders (Figure 17) needed to decide what to do with information on prices and taxes on five different products in order to calculate the before-tax and after-tax totals. By asking students to show more than simple numerical answers, each of the assignments asked for at least some written mathematical communication. The connection to students' lives was most clear in the eighth-grade problem that asked for calculation of sales taxes and prices of items the students would choose. The sixth-grade exercise on stock prices had some con-

Figure 16: High-scoring Assignment and Student Work
Grade 6 Mathematics

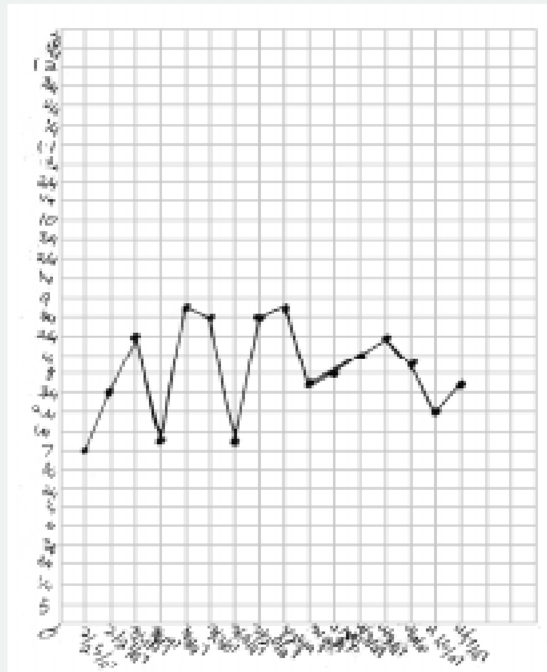
Assignment: In an eight-week project, each student chose a stock and followed it. Examples included IBM, Disney, and Nike. Each student recorded the prices of his/her stock, indicating gains and losses on a graph flip chart on the wall. The culmination of the unit was a test that asked students to compute gains and losses of a given stock for 15 time intervals over about two months and to display the information on a graph.



STOCK TEST NAI

Fill in the blanks and graph this stock as you have graphed your own for the past 8 weeks. Use + or − signs to show gains or losses.
Display this information on a graph.

DATE	PRICE	CHANGE + OR −
2/25/96	7	
2/27/97	7 3/4	[illegible]
3/4/97	8 1/2	[illegible]
3/6/97	7 1/8	[illegible]
3/11/97	8 7/8	[illegible]
3/13/97	8 3/4	[illegible]
3/18/97	7 1/8	[illegible]
3/20/97	8 3/4	[illegible]
3/25/97	8 7/8	[illegible]
3/27/97	7 7/8	[illegible]
4/1/97	8	[illegible]
4/3/97	8 1/4	[illegible]
4/8/97	8 1/2	[illegible]
4/10/97	8 1/8	[illegible]
4/15/97	7 1/2	[illegible]
4/17/97	7 7/8	[illegible]



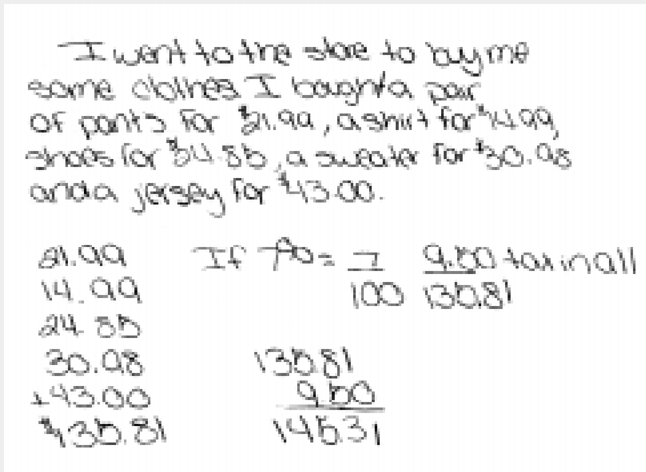
This assignment called for elaborated mathematical writing and organization of mathematical information through graphing of stock trends. However, the student's errors indicate deficiencies in understanding addition and subtraction of fractions.

nection to a mathematics problem students might confront beyond school, and the third-grade assignment offered students the opportunity to devise math problems familiar in their lives beyond school, but did not make the connection clear.

Although these assignments ranked among the very best of what we collected in the sample of Chicago schools, they can hardly be considered exemplars of all three standards for authentic assignments. To place these Chicago work samples in some larger context, Figure 18 illustrates a mathematics assignment collected from an urban school in another city, that makes more impressive demands for authentic mathematical work. This assignment makes high demands for mathematical analysis, requiring knowledge of basic principles of geometry. Students also must explain in writing how they arrived at a solution to which geometric shapes best form a pattern to cover a surface. Finally, the task is set in the context of a concrete, real-world problem—how to tile a floor. Thus, this assignment scored high

Figure 17: High-scoring Assignment and Student Work
Grade 8 Mathematics

Assignment: Students were told to choose five actual products with the current prices from a grocery store and calculate the total price of the products before and after taxes, using a tax rate of 7 percent.


I went to the store to buy me some clothes I bought a pair of pants for $21.99, a shirt for $14.99, shoes for $24.85, a sweater for $30.98 and a jersey for $43.00.

21.99
14.99
24.85
30.98
+43.00
$135.81

If 7% = 7/100 9.50 tax in all 135.81

135.81
9.50
145.31

By calculating before- and after-tax prices, this student demonstrated an understanding of the concepts of decimal addition and calculating percentages. The assignment called for analysis of a mathematics problem commonly encountered by consumers.

on all three standards—construction of knowledge, written mathematical communication, and connection to students' lives.

In short, even the best of the assignments that we collected from our sample of Chicago schools could be improved, especially in mathematics. Moreover, this contrast becomes even sharper when we compare challenging intellectual work illustrated in Figure 18 to what is typically assigned in Chicago as previously presented in Figures 1 to 6. On balance, we are not arguing that those basic skills assignments should be avoided. Such assignments can be useful in developing a skill and knowledge base on which to build more authentic intellectual work. However, if students are exposed only to assignments like this, as is the case in some Chicago schools, it is unlikely that students will ever learn to succeed against more-authentic intellectual challenges. Given the rising demands for intellectual competence in both the workplace and in our democratic society, as noted earlier, these results are worrisome.

Figure 18: Exemplary Assignment
Grade 8 Mathematics

Assignment: "Your group is going to design titles which can be used to decorate part of the classroom. You can use shapes on the attached Shape Sheet to cut out as many copies of each of the shapes as you need. You may use any other tools you wish (calculators, rulers, glue, string, protractors, compasses, pens, etc.)."

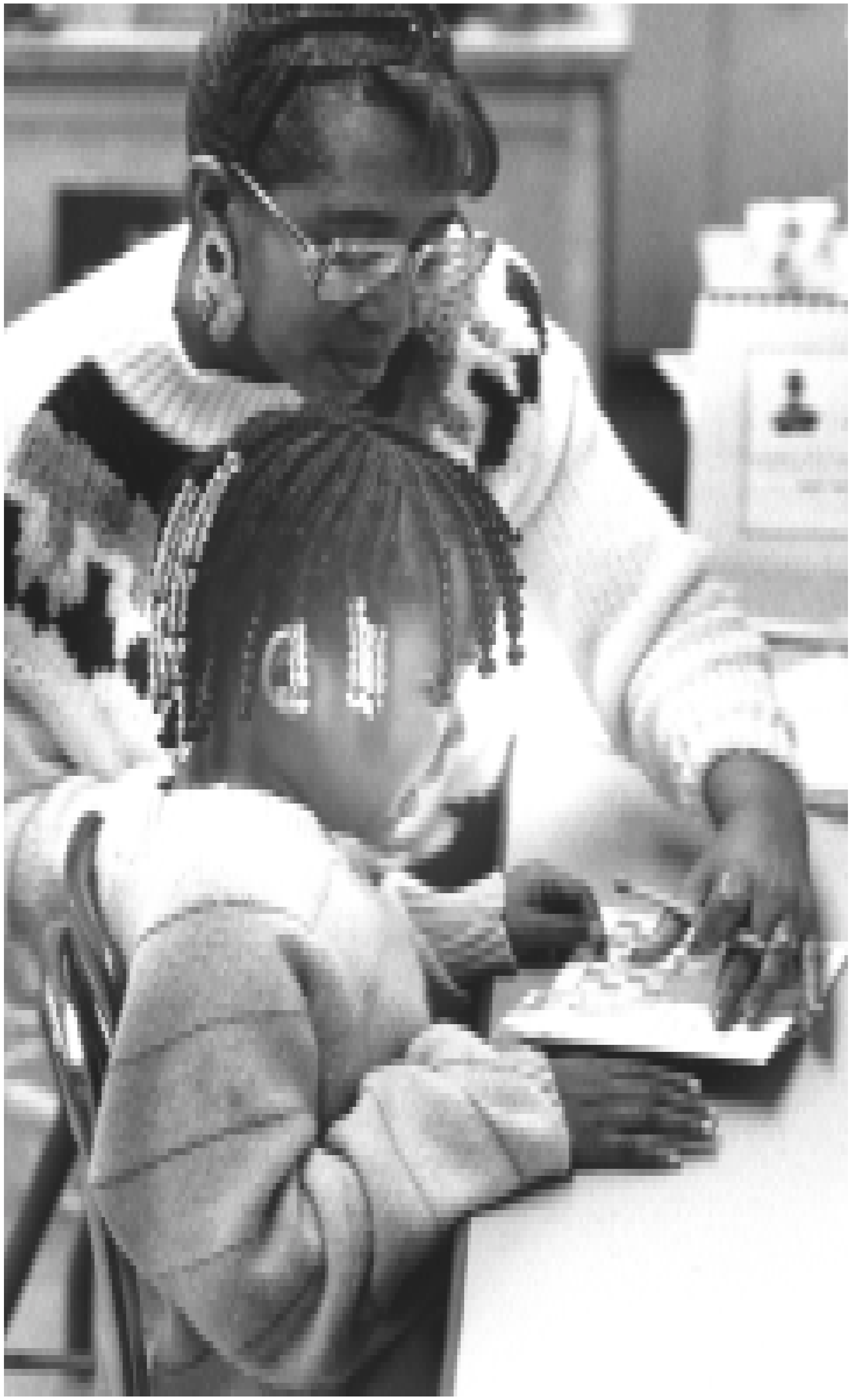
Accompanying the assignment was a list of vocabulary words that included *regular polygon* (a shape whose sides are all the same length and whose corners all have the same "sharpness"), *complex polygon* (a shape which is not regular), *tile* (a regular or complex polygon which is used like a puzzle piece to attempt to cover a surface), *tessellate* (to cover a surface with tiles, all the same shape, so that no tiles overlap and so that there are no gaps between tiles), *good tile* (a tile that tessellates), and *bad tile* (a tile that doesn't tessellate).

The task included two parts. For Part I, students were told to:

> "Find out which regular polygons make good tiles (remember: good tiles tessellate). For each good tile you find, cut out enough shapes to cover half a page of paper to show that the tiles tessellate (you can also do this by tracing). For two shapes that are bad tiles, cover half a page showing how they overlap or leave gaps.
>
> Find a pattern that shows which regular polygons are good tiles. Write an explanation as to why these are good tiles. Based on the pattern that you have found, are there any other regular polygons which make good tiles? Why or why not? Write an explanation which uses information on the papers that you covered with the tiles and the patterns that you looked for."

Part II of the assignment asked the students to create complex polygons and explore how they could be used to cover a surface. Students were asked to write up their findings and conjectures about this.

This assignment comes from a national study of school restructuring (Newmann, Secada, and Wehlage, 1995, pp. 22-23). It made high demands for mathematical analysis by requiring students to discover which geometric shapes tessellate to cover a surface. By asking students to explain how they determined which tiles formed the best patterns, the assignment asked for written mathematical communication. Since the practical goal of the assignment was to decorate part of the classroom, this knowledge could easily be transferred to decoration in other contexts, such as students' rooms at home, so it made some connection between mathematics and students' lives.



SECTION III

Students' Work: Assignments Make the Difference

Having examined the kinds of assignments that teachers assign, we turn now to the work that students produce. As shown in Figure 19 (next page), student writing scored much higher than mathematics work on standards for authentic intellectual performance. At each grade level, at least 17 percent of student work in writing was categorized as *extensive authentic intellectual work*, meaning that the student work demonstrated substantial construction of knowledge and elaborated written communication, and had satisfactory mastery of grammar, usage, mechanics, and vocabulary for the grade level. In mathematics, less than 2 percent of student work at each grade reached the *extensive* level. Within mathematics, student performance was somewhat higher in grade six than in grades three and eight. Within writing, performance was highest in grade six, followed by grade eight, and finally grade three.

Examples of Typical and High-Scoring Work

Figures 1 through 6, on pages 2-5, include examples of typical student work. They represent average-scoring student papers in response to modal assignments from the Chicago schools we studied.[14] To what extent does this typical student work reflect standards of construction of knowledge and disciplined inquiry as defined in Figure 8 (page 12)? In third grade, the writing sample (Figure 1) shows virtually no construction of knowledge or elaborated communication, and several errors in vocabulary usage. In sixth grade, the writing sample (Figure 2) shows some correct insertion of words into a sentence diagram, but no construction of knowledge or elaborated written communication. In eighth grade, the written book report (Figure 3) includes a clearly written narrative about two girls (with some spelling errors), but the account involves minimal construction of knowledge and no significant elaboration of conclusions or generalizations.

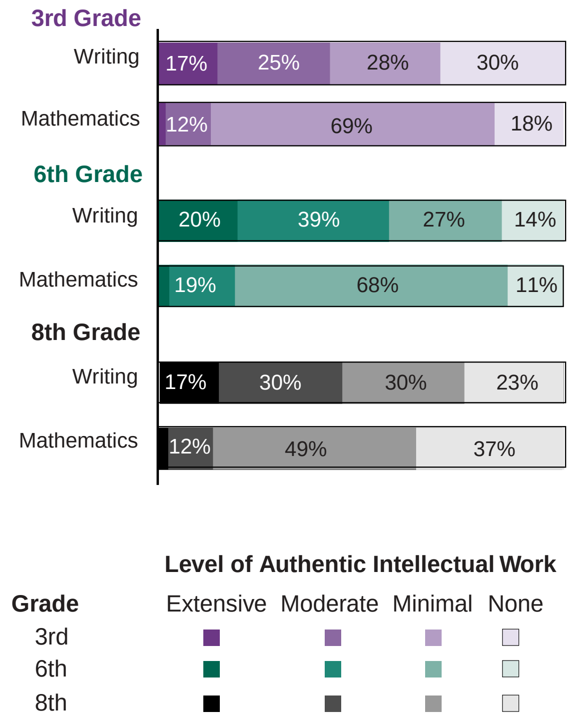
The third-grade mathematics work (Figure 4) shows correct simple division of double digit numbers by single digit numbers. The sixth-grade mathematics work (Figure 5) shows some success in multiplying single digit numbers by mixed numbers (there are many errors). The eighth-grade mathematics sample (Figure 6) illustrates correct computation of the volume of several prisms. But none of this mathematics work demonstrates construction of knowledge, written mathematical communication, or conceptual understanding. These samples of typical student work show that students may succeed in completing teachers' assignments, but still fail to produce authentic intellectual work as we have defined it. As we show below, a major reason for this deficiency in students' work is that teachers' assignments often fail to ask for authentic intellectual work.

How does typical student work compare with some of the best collected in this study? The student work shown in Figures 12-17 (pages 19-24) illustrates some of the higher scoring student work that we collected in writing and mathematics. We first consider the high scoring writing assignments (Figures 12-14).[15] In the third-grade composition on caring for a dog, the student organized the presentation around feeding and bathing the dog and offered a number of details for each point. While the student neglected to mention bathing in the conclusion, the writing shows interpretation and synthesis of knowledge and effective support for conclusions (in terms of reasonable expectations for third grade). The sixth-grade writing example, "The Bear's Decision," gives a clear account of a creative fable in which the facts of the story support the final moral: "persuasion is better than getting what you want through force." The story shows imagination and interpretation extending beyond reproduction of knowledge. The eighth-grade essay on going to church is another example of authentic writing. An argument constructed by the student, not memorized from a text, gives three reasons, each elaborated with some detail: "to thank God, to pray, and to show how much you love him." Each of the examples contains some errors in form and conventions of writing (e.g., capitalization, punctuation, spelling, vocabulary), which lowers the overall score somewhat. But considering the grade level of the students, none of the errors significantly obscures the meaning of the student's message. Compared with the examples of typical work in Figures 1, 2, and 3, student writing of this sort represents a much higher level of authentic intellectual work.

Now consider some of the best mathematics work we scored (Figures 15-17).[16] The third-grade

Figure 19

Writing Showed More Authentic Intellectual Work Than Mathematics



student (Figure 15) showed mathematical analysis by correctly deciding when to multiply and divide for the different problems and by devising and solving some original story problems involving these operations. By correctly solving problems with somewhat different formats, the student showed an understanding of the concepts of multiplication and division. By presenting prose descriptions of the problems and writing out the steps in the solutions, the student produced some elaborated written mathematical communication. The sixth-grade student's graphing of stock trends (Figure 16) indicated some organization of mathematical information and elaborated mathematical writing, but errors in computing indicated deficiencies in the student's understanding of fractional computation. The eighth grader, by organizing and correctly representing the information on prices and tax rate and by computing the before- and after-tax amounts correctly (Figure 17), demonstrated mathematical analysis and an understanding of decimal addition and finding percent. In showing clearly through prose and mathematical notation how the problem was solved, the student demonstrated elaborated written mathematical communication.

These examples from Chicago Annenberg Challenge schools demonstrate a higher degree of mathematical analysis, conceptual mathematical understanding, and elaborated written mathematical communication than the typical examples in Figures 4-6. Nonetheless, the three examples of higher scoring student mathematical work do not represent impressive exemplars of all three standards. Again to provide a sharp contrast in this regard, a more outstanding example of student work from another study appears in Figure 20 (next page). A comparative analysis of this example with the best work samples that we collected in our study leads readily to the conclusion that considerable room for improvement remains.

The Connection between Assignments and Student Performance

The contrast between typical and high-scoring samples of student performance presented above also illustrates the importance of the demands of the assignment. It stands to reason that if an assignment makes low demands for authentic intellectual work, students will almost surely score low on the standards for authentic performance, because they will have virtually no opportunity to show proficiency in construction of knowledge and disciplined inquiry. In contrast, when teachers require authentic work, students will have

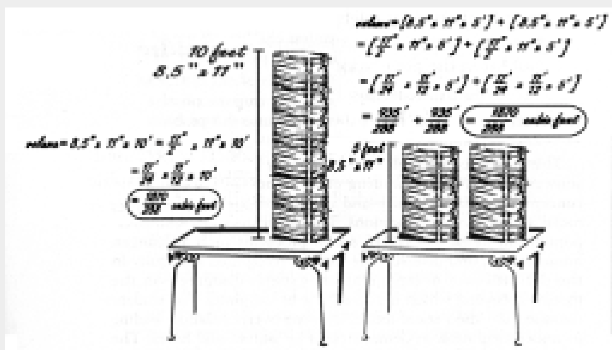
Figure 20: Exemplary Student Work
Grade 8 Mathematics

Assignment: The teacher told eighth graders that she had a 10-foot-high stack of papers (8.5 inches by 11 inches) on her desk. If she took one-half of them to form another stack, one-fourth of the desk would be covered with papers. If she divided these stacks into equal stacks to cover the desk, what would be the volume of papers covering the desk?

A student submitted a paper showing a sketch of the problem situation and the computations to find the volume of the entire stack before it was split. She explained her answer:

> "What I did is I found the volume of the entire stack. The volume never changes, no matter how the papers are arranged. For instance, a 5-foot volume box equals two 2.5 foot volume boxes."

Next to her explanation, the student had sketched another desk with two stacks of papers, each of them 5 feet high, as an illustration of her example. Next to that illustration, she had computed the volume of each stack, added the two volumes to get her original answer, and circled her final answer as if to show that it still equaled the volume of the original pile.



This example comes from a national study of school restructuring (Newmann, Secada & Wehlage, 1995, pp. 54-55). This eighth-grade student demonstrated, through elaborate drawing and mathematical notation, that total volume remained constant, even though the height of the stack of papers was cut in half. The explanation showed that the student understood how the formula for calculating volume would give the same result if the two stacks were cut in half again.

the opportunity to demonstrate such proficiency. Thus, to have any indication of the extent to which students can succeed with authentic intellectual work, teachers must first ask them to undertake authentic assignments. On the other hand, merely asking for authentic intellectual work offers no guarantee that all students will succeed in producing it. In addition to assigning challenging work, teachers must offer instruction that builds students' skills to succeed in construction of knowledge through disciplined inquiry. In short, giving assignments that demand authentic intellectual work is a necessary, though not sufficient condition for students to demonstrate authentic intellectual performance.

We investigated this proposition through a statistical analysis that produced an estimate of the strength of the connection between assignment quality and student performance. We found that in both writing and mathematics there was a strong connection at all three grades: When teachers gave more authentic assignments, students performed at a higher level on construction of knowledge and disciplined inquiry than students of teachers who

Figure 21

Students Whose Assignments Were More Authentic Produced More-Authentic Intellectual Work in Writing

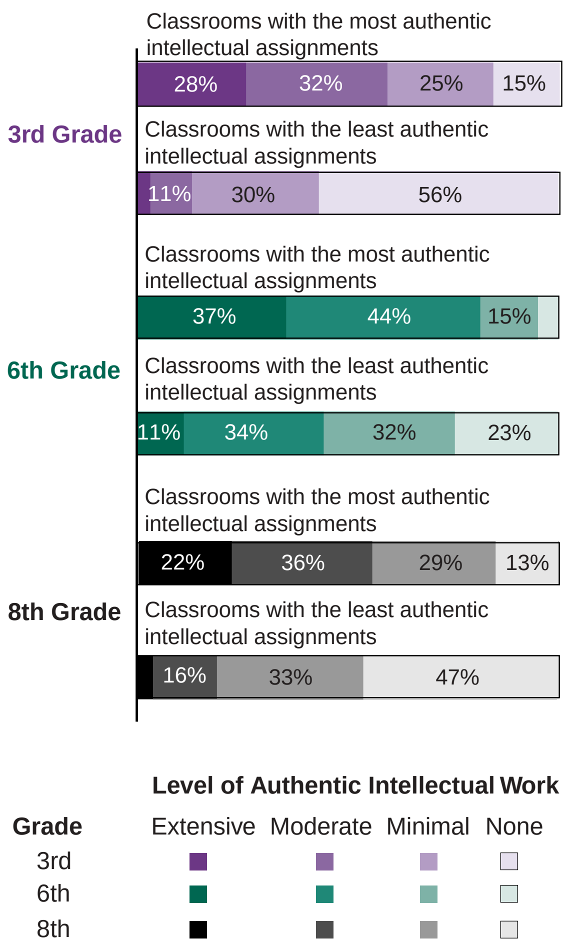
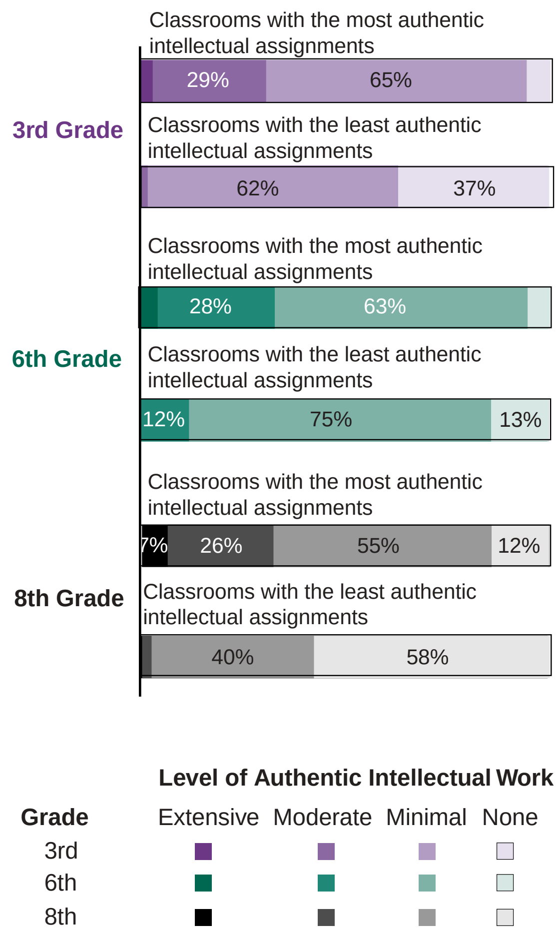


Figure 22

Students Whose Assignments Were More Authentic Produced More-Authentic Intellectual Work in Mathematics



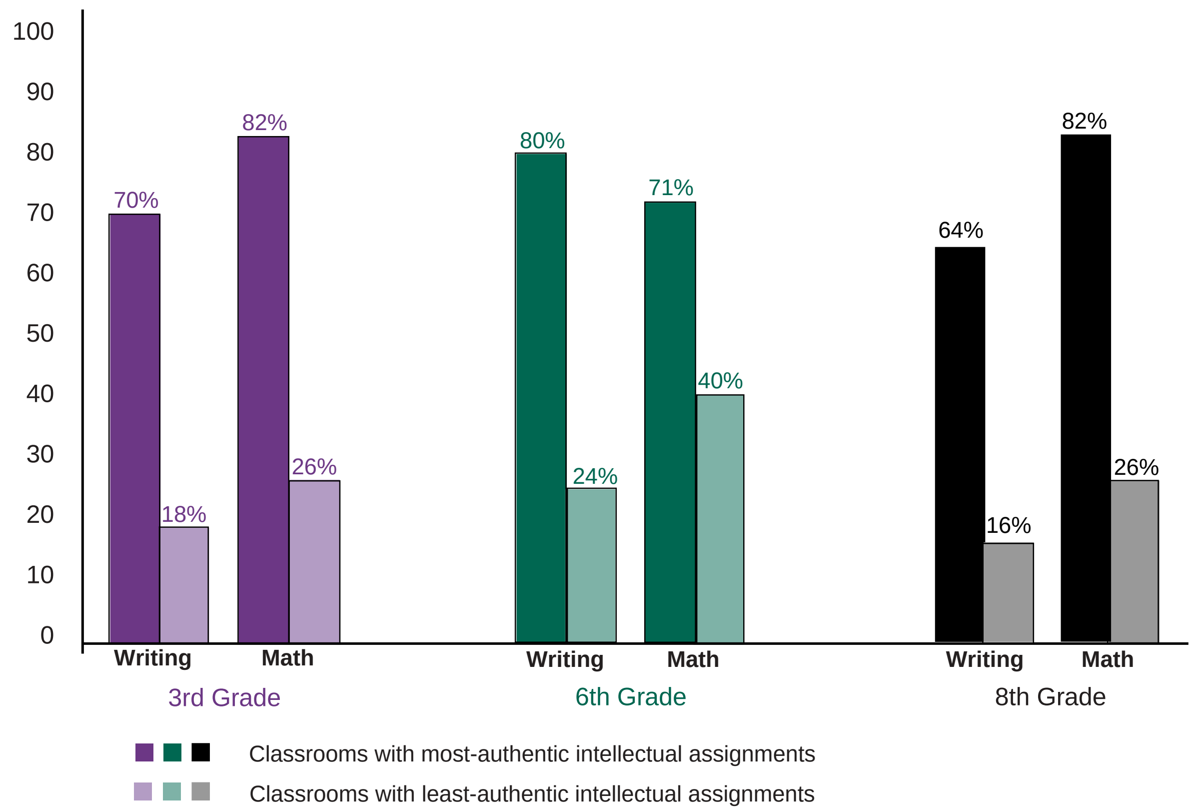
assigned less authentic assignments.[17] The strength of the relationship is shown in Figures 21-23.

Figure 21 illustrates how students in the classrooms with the most and least challenging assignments performed on our scale of authentic intellectual student work in writing.[18] The difference between these two groups of classrooms is highly significant. For example, in grade six, 37 percent of the students in classrooms with the most challenging assignments performed extensive authentic intellectual work, compared with only 11 percent of the students in classrooms with the least challenging assignments. This pattern is consistent across the three grades. It is especially notable at the low end of the scale in grade three, where 56 percent of the students who received the least challenging assignments produced no authentic writing, compared with only 15 percent in classrooms with the most challenging assignments.

Figure 23

Average Student Performance in Writing and Mathematics Was Higher in Classes Where Assignments Were Most Authentic

Performance Indicated by Percentile Rankings Within Grades



Note: The bars represent the average score for all student work in each category of assignment, expressed as a percentile within a grade level and subject. Percentile rankings were derived from the distribution of student work scores on our 10-point scale. Thus for third-grade writing, the average student in classrooms with the most authentic assignments scored above 49 percent of the students in the grade level, but the average student in classrooms with the least authentic assignments scored above only 18 percent of the students in the grade level.

Figure 22 shows the same relationship occurring in mathematics. Students in classrooms with the most demanding assignments produced more authentic mathematical work than those in classrooms with the least challenging assignments.

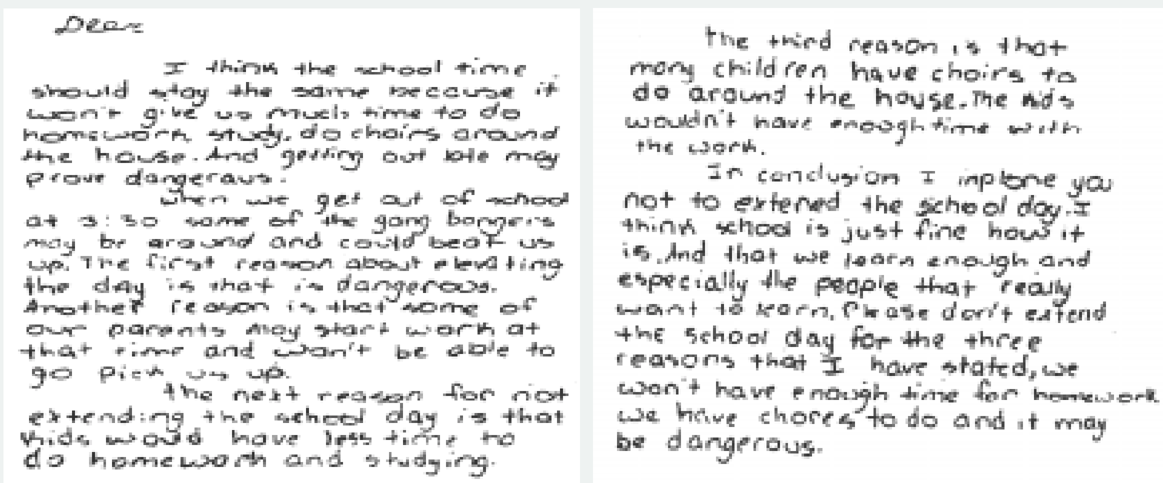
Figure 23 summarizes average student performance in writing and mathematics according to our scale for authentic intellectual work. It shows substantial benefits in percentile rankings to students who are asked to undertake authentic intellectual assignments. In grade three writing, for example, students whose teachers assigned the most challenging assignments performed 52 percentile points higher than students whose teach-

Figure 24A: Average Performance of Sixth Graders Receiving a High-Scoring Assignment in Writing

Assignment: "Our principal, Mrs. X, wants to extend our school day by one hour. Write a paper (or letter) to convince her why or why not you think she should do it.

1. Read the prompt carefully.
2. Take a stand for or against it.
3. First paragraph. Intro sentence. Tell the three things you will write about.
4. Second paragraph. Intro sentence. Tell about the first reason you mentioned. Three sentences about the first reason.
5. Third paragraph. Intro. Second reason.
6. Fourth paragraph. Intro. Third reason.
7. Fifth paragraph. Intro. Mention all three reasons. Concluding sentence."

A student who scored at about the mean submitted the following paper.


Dear

I think the school time should stay the same because it won't give us much time to do homework, study, do chairs around the house. And getting out late may prove dangerous.

When we get out of school at 3:30 some of the gang bangers may be around and could beat us up. The first reason about elevating the day is that is dangerous. Another reason is that some of our parents may start work at that time and won't be able to go pick us up.

The next reason for not extending the school day is that kids would have less time to do homework and studying.

The third reason is that many children have choirs to do around the house. The kids wouldn't have enough time with the work.

In conclusion I implore you not to extened the school day. I think school is just fine how it is. And that we learn enough and especially the people that really want to learn. Please don't extend the school day for the three reasons that I have stated, we won't have enough time for homework we have chores to do and it may be dangerous.

This assignment gave students a topic of personal significance to them and asked them to organize a persuasive argument and elaborate on it. The typical student used appropriate writing conventions and gave evidence of interpretation and synthesis in constructing a coherent argument.

ers assigned the least authentic intellectual assignments. For mathematics in grade three, the advantage was 56 percentile points for students receiving the most authentic assignments. The average advantage to students receiving the most challenging assignments across all grades and subjects was 46 percentile points.

What kinds of assignments and student work do these numbers actually represent? To illustrate, Figures 24 and 25 compare examples from sixth-grade writing and mathematics of typical student performance from classes with the most and least challenging assignments.[19]

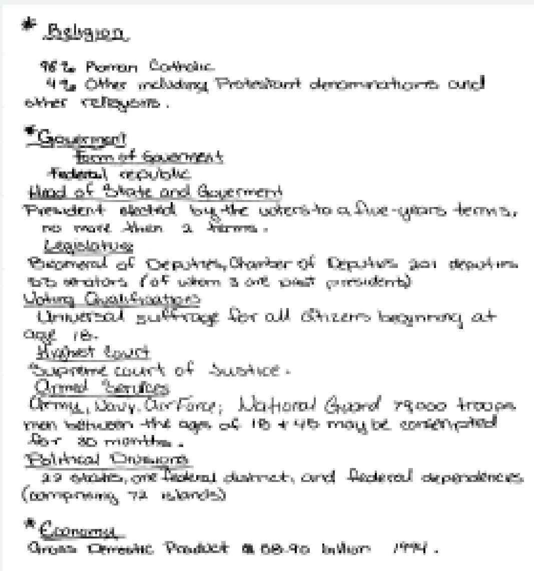
In Figure 24A, the more challenging assignment asked students to organize a persuasive argument and to elaborate on the argument with several reasons, each explained in a paragraph. The topic, extending the school day, presented a problem of personal significance to students. The typical student responding to the assignment gave evidence of interpretation and synthesis in constructing an argument, opposed the extension of the school day

Figure 24B: Average Performance of Sixth Graders Receiving a Low-Scoring Assignment in Writing

Assignment: “You are to write a report of your choice. You can obtain your information from the library. Use books about the country, magazine articles or encyclopedias.”

The assignment then specified a list of topics to include in the report. Under the heading *Geographic Data*, students were told to begin their presentation of the report by giving the latitude and longitude of the country’s capital city. Classmates then would use their atlases to locate the city and identify the country. Other headings for which specific information was requested were *Religion, Government, Language, Population, Major Products, Map,* and *Title.*

A student who scored at about the mean submitted the following paper.

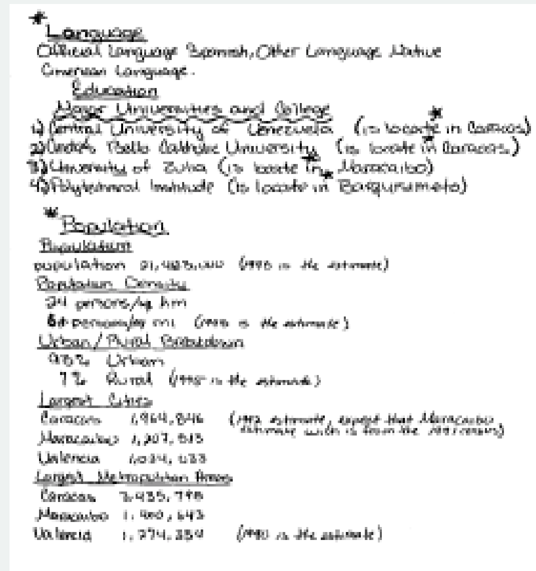


* Religion

96% Roman Catholic
4% Other including Protestant denominations and other religions.

* Government
Form of Government
Federal republic
Head of State and Government
President elected by the voters to a five-years terms, no more than 2 terms.
Legislature
Universal suffrage for all citizens beginning at age 18.
Highest Court
Supreme court of Justice.
Armed Services
Army, Navy, Air Force; National Guard 79,000 troops men between the ages of 18 + 45 may be conscripted for 30 months.
Political Divisions
22 states, one federal district, and federal dependencies (comprising 72 islands)

* Economy
Gross Domestic Product



* Language
Official Language Spanish, Other Language Native American Language.
Education
Major Universities and College
1) Central University of Venezuela (is locate in Caracas)
2) Andres Bello Catholic University (is locate in Caracas)
3) University of Zulia (is locate in Maracaibo)
4) Polytechnical Institute (is locate in Barquisimeto)

* Population
Population
Population Density
Urban / Rural Breakdown
93% Urban
7% Rural
Largest Cities
Caracas
Maracaibo
Valencia
Largest Metropolitan Areas
Caracas
Maracaibo
Valencia

Instead of calling for synthesis or interpretation, this assignment asked only for specific descriptive information. The typical student produced a list of facts, with virtually no elaborated written communication. The report shown here was eight pages long and included a drawing of the Venezuelan flag, a drawn map, and a photograph of an oil production facility. More than four pages included the kind of writing shown in this excerpt.

with several reasons, and used appropriate conventions of written expression. The report on a country required in the low challenging assignment (Figure 24B), had the potential of meeting all three standards for authentic intellectual work, but instead it asked only for six types of descriptive information and a map—all of which could be reproduced from an encyclopedia. The average student work on this assignment produced a list of facts on the required topics which reflected virtually no construction of knowledge or elaborated written communication, although grammar, usage, mechanics and vocabulary were adequate.

Similarly, the challenging mathematics assignment in Figure 25A asked students to organize and interpret mathematical information, to communicate findings in extended writing, and to connect students’ preferences to life outside of school. Average student performance on this assignment demonstrated analysis in the manipulation of the information, understanding of bar and pie graph representation of data, and proficiency in written

Figure 25A: Average Performance of Sixth Graders Receiving a High-Scoring Assignment in Mathematics

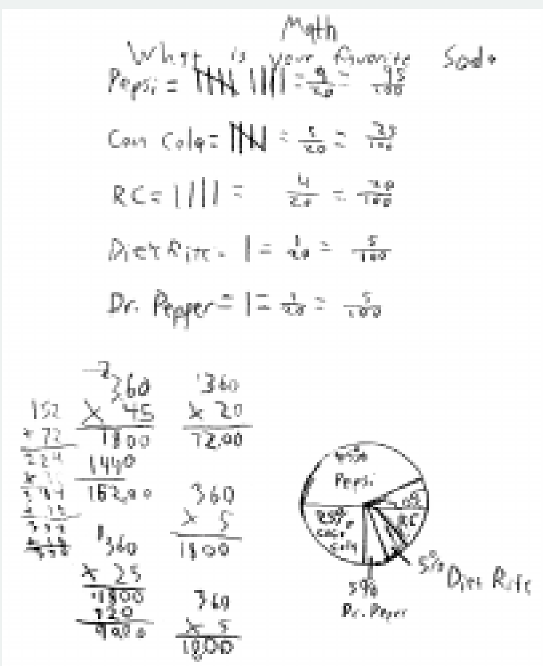
Assignment: “You are to interview 20 fellow students and ask them what is their favorite . . . (pop, team, color, ice cream), whatever you choose. Limit the choices to five: otherwise your data will be too scattered to convert the data to a pie/circle graph. After you ask each other, tally the results as shown on the sample. Note that you write four slashes vertically and the fifth one goes across the other four. This makes it easier to count when you are tallying larger numbers.

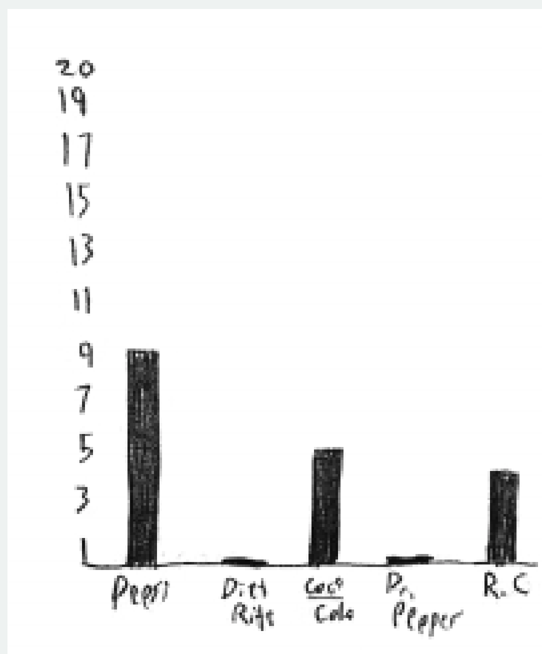
Now make a bar graph. Put a title so everyone knows what this is about. List your five choices at the bottom of the X-axis. Put numbers 0-20 on the Y-axis. Draw the graph as shown on the sample. Now convert the bar graph to equivalent fractions with 100 as the denominator because all percents are based on 100, i.e., 5/20 = 25/100 = 25%.

The final step is to convert the percents to the proper degrees of the circle graph. How many degrees are in a circle? 360^0. In order to convert the percents to degrees, multiple 360 x % (converted to a decimal) i.e., 360 x .20 = 72^0. Draw a circle and mark the center. Draw a radius which will be used as 0^0. Put the protractor on the circle and mark (i.e. 72^0) Draw a line from the 72^0 point to the center. Write in that section, (i.e. 20% - Bulls). Using the line just drawn, put the 0^0 on that line and mark the next degree. Continue until you have done four.

Now you have two kinds of graphs: bar graphs and circle graphs, so that the data you collected can be read visually easily.”

A student in this class who scored at about the mean on standards for authentic performance submitted the following work:



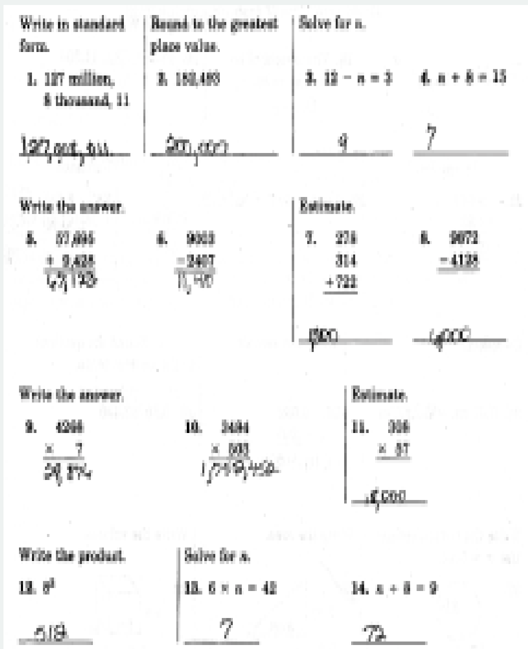


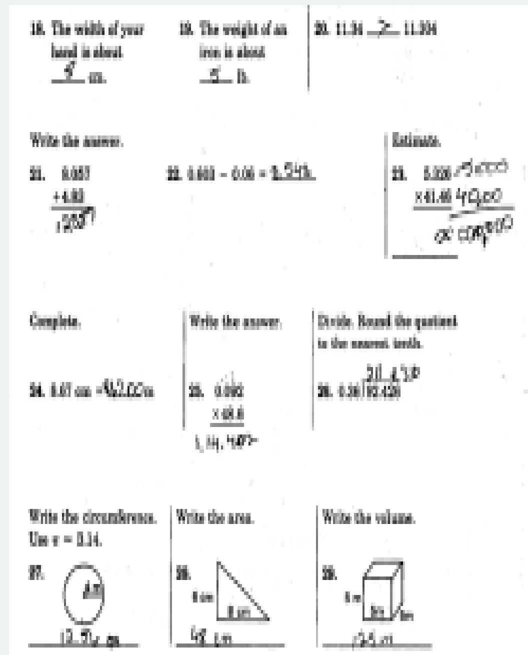
The student successfully completed an assignment that required organizing information collected in class, converting it into fractions and percentages and, finally, communicating it in two mathematical representations: pie graph and bar graph.

Figure 25B: Average Performance of Sixth Graders Receiving a Low-Scoring Assignment in Mathematics

Assignment: "You may use your textbook to look back at procedures you may have forgotten. Do all necessary work on your scratch paper. Put only your 'final' answers on the test sheet. Good luck."

The assignment is shown with the student's work. (There were 32 problems in all.)





This assignment contained various computations, but each required only the application of previously learned mathematical computation rules or formulas. Although this student answered almost all the questions correctly, the answers did not demonstrate mathematical analysis, understanding of key mathematical concepts, nor proficiency in written mathematical communication.

mathematical communication. In contrast, the low scoring assignment (Figure 25B) asked only for reproduction of algorithms on problems unrelated to students' lives. While the average scoring student on this assignment answered almost all questions correctly, the answers reflected neither mathematical analysis, understanding of key mathematical concepts, nor proficiency in written communication.

Assigning challenging work to students does not by itself cause high levels of student performance. In order to stimulate high-level performance, we need to focus also on the kinds of teaching that maximize student success with challenging assignments. At a minimum, however, we have shown that high-quality assignments provide the opportunity for students to demonstrate such performance, whereas low-quality assignments offer no such opportunity.[20]

SECTION IV

Interpretation

Our analyses produced two main findings. The bad news is that in writing and mathematics, both teachers' assignments and student work generally scored toward the lower end of the scale for authentic intellectual quality. The better news is that when we asked teachers for samples of the most challenging tasks they assigned, these assignments, on average, were more intellectually challenging than the typical work asked of students, and, more importantly, there was a strong relationship between the quality of teachers' assignments and student work. That is, teachers who assigned more demanding tasks were more likely to get authentic intellectual work from students than teachers who assigned less challenging tasks. At least some Chicago students have some opportunity to engage in more intellectually demanding work, even if such opportunities are not commonplace. While teaching basic skills and preparing for standardized tests has its place, if it drives out opportunities for more challenging work, it deprives students of the education they need for success in vocation and citizenship.

These findings represent only an initial look at research in progress, but we hope the argument for authentic intellectual work and the evidence presented will generate widespread discussion about standards for teachers' assignments and student work that extend beyond conventional assessment of knowledge and skills.

Will State Goals and Chicago Standards Help?

In response to widespread concern about low levels of student achievement across the United States, schools, districts, and states have tried to clarify and raise academic standards. In spring 1997, the Chicago Public Schools issued academic standards for outcomes expected of all students. Developed in collaboration with the Chicago Teachers Union, Chicago's standards present detailed expectations of what students should know and be able to do at different grade levels in the subjects of English Language Arts, Mathematics, Science, and Social Science.

To what extent are Chicago's academic standards likely to promote authentic intellectual work as described in this report?[21]

Chicago's academic standards are designed to align with the Illinois state education goals. There are 18 state goals across the four subject areas. Chicago in turn has specified three to five standards for each state goal at a particular grade level. And each Chicago standard is further described by several "curriculum frameworks," or content requirements that describe more specific knowledge and skills relevant to the standard. The connections among state goals, Chicago standards and Chicago frameworks are illustrated in Figure 26A for sixth-grade language arts and in Figure 26B (page 40) for sixth-grade mathematics.

A push to cover a large number of varied topics works against in-depth conceptual understanding.

Depending upon the grade level and subject, the number of Chicago standards for each state goal varies from one to five. There are then from one to 10 Chicago curriculum frameworks for each Chicago standard. In grade three, for example, to meet the 18 state goals across all four subjects, Chicago specifies about 55 standards and about 200 frameworks. Similar numbers of standards and frameworks are specified in the other grade levels. For example, in grade eight, the 18 state goals are to be implemented through about 65 standards and 230 frameworks. We have not conducted a thorough review of the more than 500 standards and 1500 frameworks that comprise the CPS system, but for illustrative purposes we examined the frameworks for sixth grade mathematics.

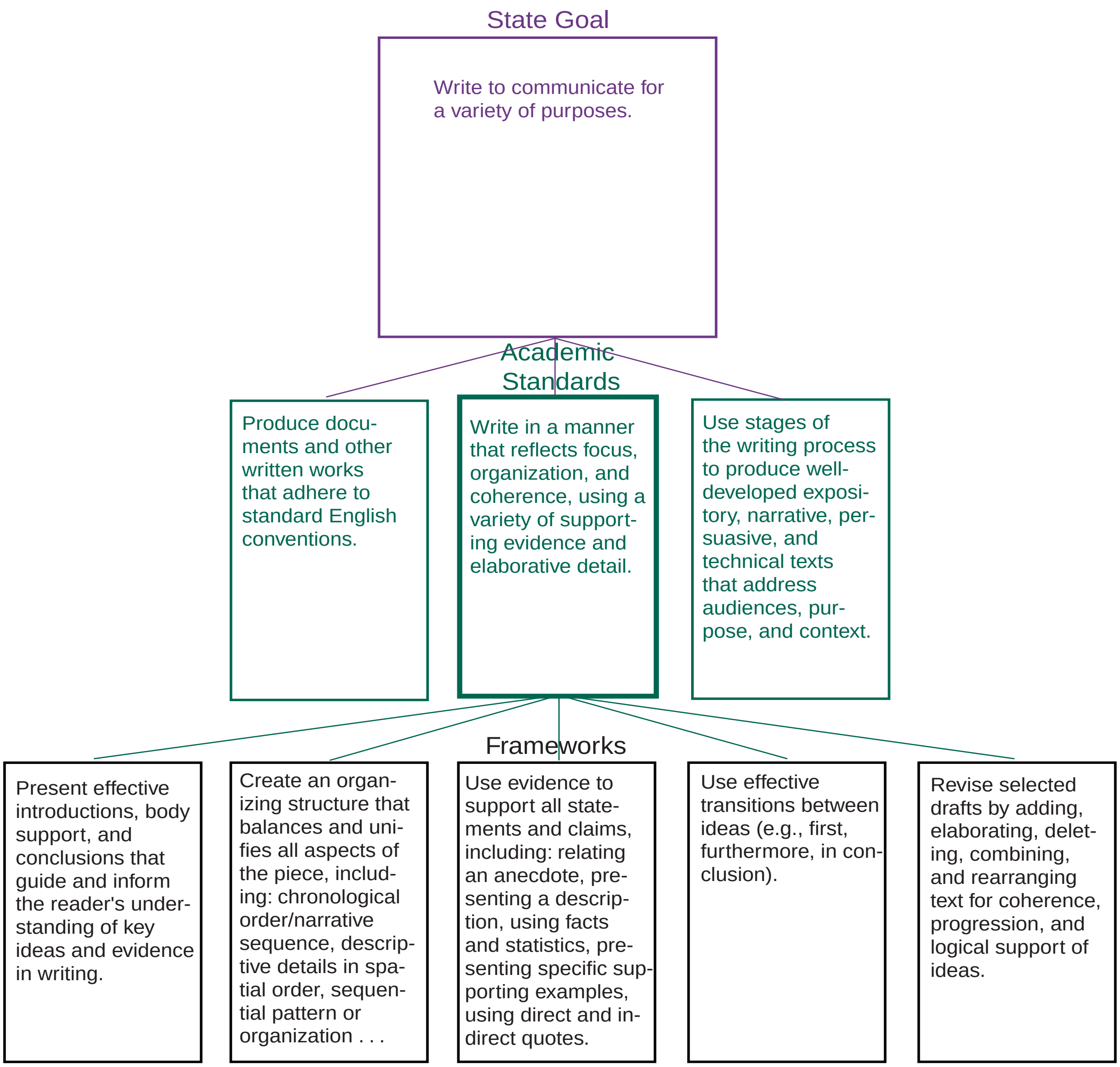
Taking the wording of the frameworks at face value, we asked whether the frameworks seem consistent with the standards for authentic intellectual work used in this report. We noticed many instances of apparent demands for construction of knowledge and disciplined inquiry, but far fewer that emphasized connections of academic work to issues beyond school. Some examples are presented in Figure 27. The wording of the frameworks, however, makes it difficult to know whether they will be implemented in ways that promote authentic intellectual work. (See the examples under the "Vague" heading in Figure 27). Of course, frameworks that appear to call for authentic work also can be taught in ways that require students only to memorize and reproduce information without achieving in-depth understanding, elaborated communication, or meaning beyond completion of a school requirement. Most importantly, if high-stakes tests used in Chicago (the Iowa Tests of Basic Skills), fail to call for authentic intellectual work, even the more authentic of Chicago's curriculum frameworks are unlikely to have significant impact.[22]

Further, the large number of frameworks to implement poses a significant risk that much of the content will be covered only superficially. A recent comprehensive international study of mathematics and science teaching found that curriculum in higher performing countries focused on fewer topics, compared to curriculum in the lower-performing United States that covered superficially many more, more-varied topics.[23] In general, a push to cover a large number of varied topics works against in-depth conceptual understanding, because there is less time to explore the complexities of any single topic.[24] In short, the Chicago academic standards may offer some support for authentic intellectual

Figure 26A

Illinois Goals and Chicago Academic Standards and Frameworks: Grade 6 Language Arts

Illustration: "State Goal 3"



Note: There are five goals, 12 standards, and 61 frameworks in all.

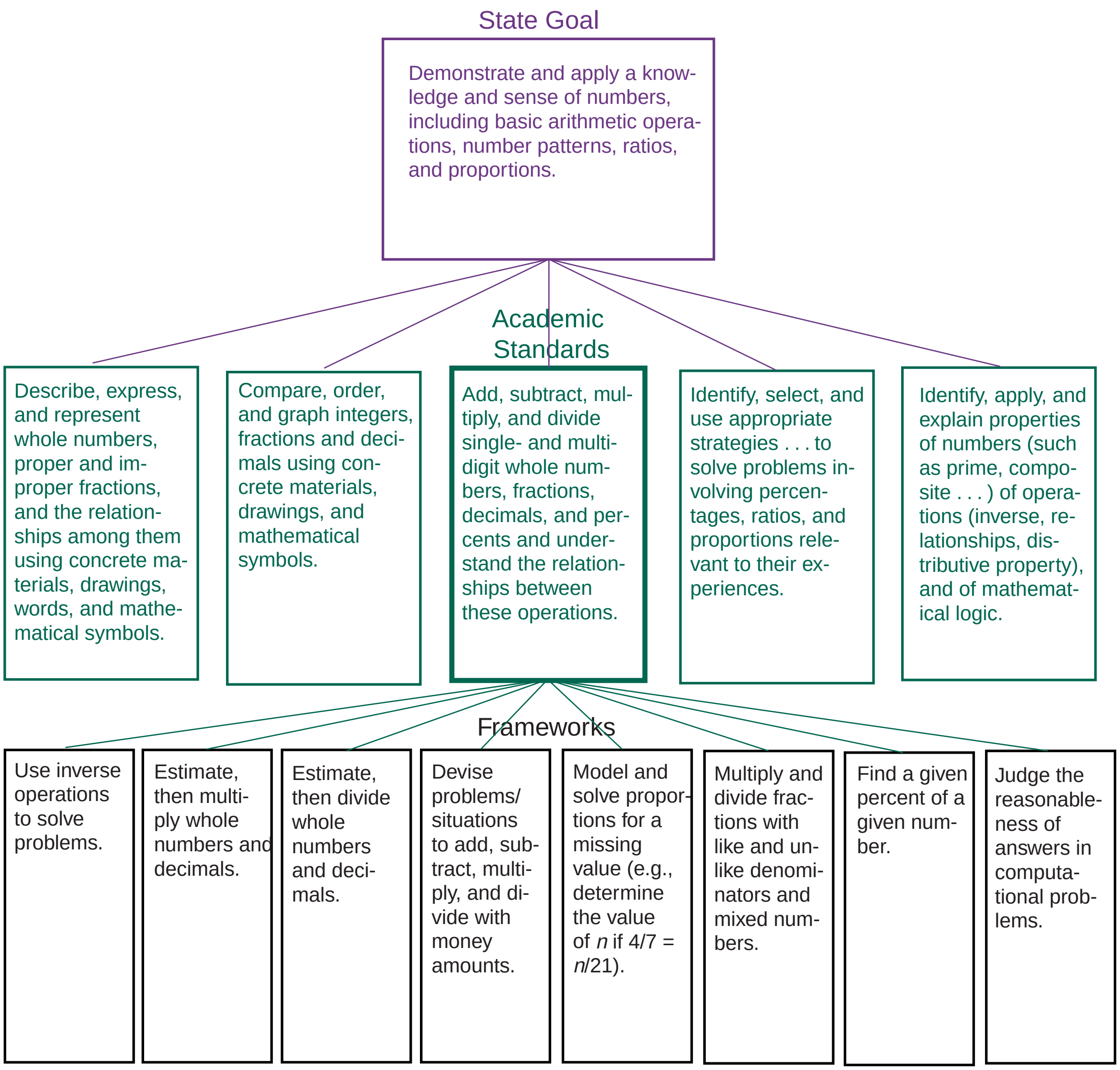
work, but whether they actually will help to promote authentic intellectual work is not assured. This can only be assessed by direct examination of what is actually happening in classrooms, as we have piloted in this study.

Need for System Support

Our findings suggest that teachers should give more assignments that require construction of knowledge and disciplined inquiry to study questions of social or personal significance. This

Illinois Goals and Chicago Academic Standards and Frameworks: Grade 6 Mathematics Figure 26B

Illustration: "State Goal 6"



Note: There are five goals, 19 standards, and 84 frameworks in all.

seemingly simple solution to the problem of generating more authentic intellectual work from students is not as easy as it sounds. Even teachers who would like to follow this advice face many challenges. Teachers may not understand the criteria for authentic intellectual work or how to create assignments consistent with them. Teachers may rightfully notice the need to teach for basic knowledge and skills as a foundation for more authentic intellectual work, but not know how to

Figure 27: Chicago Curriculum Frameworks' Demands for Authentic Intellectual Work
Illustrations for Grade 6 Mathematics*

Construction of Knowledge

- Judge the reasonableness of answers in computational problems (p. 72).
- Gather, organize, and display data using tallies, tables, charts, bar graphs, line graphs, line plots, circle graphs, and stem and leaf plot (p. 77).

Disciplined Inquiry

Prior Knowledge Base

All frameworks can be considered efforts to build a knowledge base in mathematics.

In-Depth Understanding

- Show that an equality or inequality relationship between two quantities (integers and whole numbers) remains the same as long as the same change is made to both quantities (p. 74).
- Explain the concept of "sample," including the understanding that the larger the sample, the more reliable the information will be (p. 77).

Elaborated Communication

- Explain (orally and in writing) solutions to problems involving whole numbers and fractions and support the solutions with evidence (p. 72).
- Compare data in order to make true statements (e.g., "Seven plants grew at least 5 cm") and use these statements to make a simple concluding statement about a situation (e.g., "This kind of plant grows better near sunlight because the seven plants that were near the window grew at least 5 cm and the others grew less") (p. 77).

Value Beyond School

- Solve problems involving tips, tax, discounts, and simple interest (p. 72).
- Use simple two-dimensional coordinate systems to find locations on a map or diagram.

Vague: May or May Not Call for Authentic Intellectual Work

- Read, write, and identify any decimals (p. 71).
- Identify and explain prime and composite numbers, prime factorization, the greatest common factor (GCF), and the least common multiple (LCM) (p. 72).
- Construct scale drawings from given data (p. 73).
- Solve equations involving whole numbers (p. 74).
- Solve problems involving fractions, decimals, integers, and numbers with exponents (p. 75).
- Read and interpret schedules (e.g., bus schedule, television guide) (p. 77).

***** These frameworks are published in Chicago Public Schools (1997), *Expecting More: Higher Standards for Chicago's Students, 4-6.* The more general state goals and Chicago standards relevant to each framework can be found by referring to the pages listed.

balance conventional demands with the more authentic ones, especially if district and state tests make conventional demands dominant. Teachers may feel so much pressure to cover all of the material called for in the Chicago standards that no time is left for more in-depth assignments. Parents may also resist moving toward authentic intellectual standards if they believe it would jeopardize student mastery of basic knowledge and skills.[25] Finally, even if more authentic tasks are assigned, there is no guarantee that all students will succeed on them. Teachers also need to know how to help students succeed with the more demanding work.

Resolving these issues is complicated. It requires faculty time for collegial discussion in a supportive school environment with strong leadership sympathetic to standards for authentic intellectual work. In many schools, opportunities for professional work of this sort is rare, and time reserved for faculty discussion is often devoted to crisis management or administrative matters. Local school leaders may have other priorities or find it difficult to facilitate honest collegial discussion about teaching toward these standards.

Promoting more challenging intellectual work will require special efforts from both top leadership in the district and administrators and teachers in local schools. For example, in addition to standardized test scores, the district accountability system should include indicators that tap student performance on more authentic assignments. District mandates on academic standards should push for significant instructional time devoted to those frameworks that emphasize in-depth understanding of a limited set of topics, rather than short periods of instruction that can offer only superficial exposure in order to cover a vast range of topics. Professional development offerings should help teachers and principals reflect on the nature of authentic intellectual work, specific standards for recognizing it, and concrete ways of promoting it in classrooms. Finally, the district needs to address the time issues that make it difficult for teachers to focus in a sustained way, through continuous professional dialogue, on the promotion of more authentic work in their schools.

Even if the district were to offer such support, much work remains at the school level. Principals and staff will need to structure school improvement plans along lines consistent with the promotion of authentic intellectual work, including specification of goals and monitoring progress in this area. This entails promoting a school climate in which innovations related to more challenging work are proposed, tried, evaluated, and redesigned. Helping teachers to move in this direction will require allocation of significant time for staff development and collegial discussion on these issues. And school staffs will need to explain the justification for more authentic work to students and parents.

A central goal of the Annenberg Challenge is to help schools create more personalized learning environments in which teachers can, through inquiry and discussion, build a foundation for teaching toward more authentic intellectual work. The research described here offers only a baseline portrait. Future reports will address the extent to which Annenberg schools progress along these lines and what helps them to improve. The Challenge's efforts to promote broad civic engagement around these problems, and to learn from sustained efforts now occurring in many schools, holds promise for promoting meaningful educational improvements for the city's students.

Endnotes

[1]See the first major report in the series: Bryk, Thum, Easton, and Luppescu (1998).

[2]The assignments and student work were collected and scored according to the methods explained in the sidebar on Research Design and Methods (page 15). The examples in Figures 1-6 were selected within each grade level and subject by: a) locating a teacher assignment that scored near the mean within the most frequently occurring category of our scoring system (*extensive*, *moderate*, *minimal*, or *no challenge*), and b) selecting student work from that assignment that scored close to the mean for that assignment according to our standards for scoring student work.

[3]See, for example, Boyer (1995), Kearns and Doyle (1988), and Stevenson and Stigler (1992).

[4]This perspective on authentic intellectual work was originally proposed by Archbald and Newmann (1988), then revised and further developed by Newmann, Secada and Wehlage (1995). Empirical research using this conception of achievement is presented in Newmann and Associates (1996).

[5]A broad definition of human achievement might not always illustrate disciplined inquiry as suggested by academic study (Gardner, 1983). For example, feats of wilderness survival that depend largely on ingenuity and courage, forms of athletic prowess, or selfless acts of caring and personal sacrifice might all be considered authentic, but they may not illustrate much disciplined inquiry. Since schooling, at a minimum, should promote academic study, our conception of human accomplishment is intentionally limited to achievements that depend on the use of formal knowledge.

[6]See Cappelli, Bassi, Katz, Knoke, Osterman, and Useem (1997); Decker, King Rice, Moore, and Rollefson (1997); Murnane and Levy (1996); National Center on Education and the Economy (1990).

[7]The two examples are taken from Murnane and Levy (1996); the quotation is on p. 30.

[8]Aristotle (trans. 1946), Barber (1984), Dewey (1916/1966), Jefferson (1939 version).

[9]Newmann and Associates (1996); Kane, Khattri, Reeve, Adamson, and Pelavin Research Institute (1995); Marks (1997).

[10]The manual for scoring assignments and student work in writing and mathematics is available from the Consortium on Chicago School Research.

[11]The 18 mathematics teachers were guided by Eric Gutstein, Assistant Professor of Mathematics Education, DePaul University, and his team of experienced mathematics educators: Michael Arny, Judy Merlau, and Joe Tillman. The 18 language arts teachers were guided by David Jolliffe, Professor of English, DePaul University, and his team of experienced language arts educators: Anna Chapman, Carmen Manning, and Kendra Sisserson.

[12]In comparing scorers' initial scores on assignments we found that overall, scorers agreed precisely about 70 percent of the time, and 95 percent of the time they either had exact agreement or were off by only one point. The degree of agreement varied slightly depending upon the subject (higher agreement on writing assignments), the standard (higher agreement on connection to students' lives), the grade level (higher agreement in grade eight), and the type of task (higher agreement on typical assignments). In comparing scorers' initial scores for student work we found that overall, scorers agreed precisely about 59 percent of the time, and 92 percent of the time they either had exact agreement or were off by only one point. The level of precise agreement, however, was considerably higher for mathematics work (67.6 percent) compared to writing (49.6), but this is probably due to the fact that for mathematics, the scores were significantly skewed toward the lower end of the scale and in writing the scores were considerably more varied over the entire range. The degree of agreement also varied somewhat depending upon the standard. For mathematics, agreement was higher on analysis than the other two standards. For writing, agreement on elaborated written communication was highest. In neither mathematics nor writing did the degree of agreement vary substantially by grade level. See Appendix for percent agreement by grade and standard.

[13]In the end, it was not necessary to use the final negotiated scores in reporting of results, because Rasch

analysis was used to adjust for rater bias. The Rasch model used to calculate the score is: $\log(P_{nijk}/P_{nijk}-1)= B_n - D_i - C_j - F_k$, where B_n is the raw score of the task *n*, D_i is the difficulty of the standard *i*, C_j is the severity of the judge *j*, and F_k is the difficulty of the step up from category k-1 to category k and so forth. Thus, the Rasch score is the total score across all the standards with adjustments for the difficulty of the standards and the severity of the raters on each of the standards. Once the Rasch score was calculated in a log odds metric, it was converted to a 10-point scale by subtracting the minimum value from each measure, dividing this by the range of all measures, and multiplying it by 10 (i.e.,10-point scale measure =10 x [observed measure – minimum measure] /range).

[14]Each of the assignments presented in Figures 1 through 6 scored within the most frequently occurring category for the subject and grade level as presented in Figure 11: for grade three, *no challenge* in both subjects; for grade six, *no challenge* in writing and *minimal challenge* in mathematics; for grade eight *minimal challenge* in writing and *no challenge* in mathematics.

[15]The average student work selected for each high-scoring assignment fell in the *extensive* category for student work and in the upper quartile of all student work in the subject and grade level.

[16]This represents the work of students who scored close to the mean on standards for authentic student work on each of the higher scoring mathematics assignments. The student work in these figures fell into the upper quartile for the grade level and into the category of *moderate authentic intellectual work.*

[17]We estimated through a 2 level HLM model the structural relationship between the quality of the tasks teachers assign and the average student work performed in those classrooms. Level 1 in the HLM analysis is a measurement error model that takes into account the rater reliability in scoring the task and student work. This allows us to estimate at level 2 the latent correlation (disattenuated for rating error) between the quality of teacher assignments and average student work connected to the assignments. When we did this we found that the structural relationship between the assignments and student work ranged from a low of .71 in sixth-grade math to a high of 1.0 in third-grade math with most of the correlations in high .80s. The magnitude of these relationships is impressive when taking into account that the rating processes were completely independent. In essence, these results indicate that the quality of the assignments teachers assign to their students is virtually deterministic of the quality of work that students produce on average.

[18]Using the average score (the mean of the 10-point score weighted by the inverse standard error obtained from the Rasch analysis) a teacher received on the two challenging assignments he/she submitted, we identified the top and bottom quartiles of the teachers in terms of the authenticity of the assignments given.

[19]The assignments were selected from those scoring near the mean of the top and bottom quartiles on the total score for authentic assignments for each subject, and the student work was selected from work scoring near the mean on each assignment.

[20]It is possible that teachers may give more challenging assignments only to higher achieving students in order to protect lower achieving students from predicted failure. Future reports will examine this possibility through analysis of the relationship of scores on the Iowa Tests of Basic Skills to teachers' assignments and student performance according to standards for authentic intellectual work. However, it is important to recall that the sample of schools in this initial study is actually slightly more disadvantaged than the average CPS school. In short, the students (and classrooms) that we studied were not "high ability," and we have not yet examined other reasons why some students had significantly greater opportunity to undertake authentic assignments than others.

[21]Information on Chicago's standards is taken from four documents published by the Chicago Public Schools in collaboration with the Chicago Teachers Union in spring 1997. All four documents have the same title, *Expecting More: Higher Standards for Chicago's Students*. One offers an introduction and overview, and the other three present the standards and frameworks for grades K-3, grades 4-6, and grades 7-8.

[22]Research indicates that when districts or states impose high-stakes tests focusing on factual information, teachers teach the tested information, but not the underlying concepts. The curriculum may change to conform to the tests, without significant change in teaching practices

(Darling-Hammond and Wise, 1985; Smith, 1991; Smylie, 1998; Wilson and Corbett, 1990).

[23]See Peak (1996).

[24]Porter (1989) documented the problems of superficial exposure to too many topics in elementary school mathematics. In a review of national and state standards, Marzano and Kendall (1997) concluded that on average, the amount of time available for instruction would have to be increased by over 80 percent in order to teach all the standards.

[25]One should not assume that time spent on more authentic intellectual work will jeopardize students' scores in standardized tests. To the contrary, some evidence indicates that it may enhance student performance on traditional measures (e.g., Carpenter, Fennema, Peterson, Chiang, and Loef, 1989; Cobb, Wood, Yackel, Nicholls, Wheatley, Trigatti, and Perwitz, 1991; Silver and Lane, 1995; Knapp, Shields, and Turnbull, 1992; Lee, Smith, and Croninger, 1997; Tharp, 1982). Future reports will address this issue for Chicago students.

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Appendix

Percent of Agreement Between Scorers on Assignments Within Subjects by Standards and Grade Levels

Writing	Perfect Agreement	Agreement Within 1 Point	Total
Standards			
Construction of Knowledge	66	26	**92**
Elaborated Written Communication	70	25	**95**
Connection to Students' Lives	77	21	**98**
3rd Grade			
Construction of Knowledge	68	21	**89**
Elaborated Written Communication	60	29	**89**
Connection to Students' Lives	71	26	**97**
6th Grade			
Construction of Knowledge	63	36	**99**
Elaborated Written Communication	74	23	**97**
Connection to Students' Lives	84	15	**99**
8th Grade			
Construction of Knowledge	67	21	**88**
Elaborated Written Communication	79	21	**100**
Connection to Students' Lives	75	23	**98**

Mathematics	Perfect Agreement	Agreement Within 1 Point	Total
Standards			
Construction of Knowledge	65	30	**95**
Elaborated Written Communication	68	27	**95**
Connection to Students' Lives	71	25	**96**
3rd Grade			
Construction of Knowledge	64	33	**97**
Elaborated Written Communication	72	27	**99**
Connection to Students' Lives	72	20	**92**
6th Grade			
Construction of Knowledge	58	30	**88**
Elaborated Written Communication	60	30	**90**
Connection to Students' Lives	62	34	**96**
8th Grade			
Construction of Knowledge	74	26	**100**
Elaborated Written Communication	72	23	**95**
Connection to Students' Lives	79	21	**100**

Percent of Agreement Between Scorers on Student Work Within Subjects by Standards and Grade Levels

	Perfect Agreement	Agreement Within 1 Point	Total
Writing			
Standards			
Construction of Knowledge	47	37	**84**
Elaborated Written Communication	53	34	**87**
Grammar, Usage, Mechanics, and Vocabulary	49	41	**90**
3rd Grade			
Construction of Knowledge	49	35	**84**
Elaborated Written Communication	52	33	**85**
Grammar, Usage, Mechanics, and Vocabulary	46	47	**93**
6th Grade			
Construction of Knowledge	45	39	**84**
Elaborated Written Communication	54	33	**87**
Grammar, Usage, Mechanics, and Vocabulary	51	38	**89**
8th Grade			
Construction of Knowledge	48	37	**85**
Elaborated Written Communication	51	34	**85**
Grammar, Usage, Mechanics, and Vocabulary	51	38	**89**

	Perfect Agreement	Agreement Within 1 Point	Total
Mathematics			
Standards			
Mathematical Analysis	69	29	**98**
Disciplinary Concepts	68	29	**97**
Elaborated Written Communication	69	30	**99**
3rd Grade			
Mathematical Analysis	65	34	**99**
Disciplinary Concepts	73	26	**99**
Elaborated Written Communication	82	18	**100**
6th Grade			
Mathematical Analysis	76	23	**99**
Disciplinary Concepts	68	28	**96**
Elaborated Written Communication	64	34	**98**
8th Grade			
Mathematical Analysis	66	28	**94**
Disciplinary Concepts	59	35	**94**
Elaborated Written Communication	54	43	**97**

This report reflects the interpretations of the authors. Although the Consortium's Steering Committee provided technical advice, no formal endorsement by these individuals, their organizations, or the full Consortium should be assumed.

Consortium on Chicago School Research

Mission

The Consortium on Chicago School Research is an independent federation of Chicago area organizations that conducts research on ways to improve Chicago's public schools and assess the progress of school improvement and reform. Formed in 1990, it is a multipartisan organization that includes faculty from area universities, leadership from the Chicago Public Schools, the Chicago Teachers Union, education advocacy groups, the Illinois State Board of Education, and the North Central Regional Educational Laboratory, as well as other key civic and professional leaders. The Consortium does not argue a particular policy position. Rather, it believes that good policy is most likely to result from a genuine competition of ideas informed by the best evidence that can be obtained.

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Improving Chicago's Schools

Sponsored by the Chicago Annenberg Research Project with assistance from the Consortium on Chicago School Research

The Chicago Annenberg Research Project is a five-year program of the Consortium on Chicago School Research to document and analyze the activities and accomplishments of the Chicago Annenberg Challenge. The project focuses on four related areas of inquiry.

1. **Outcomes for students.** Change in academic achievement, including basic skills and higher levels of learning. Also change in social attitudes, conduct, and engagement among students in Annenberg schools.

2. **School development.** Improvement in key organizational conditions of Annenberg schools that affect student learning. These conditions include school leadership, parent and community partnerships, student-centered learning climate, professional development and community, and quality instruction, as well as the Challenge's organizational themes of time, size, and isolation.

3. **Networks.** How networks, their external partners, and other change mechanisms promote the development of Annenberg schools.

4. **Larger contexts needed to support school development.** How the Challenge develops as an organization to support networks and school development. How the broader institutional contexts of Chicago affect the development and accomplishments of the Challenge.

The project's research design includes longitudinal surveys and case studies, multiple levels of analysis, and comparison groups. Data are collected from several sources including surveys of teachers, principals, and students; observations of schools and classrooms; classroom tasks and student work products; interviews; documents of Challenge activities; and administrative records from the Chicago Public Schools.