Elementary and Secondary Education:

An International Perspective

U.S. Department of Education
Office of Educational Research and Improvement

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NATIONAL CENTER FOR EDUCATION STATISTICS
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Highlights

Achievement…

U.S. 9- and 13-year-olds performed at a level higher than most of their peers in other countries in reading, roughly the same in science, and lower in mathematics.

In eighth grade, boys and girls in the United States performed at roughly the same levels in mathematics and science. Internationally, where gender gaps did exist, they tended to favor boys in mathematics and science, and girls in reading.

Adults in the United States with only a high school diploma had weaker literacy skills than their counterparts in other countries studied. Approximately one-fifth of U.S. high school graduates with no postsecondary education were unable to perform beyond the most basic literacy tasks.

Enrollment and completion rates…

The United States has one of the highest percentages of 25- to 64-year-olds who have completed secondary education.

At 35 percent, the enrollment rate of U.S. 18- to 21-year-olds in tertiary (higher) education surpassed that of all other countries but Canada, whose enrollment was 40 percent.

Labor market outcomes…

Over three-fourths of 25- to 64-year-olds with an upper secondary education participated in the labor force in all countries studied, with the United States falling in the low to middle range compared to other countries. Participation rates for those who had completed upper secondary education were much higher than for those who had not, particularly in the G-7 countries.

Upper secondary graduates have substantially higher earnings than those who did not complete a secondary education. The biggest earnings differential was seen in the United States, where those without a high school diploma earned about 64 percent of the salaries earned by those with a high school diploma.

Financial resources and expenditures…

The United States allocated 3.8 percent of GDP on elementary and secondary education, ranking below Sweden, Canada, Switzerland, France, and the United Kingdom, and above Australia, Italy, Spain, Japan, Germany, and Korea.

The United States had the highest per-pupil expenditures of the G-7 countries in 1993, but was below all other countries except France and the United Kingdom in the percentage of current expenditures spent on staff compensation.

Classroom, student, and teacher characteristics…

Across most industrialized nations, the range of student/teacher ratios is wide at both the elementary and secondary level. The United States has a higher-than-average student/teacher ratio for the other G-7 countries.

Schools in the United States allocated as much or more instructional time than most other countries in terms of overall hours of education, minutes of subject instruction in mathematics and science per week, and frequency of lessons.

The United States had a greater incidence of child poverty than its G-7 counterparts. One-fifth of all U.S. children lived in poverty after the effect of government taxes and transfers in 1991, compared with just over 13 percent in Canada, about 10 percent in the United Kingdom, and less than 7 percent in France.

The majority of elementary and secondary school teachers in the United States and in most other G-7 nations are female. However, in Germany and Japan, approximately three-quarters of secondary school teachers are male. While it takes 15 to 17 years of education to become a teacher in most nations, Germany and Japan maintain more extensive mentoring and training systems for new teachers than the United States.

1

Introduction

Chapter 1 Introduction

In recent years, public concern over the academic standing of U.S. students relative to students in other countries has increased dramatically. Much of this concern is due to the results of recent comparative reports that show U.S. students lagging behind their international classmates, especially in mathematics. International assessments of academic achievement provide important benchmarks to measure the progress of U.S. students, yet these studies often fail to explain the differences in achievement across countries. We are interested in not only how well U.S. students perform on achievement tests relative to their counterparts in other nations, but how different their education is in all respects. For example, we often hear people explain the low U.S. test scores by saying that the students in the United States represent a more diverse population: there are more different languages spoken in the United States, and we have higher poverty rates than other major industrialized nations. But how much truth is in this type of statement?

This report will examine the elementary and secondary school system in the United States relative to the education systems in 11 other countries. It will attempt to answer questions such as:

- Are there more children in poverty in the United States than in other countries?
- What percentage of students speak a language other than English at home and how does this compare to other countries?
- Do teachers receive the same amount of training in the United States as in other countries?
- Does the United States spend the same amount of money on education as other countries?
- How do U.S. students compare to students in other countries in reading, mathematics, and science?
- How literate are our adults who have a high school diploma compared to adults in other countries with similar education backgrounds?
- How well does a high school education prepare U.S. students to enter the work force? Do our high schools do better or worse than equivalent schools in other countries?

Finally, this report will try to connect selected educational inputs, such as teacher training and educational expenditures, to student outcomes, such as achievement and labor force participation.

Background

The need to compete effectively in the international marketplace has convinced U.S. business, economic, and political leaders of the importance of understanding the education systems of other industrialized nations. Studying how other countries educate their citizens provides insight into the competitiveness of those nations, as well as a benchmark for comparing our own education system.

Data published over the last decade have shown the United States to be lacking compared with other countries in some areas of school performance, particularly at the higher grade levels. While U.S. students perform reasonably well at the 4th-grade level, especially in reading, mathematics and science scores at the secondary school level have raised some concerns. Subsequent to several reports published in 1990, the nation's governors established the National Education Goals, which included two goals relevant to international competitiveness:

- "By the year 2000, United States students will be first in the world in mathematics and science achievement;" and
- "By the year 2000, every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship."

Elementary and secondary education is the backbone of every nation's education system. These levels educate all persons from approximately age 6 through age 16, and for some students it is the only education they receive. Many early childhood and postsecondary school programs charge tuition fees or have admission standards. Elementary and secondary education is available free of charge and attendance is mandatory for all children of certain ages in each country discussed in this report. The success of the U.S. elementary/secondary education system as compared to other countries has implications for our economic and technological competitiveness in the global marketplace.

To provide a broader perspective on these issues, the United States has participated in the Organization of Economic Cooperation and Development's (OECD's) Indicators of National Education Systems (INES) Project and several major international assessments. The latter include the Third International Mathematics and Science Study (TIMSS), the Reading Literacy Study, and the International Adult Literacy Survey (IALS).

The OECD has published five comprehensive reports of education indicators to date called *Education at a Glance*.[1] The National Center for Education Statistics (NCES) has also used the information collected by these projects and studies to support the Center's international statistics program. OECD data have been reported in regular publications such as *The Condition of Education* and used recently in such special publications as *Education in States and Nations* and *Education Indicators: An International Perspective*. These publications have encompassed the full scope of education from early childhood through postsecondary and adult education. They have not, however, focused specifically on a particular education sector. This report addresses this gap by comparing the U.S. elementary and secondary education sector with that in other developed nations.

[1]The fifth report, Education at a Glance: OECD Indicators, 1997, was published while this report was in review, so most of the data included in this report come from the 1996 edition.

Purpose of This Report

This report attempts to analyze the role of elementary and secondary schools in preparing students either to continue their education or to enter the labor force and become productive, literate citizens. Unlike many international publications that provide information about the entire education system from early childhood through tertiary education, the focus here is solely on elementary and secondary education, the equivalent of U.S. grades 1 through 12. While previous OECD and NCES publications have presented much of these data in an indicator format using bullets and tables, this report attempts to tell a story about the elementary and secondary school systems in the United States, as compared to those in other major industrialized nations. The story is told in four chapters, each focusing on a particular aspect of the elementary and secondary school system. It ends with an examination of the links between educational inputs and outputs and the relative success of the U.S. elementary and secondary education system compared to that of other countries. Some trends and regional differences are examined within countries and comparisons are made among 12 major industrialized nations.

Organization of the Report

The balance of this report is divided into four chapters, a conclusion, a technical appendix and supplemental tables. The first two chapters describe inputs into the elementary/secondary education system: *Student, Teacher, and Classroom Characteristics* and *Education Resources and Expenditures*. Chapter 2 describes the background characteristics of students, such as poverty level and language skills; teacher characteristics, such as training time and gender distribution; and school characteristics, such as time students spend in the classroom and student/teacher ratios. Chapter 3 focuses on the financial inputs countries provide for their education systems, and compares these inputs across countries. These financial inputs include expenditures relative to GDP, expenditures per student, and teacher salaries. Examining what the students and teachers bring to the classroom along with the financial resources of an education system provides a context to examine some of the outcomes described in chapters 3 and 4.

The next two chapters analyze the outputs of elementary and secondary education systems: *Student Achievement* and *Labor Market and Other Outcomes*. Chapter 4 analyzes the results of recent international assessments in mathematics, science, and reading, compares them across countries, and relates them to certain teaching practices and student attitudes. Chapter 5 examines the success of the elementary and secondary education system in preparing students either to continue their education beyond secondary school or to enter the labor force. It analyzes unemployment rates and relative salaries of secondary school graduates across the different countries and also compares the relative success of women and men in each of the countries. In addition, this chapter examines adult literacy scores of persons with an upper secondary education and compares them to those of persons who attained different levels of education to determine how well elementary and secondary schools prepare students to become functionally literate adults.

Finally, the conclusion attempts to draw links between the inputs described in chapters 2 and 3 and the outputs analyzed in chapters 4 and 5, and tries to answer the question “What matters?” Different contextual and financial inputs are correlated with achievement scores and education and labor market outcomes to determine whether certain factors appear related to these outcomes. Following the conclusion are the appendices describing the technical aspects of the data and the analyses performed. In addition, data tables of percentages, means, and frequencies with their appropriate standard errors are included as an appendix. Each chapter has been supplemented

with graphical representations of the data, but the statistical tables are presented exclusively in the appendix. In addition, as described below, this report focuses on only 12 countries, thus only their data appear in the body of the text. The appendix tables, however, include data for other countries that participated in the relevant surveys. Finally, this report includes an index for those persons wishing to concentrate on a particular issue.

Data

The data analyzed in this report come primarily from the Organization for Economic Cooperation and Development (OECD). Much of the data in the tables were reported in the 1996 OECD publication *Education at a Glance: OECD Indicators*; other tables were created from OECD's unpublished survey data. OECD collects data from 29 member countries; the U.S. data were generated by NCES. The majority of the achievement data came from two sources: the Third International Mathematics and Science Study (TIMSS) and the International Assessment of Educational Progress (IAEP). These data are discussed in more detail in chapter 3. In addition, data on adult literacy came from the International Adult Literacy Survey (IALS) conducted in 1994.

Countries selected for study in this report include the "Group of Seven" (G-7) countries as well as five other major industrialized nations. The G-7 countries are recognized as the world's major industrialized economies and include the United States, Canada, Japan, France, Germany, Italy, and the United Kingdom. These countries are relatively similar to one another in terms of economic development, and are primary commercial competitors with the United States. In addition to these countries, this report also compares the United States to Australia, Korea, Spain, Sweden, and Switzerland. These five countries were chosen for several reasons, such as the availability of data, variation of types of education systems, range of findings,[2] and the size and economic competitiveness of these nations as compared to the United States. All 12 countries are shown in the figures whenever possible. When data are unavailable for a particular country, that country is omitted from the graph and the reason is footnoted.

All statements in this report have been tested for statistical significance. T-tests were used primarily, with Bonferroni adjustments made as needed. Any statement comparing one country to another or one subgroup to another must show statistical significance at the 0.05 level. Any comparison that did not meet this test of significance is referred to as "approximately equal" or "showing no differences" or is simply not included in a list of countries or subgroups that were higher or lower than the referent country or subgroup on that particular measure. A more detailed description of these statistical tests can be found in the technical appendix.

[2]For example, one of the reasons Korea was selected was because Korean students consistently show high levels of achievement in all subjects.

2

Student, Teacher, and Classroom Characteristics

Chapter 2 Student, Teacher, and Classroom Characteristics

The question of "what matters" in U.S. education has taken on an international perspective. Faced with recent reports that show some grades of U.S. students lagging behind their international classmates in several subjects, researchers, educators, and policy makers are interested in identifying the factors that account for this gap in achievement. This chapter explores some of the contextual "inputs" that may be related to educational outcomes and may contribute to differences in student performance across countries. Comparative data are presented on the language skills and poverty levels of students, the training time and gender distribution of teachers, and the structure of the classroom, including time in formal instruction and student/teacher ratios. This chapter highlights a few contextual factors related to students, teachers, and classrooms—it is not meant to be exhaustive, but rather illustrative of how the nature of the student body, the experiences of teachers, and the structure of the classroom combine to create unique education environments in different countries. These "inputs" are later discussed in relation to the "outputs" presented in chapters 4 and 5.

In the United States, there has been intense national debate regarding the quality of education. Critics contend that the U.S. education system is failing, and is characterized by undertrained teachers, overcrowded classrooms, and less-than-rigorous academic standards. Some calls for reform include a comprehensive overhaul of the system, with a strong focus on internal school structuring issues.

Others assert that U.S. schools are succeeding, and more attention should be paid to what is right about education in the United States, rather than what is wrong. They contend the "myth of school failure" is perpetuated through the popular media and political agendas, without any substantial supporting data. While public attention has focused on the failure of U.S. schools, other socioeconomic challenges to the education system have been ignored, such as an increasingly diverse student body and the growing demands on teachers to do much more than teach.

The public debate over education in the United States has called attention to a number of factors thought to be related to student outcomes. The current research literature provides an empirical perspective on these factors, and presents some evidence of relationships between student and community inputs and educational outputs. Although research conducted in the United States suggests answers to the question of "what matters" in education as a whole, it does not provide a definitive picture of exactly what influences student achievement. As this chapter will show, there is mixed international evidence on many of the factors associated with academic performance.

A significant amount of research indicates a relationship between student outcomes and socioeconomic factors. For instance, increased language diversity among the student population has created new challenges for school systems in many countries. In the United States alone, there are 2.1 million public school students with limited-English proficiency (LEP) (U.S. Department of Education, NCES, 1997a), and similar patterns can be seen in many European

countries, where there are rising levels of immigrants who do not speak the official school language (OECD, 1994). A recent U.S. study of 1st- and 3rd-grade students showed LEP students significantly lagging behind their classmates as measured by grades, standardized test scores, grade retention, and teacher judgments. Compared to other students, LEP elementary school children had significantly lower science and math scores and were more likely to repeat a grade in elementary school (U.S. Department of Education, PES and OBEMLA 1995). LEP students bring instructional challenges to the classroom that have fiscal implications for schools that must provide additional or specialized services.

Economic status is another contextual factor associated with educational success. There is a substantial body of research documenting the damaging effects of poverty on academic achievement. Children living in low-income families have lower levels of performance in school, are more likely to be kept back a grade, and have below-average graduation rates (Jencks & Mayer, 1990; Zill, 1991). Although beyond the scope of this publication, it is important to note that poor children living in urban areas often face additional challenges that can limit their education experience. These challenges include prenatal exposure to drugs, premature birth and related health problems, and the physical risks associated with living in a crime-ridden area (Carta, 1991).

While international variance in student performance can be partially explained by socioeconomic factors, practitioners, researchers, and policy makers also are interested in the nature of training that teachers receive. Within the United States, there has been considerable debate over the quality of preservice teacher education. Many argue that U.S. teachers are drastically undertrained. In fact, over 12 percent of all new teachers do not have any teacher training, 15 percent have not fully met state teaching standards, and about a quarter of all teachers have not had training in child development, learning processes, or teaching methods (National Commission on Teaching and America's Future, 1996).

One argument is that today's teachers, especially those that are undertrained, are not prepared to deal with an increasingly diverse student body, and that longer and more intense preservice programs, such as those in many other nations, are needed. Research indicates that extended training time, such as a four-year undergraduate program and one or more years of pedagogical training, may ultimately improve student achievement. Some studies have shown that student performance has increased as a function of teachers' understanding of student learning styles and needs, as well as motivational techniques (National Institute of Education, 1977; Gottfredson and Daiger, 1979). It is assumed that teachers who spend more time in the appropriate type of training will be better equipped to teach once they reach the classroom.

Other research suggests that the duration of preservice programs may not be directly related to the quality of instruction ultimately presented in the classroom. For instance, Lopez (1995) reported that in Texas public schools, student performance did not differ as a function of the teacher's educational status—students performed the same whether they were taught by a teacher with a bachelor's degree or a master's degree. In fact, Lopez found that the strongest predictor of student achievement was the teacher's years of experience in the classroom.

In addition to the background characteristics that teachers and students bring to the classroom, the manner in which countries structure their education system also influences a child's educational experience, and thereby may account for differences in achievement across nations. In recent years, classroom structuring issues have attracted a great deal of attention in the United States. For instance, public attention increasingly has focused on the number of hours children spend in school, and many groups have been concerned that both the school day and

academic year are too short. These concerns are reflected in an increase of extended school day programs, initiatives for full-year schooling, and national research efforts such as the National Education Commission on Time and Learning. Created by the 1991 Education Council Act, this Federal commission was charged with studying and reporting on the use of time in U.S. classrooms, and ultimately recommended extending and maximizing time in the classroom in a variety of ways.

Members of the commission argue that concerns regarding the length of the school day in the United States are exaggerated. Rather, they contend that the number of hours spent in formal instruction is more important than the total time spent in school, and suggest that there are ways of more effectively using the existing school day. In addition to both of these arguments, other groups submit that time is not the issue—that the problems with education in the United States have more to do with the increasingly linguistic and economic diversity of the student population than with internal school structuring issues. Moreover, it is not the amount of time that matters, but how it is spent (National Education Commission on Time and Learning, 1994). Despite the controversy that surrounds the issue of time in school, there is a growing interest in how other countries have designed their educational calendars to maximize student learning.

There have also been efforts to decrease class size and student/teacher ratios in U.S. schools. Proponents of small classes argue that student outcomes can be improved by increasing a student's access to educational opportunities, and that countries that maintain low student/teacher ratios may provide a more effective learning environment for students. The research findings on student/teacher ratios and class size conducted in the United States are mixed. Harder (1990) suggests that student performance is related to the quality of instruction rather than to class size. On the other hand, reduced class size has been linked with a reduction in discipline problems, increased student participation, and greater individualized student attention (Achilles, 1996). Other studies indicate similar positive results from small classes: a study of 6,000 elementary school children in Tennessee over four years found that students in smaller classes outperformed children in larger classes (Nye, 1992); and other researchers have reported that students enrolled in small classes have higher scores in reading and mathematics than do students in larger classes (Finn & Achilles, 1990).

On the whole, the research literature does not provide a conclusive answer to the question of "what matters" in education, and the debate regarding which factors are most important in explaining student achievement will certainty continue in the United States. In addition, this debate has been taken to an international level, as more data become available that compare U.S. students with students in other countries. To help interpret the results of recent international assessments, this chapter presents comparative data on a variety of educational inputs, including student, teacher, and classroom characteristics.

This chapter looks at how student, teacher, and classroom characteristics vary across nations and combine to produce different learning environments. The primary data source comes from *Education at a Glance: OECD Indicators*, 1996, published by the Organization for Economic Co-operation and Development (OECD). Data also come from several publications of the National Center for Education Statistics (NCES), including *The Condition of Education and Education Indicators: An International Perspective*, as well as publications from IEA's Third International Mathematics and Science Study (TIMSS).

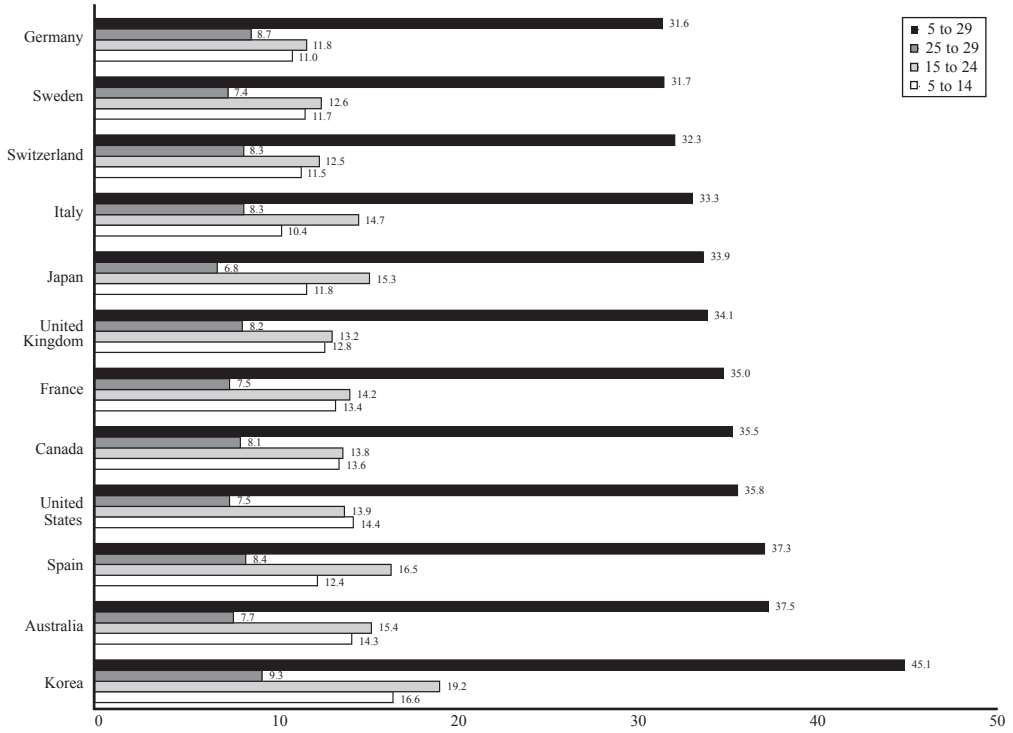
Student Characteristics

The educational environment is affected, in part, by the size and characteristics of its student body. Student diversity exists in most classrooms around the world, in the form of different ethnic, racial, socioeconomic and cultural backgrounds, and varying levels of ability. This section compares student characteristics that may have an influence on classroom processes and thus on student outcomes in the G-7 nations and five other industrialized countries. Specifically, three indicators are used as a basis of comparison between the United States and other countries: the percentage of youth in the total population, home and school language differences, and the proportion of children living in poverty.

What is the percentage of youth in the total population among various countries?

An international comparison of student characteristics begins with an examination of the relative size of the youth population compared to the total population in each country. This percentage reflects the relative number of children eligible to be enrolled in each country's school system. Countries with relatively large youth populations face greater demand for

figure **2.1** | **Percentage of persons 5 to 29 years of age in the total population, 1994**



NOTE | The countries are ordered from the smallest percentage of 5- to 29-year olds to the greatest.

SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

education, while countries with relatively small youth populations may devote fewer resources to education or may be able to invest more financial resources per pupil than other nations. In addition, by highlighting trends in the growth of the youth population and providing indicators of the size of each graduating class, policy makers and economists can forecast changes in the percentage of the population who will participate in the labor force over time.

Among the countries listed in figure 2.1, the proportion of youth ages 5 to 29 in the general population ranged from 32 percent in Germany, Sweden, and Switzerland to 45 percent in Korea. For 5- to 24-year-olds, the range went from 23 percent in Germany to 36 in Korea in 1994. For most of the countries depicted in figure 2.1, the proportion of children between the ages of 5 and 14 accounted for 10 to 14 percent of the total population. Italy had the smallest proportion of youth in that age group (10.4), followed by Germany (11.0). On the other end of the spectrum, Korea (16.6), the United States (14.4), and Australia (14.3) had the highest percentages of youth in the 5-to-14 age group.

The percentage of youth population (ages 5 to 29) varied by almost 15 percentage points in this 12-country sample, as did the percentage of children age 5 to 14. The United States had a slightly higher percentage of children age 5 to 14 in 1994 than did the other G-7 countries and most of the other countries described in this chapter with the exception of Korea. Thus, it is likely that countries such as Korea and the United States have a greater proportion of their populations in the education system than countries such as Sweden or Germany. The characteristics of these students, including language skills and socioeconomic status, can be just as important as their numbers.

How does the United States compare to other countries in terms of the percentage of students who usually speak a language at home that is different than the official school language?

Children of immigrants often speak a different language at home than the language they are expected to use at school. In addition, indigenous populations, and even those who have lived in the country for several generations, often speak a home language different from the school language.

The presence of children whose home language differs from the language of instruction at school has significant implications for the provision of education services. Differences between home and school languages affect access to educational opportunities and may inhibit parental involvement in school activities. For instance, children who speak a different language at home than the official school language face difficulties in relaying school-related information to parents, having parents assist in homework, and understanding classroom instruction.

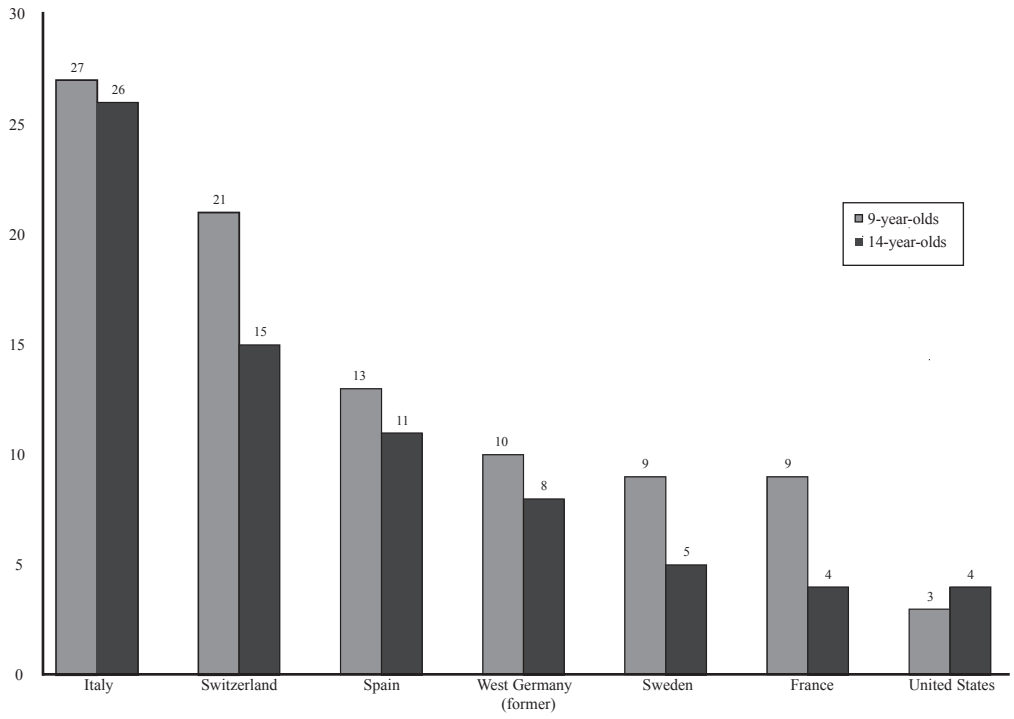
In the United States, in 1991, about 4 percent of both 9- and 14-year-olds reported that they usually speak a language at home that is different from the one spoken in their school. As seen in figure 2.2, about one-fourth of 9- and 14-year-olds reported a language difference between home and school in Italy. Among the four G-7 countries for which data were available, the United States had one of the lowest percentages of 9- and 14-year-olds who speak different languages at home and at school (3 and 4 percent respectively).

The relatively high level of language diversity reported in Italy might be attributed to Italian students sometimes differentiating between the dialect they speak at home and the dialect

spoken at school. Southern Italy, in particular, has a variety of dialects. In Northern Italy, German and French are sometimes spoken as well. Other countries, such as Sweden, are seeing increased immigration, also increasing diversity. Furthermore, four regionally based national languages are spoken in Switzerland, which again may contribute to the relatively high percentage of children who report speaking a different language at home than at school.

Although the overwhelming majority of children across the United States speak the same language at home and at school, this statistic shows wide variations across different states. In New Mexico in 1990, for example, almost 30 percent of children spoke a language other than English at home and over 10 percent had difficulty speaking English. In California, 35 percent spoke a language other than English at home and 15 percent spoke English with difficulty (U.S. Department of Education, NCES, 1996a). Overall, the percent of 5- to 17-year-olds who spoke a language other than English at home in 1990 ranged from 3 percent in West Virginia, Vermont, Kentucky, Alabama, Mississippi, Tennessee, Arkansas, and North Dakota to 35 percent in California (see appendix table 2.3).

figure **2.2** | **Percentage of 9- and 14-year-olds who say that they usually speak a language other than the official school language at home, 1991**



NOTE The data in figure 2.2 are based on students' reports of their linguistic situation. Data are unavailable for Japan, the United Kingdom, Canada, Australia, and Korea.

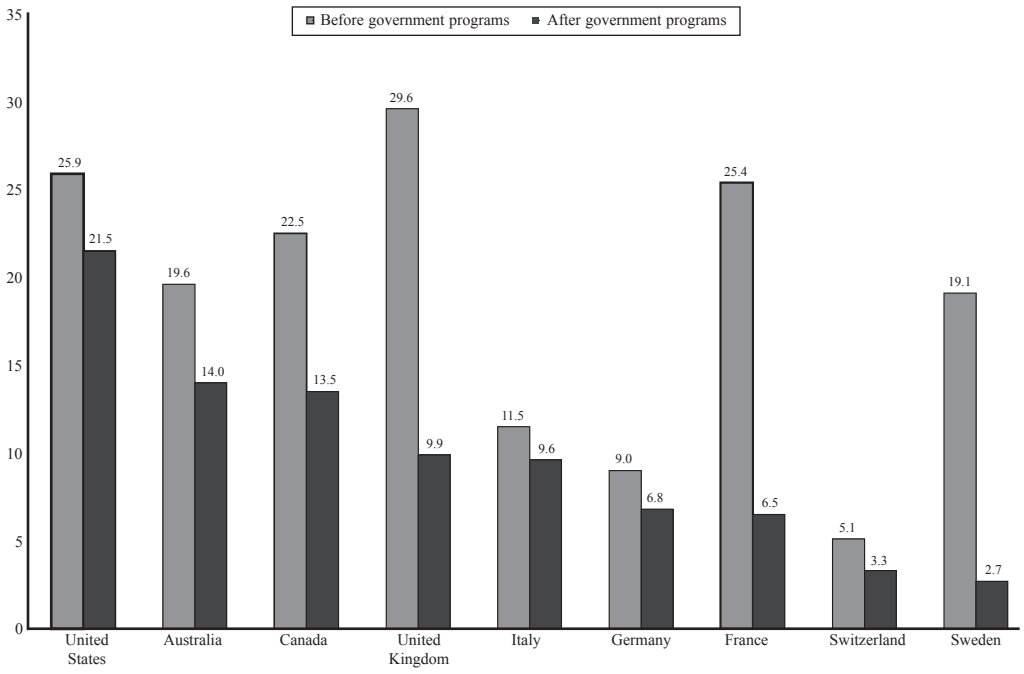
SOURCE International Association for the Evaluation of Educational Achievement, IEA Reading Literacy Study, 1992.

How does the United States compare to other countries in terms of the percentage of children living in poverty?

The challenges of serving a linguistically diverse student body can be compounded by the effects of poverty on children. A significant body of research documents the impact of poverty on children's academic development. Studies have shown, for example, that children in high-poverty districts exhibit low achievement (Abt Associates, 1993), are less likely to graduate from secondary school on time, and are more likely to switch schools than students enrolled in wealthier districts (U.S. Department of Education, NCES, 1996d).

As a result of their living in poverty, children may bring a variety of challenges to the classroom that necessitate the provision of additional services such as remediation or afterschool tutoring programs. These children may require basic provisions from the school, such as breakfast and/or lunch, and may lack essential supplies such as pencil and paper. Examining the percentage of students in poverty or from low-income families provides an indication of the extent to which a school system may have to provide these basic services in addition to the prescribed education curriculum. This situation reflects the additional time and resources that

figure **2.3** **Percentage of all children living in poverty before and after government programs (various years)**



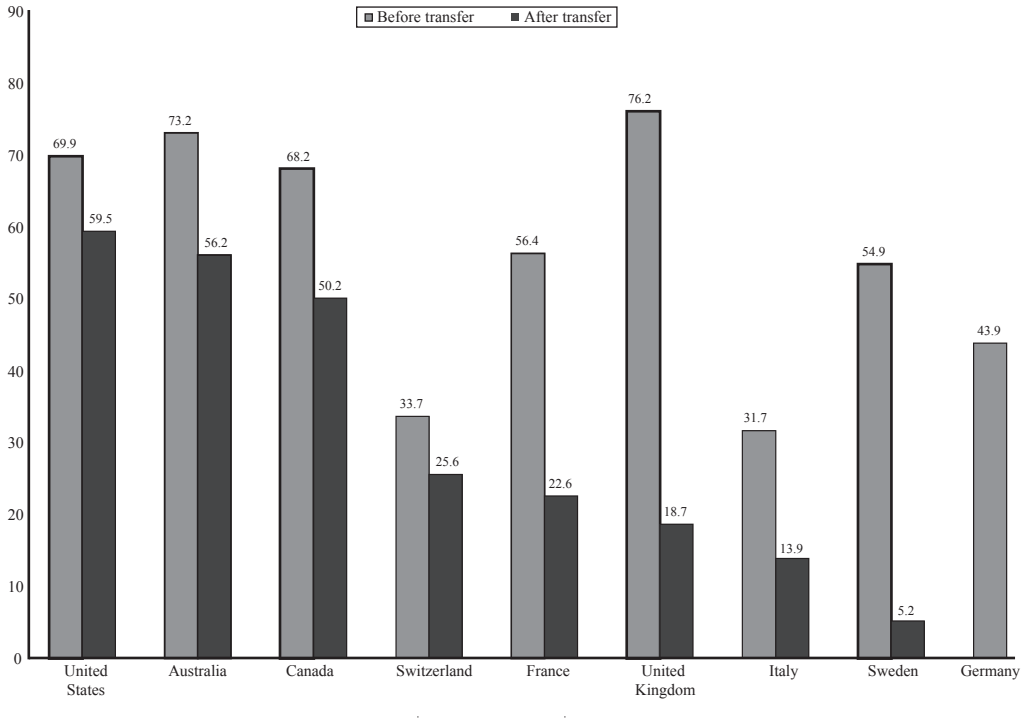
NOTE Poverty line is set at 40 percent of adjusted mean household income in each country. Data are unavailable for Japan, Korea, and Spain.

SOURCE Luxembourg Income Study, *The Real Income of American Children in a Comparative Perspective,* 1997.

may need to be devoted to the education system in each country. Figure 2.3 shows the percentage of children living in low-income families in the G-7 nations and other industrialized countries. Two measures are presented in figure 2.3: one describes the percentage of children living in low-income families, and the other specifies the percentage of children living in low-income families after the impact of taxes and government transfers on income. The intensity of government efforts to reduce poverty is reflected in the difference between these two percentages.

Two observations are immediately apparent. First, absolute poverty rates for children in the United States are relatively high. Second, the effect of government programs to reduce the proportion of children in poverty in the United States is less compared to that of many of the other countries depicted in figure 2.3. This may result from less funding being devoted to programs in the United States to reduce poverty, or from U.S. programs not being as effective as those implemented in other countries. Wealthy countries with wide distributions of income may consciously decide that some of those with income below 40 percent of the mean are not in poverty and do not require assistance. The large differences between before and after government transfers seen in such countries as France, the United Kingdom, and Sweden reflect a strong government effort to redistribute income through taxes.

figure **2.4** | **Percentage of children living in single-mother, low income households (various years)**



NOTE | Poverty line is set at 40 percent of adjusted mean income.

SOURCE | Luxembourg Income Study, *The Real Income of American Children in a Comparative Perspective,* 1997.

Before adjusting for taxes and transfers, about 26 percent of all children in the United States lived in low-income families in 1991, followed closely by France (25.4) and exceeded by the United Kingdom (29.6). After adjustment for taxes and government transfers on income, the United States had between 1.5 and 8 times the percentage of poor children than the other countries depicted in figure 2.3. Approximately one-fifth of all U.S. children lived in low-income families after taxes and transfers, compared with 13.5 percent in Canada, about 10 percent in the United Kingdom, and 6.5 percent in France.[1]

Comparable patterns can be seen for children living in single-mother homes, as shown in figure 2.4. Among the five G-7 countries for which data were available, a higher percentage of children in single-mother homes lived in poverty, compared to all children, both before and after transfer payments. Although the United Kingdom and Australia both had a higher percentage of children in poverty in single-mother families before transfers and taxes, the United States had the highest percentage of children in single-mother families living in poverty after transfer and taxes (59.5), followed by Australia (56.2) and Canada (50.2).

Teacher Characteristics

The education environment in which students learn, and their educational achievements, are strongly influenced by those who work with them daily—namely, their teachers. Therefore, it is important to investigate how teachers in the United States compare to those in other countries. We can learn more about teacher characteristics in individual countries by asking: What percentage of the country's work force enters the teaching profession? What is the gender makeup of the teaching force? What is the average level of education completed by teachers? The reader should be aware, however, that not all countries agree on a standard definition of "teacher." For example, in Australia "teachers" include principals, assistant principals, and senior teachers involved primarily in administrative tasks. In Japan the category also includes principals and vice-principals.

What are teacher education requirements across various nations?

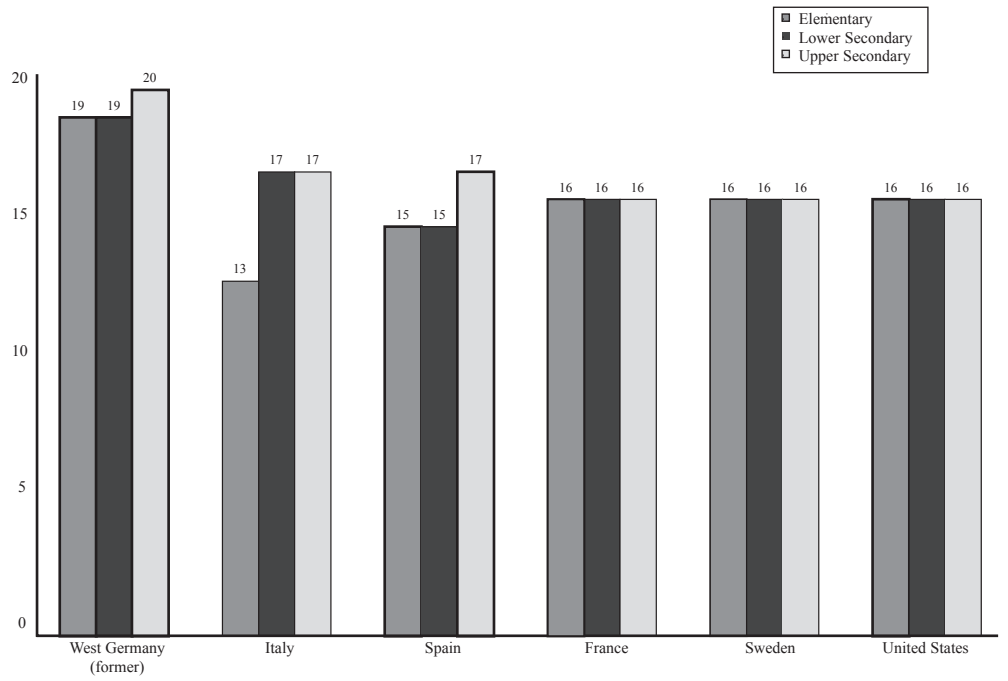
Effective teachers form the basis of effective educational systems, since they strongly influence the quality of instruction offered in the classroom. Teacher effectiveness is determined by many factors, but is certainly influenced by teacher training and professional development. Among the countries described in this chapter, the number of years of schooling required to become a teacher does not vary greatly: to become a teacher in most of the countries studied, teacher candidates spend between 15 and 17 years in school. Although figure 2.5 displays data for public school teachers only, the required duration of teacher education is similar for government-dependent private schools and for independent private schools in all countries. (See appendix A for private school data.)

In Germany, teacher candidates must study for the longest number of years—19 for elementary and lower secondary school teachers, and 20 for upper secondary school teachers.[2] Thus, German teachers complete several more years of study than those in Italy, Spain, France, Sweden, and the United States. German teachers complete 13 years of elementary and secondary school, followed by about six years of postsecondary education, after which they receive a degree

[1] Another study of poverty was conducted in 1993 by Eurostat. This study included only four of the G-7 countries, but the findings for these four were similar to those listed here. The United Kingdom showed the highest proportion of children living in poor households (32 percent), where poor is defined as less than 50 percent of the average household income for the country. France showed one of the lowest rates of children living in poverty, at 12 percent.

[2] In the United States, elementary is the equivalent of grades 1-6, lower secondary is grades 7-9, and upper secondary is grades 10-12.

figure **2.5** | **Total number of years of education required for public school teachers, by level of education, 1992**



NOTE | Data are unavailable for Australia, Canada, Japan, Korea, Switzerland, and the United Kingdom.

SOURCE | Organization for Economic Cooperation and *Developement, Education at a Glance: OECD Indicators*, 1996.

equivalent to a U.S. master's degree (U.S. Department of Education, NCES, 1996c). Aside from Germany, there is little variation among most countries depicted in figure 2.5 in the number of required years of education for the teaching profession; therefore, regardless of the country in which they live, most children are being taught by teachers with roughly the same amount of education. Consequently, differences in educational outcomes across countries probably should be attributed to differences in other variables, such as the quality of teacher preparation, curricular standards, or teaching methods.

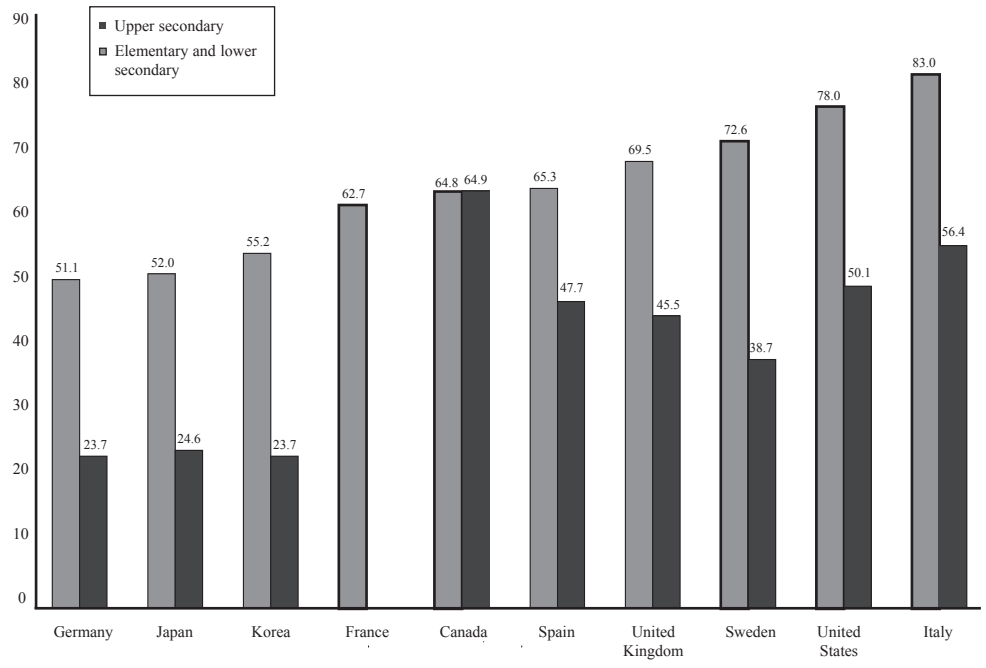
It is difficult to isolate one variable that by itself adequately describes the quality of teacher preparation and professional development across nations. However, the nature of the support provided to teachers during their first few years in the classroom reflects a country's commitment to high-quality teacher preparation. Some countries like Germany maintain an extensive, structured system of teacher support in the form of a two-year mentoring apprenticeship. During these apprenticeships, teachers receive a reduced class schedule, participate in classroom observations and assisted teaching opportunities, and receive continuing professional development. In Japan, new teachers receive intensive mentoring and on-the-job training. In contrast, in the United States, such formal training programs are scarce. In general, U.S. teachers-in-training complete 12 weeks of student teaching, and teacher apprenticeships vary widely across schools and districts in terms of availability, length, and quality (ibid.).

What percentage of teachers are female?

In most nations shown in figure 2.6, the teaching profession is predominantly female, with women representing over 50 percent of all elementary and lower secondary school teachers. At least 70 percent of elementary and lower secondary school teachers are female in Italy (83.0), the United States (78.0), Sweden (72.6), and the United Kingdom (69.5).

The proportional gap between male and female teachers narrows at the upper secondary school level. As illustrated in figure 2.6, about one-quarter of upper secondary school teachers are female in Germany (24), Korea (24), and Japan (25). Between 40 and 50 percent of all upper secondary school teachers in the United Kingdom, Spain, and the United States are female. Canada has the highest proportion of upper secondary school female teachers (64.9) of all the countries depicted in figure 2.6. Germany, Japan, and Korea consistently report having fewer female teachers than their international counterparts at all grade levels.

figure **2.6** | **Percentage of female teachers by level of education, 1994**



NOTE | Data are unavailable at all grade levels for Australia and Switzerland and at the upper secondary level for France.

SOURCE | Organization for Economic Cooperation and Developement, *Education at a Glance: OECD Indicators,* 1996. Table P31.2.

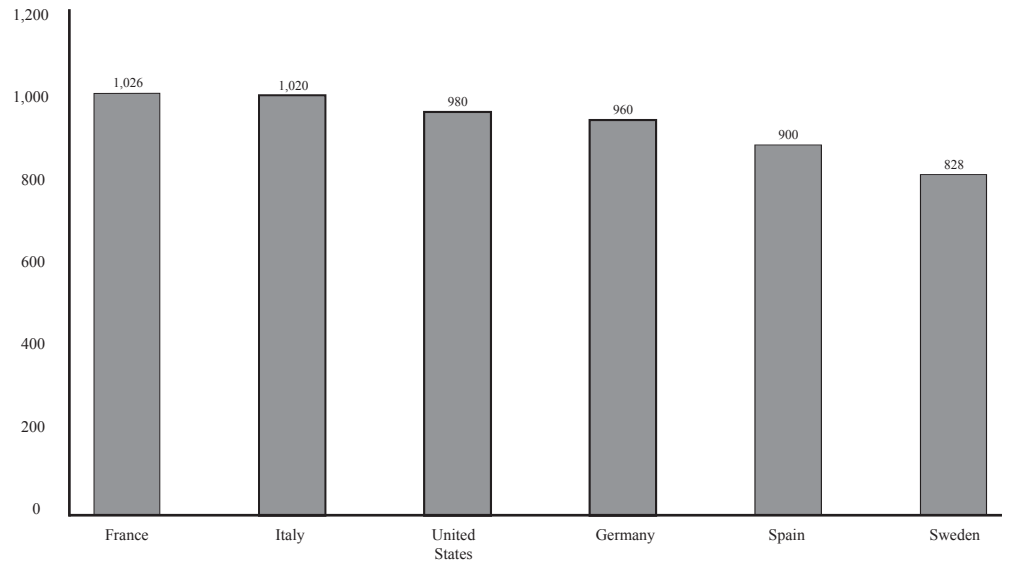
School Environment

In addition to student and teacher characteristics, structural factors contribute to the instructional environment of the classroom. Specifically, variables such as the length of the school day and pupil/teacher ratios affect a child's access to educational opportunities within the classroom. Lengthening the school day or school year and decreasing the pupil/teacher ratio have been proposed repeatedly in the United States as ways to improve student achievement. In general, educators believe that students who spend more time in instructional classes and in classes with lower student/teacher ratios are exposed to greater learning opportunities than other students.

How much time is spent on formal instruction?

Among industrialized nations, the student learning environment differs on a basic level—some children have a longer school day than others. Although the length of the school day does not necessarily reflect the quality of instruction, this indicator does describe students' exposure to educational opportunities in the classroom, and the effective use of instructional time is related to student outcomes. However, it should be noted that the data presented in figure 2.7 represent the number of hours students are exposed to instructional activities in school.
The figures do not include hours spent studying, completing homework, or participating in extracurricular tutoring or additional instruction.

figure **2.7** | **Total intended instruction time for 14-year-old students in hours per year, 1994**



NOTE | Data are unavailable for Australia, Canada, Japan, Korea, Switzerland, and the United Kingdom.
SOURCE | Organization for Economic Cooperation and Developement, *Education at a Glance: OECD Indicators,* 1996.

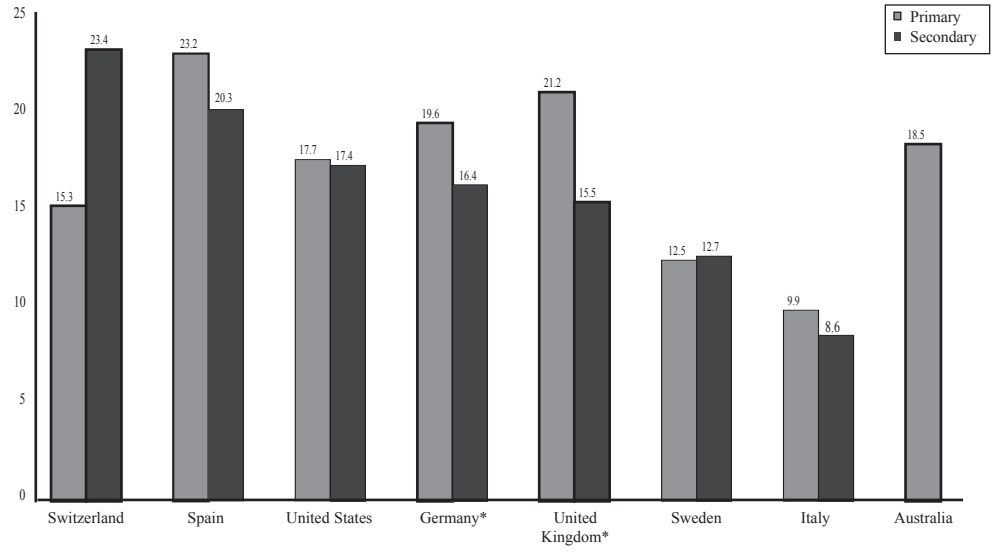
The number of instruction hours per year varied widely across countries. On average, 14-year-olds in 1994 received about 952 hours per year. Students at age 14 received over 1,000 hours of instructional time in France and Italy, and between 900 to 1,000 hours in the United States, Germany, and Spain. Sweden reported the lowest number of total instruction hours per year (828).

The length of the school day and school year also varied across countries. For instance, on average, both France and the United States had relatively long school days (6.2 and 5.6 hours respectively), and relatively short school years (174 and 178 days respectively in 1994). Students in Germany spent less time in school each day, but had an extended school year consisting of 219 days (see appendix table 2.10).

How do student/teacher ratios vary among countries?

The quantity of intended instructional time does not necessarily indicate that instruction is of higher quality. Therefore, a related measure that should be considered when examining the quantity of teacher-student contact is student/teacher ratios, which can reflect a student's access to teachers, and thus instructional opportunities. Student/teacher ratios have serious financial implications that will be discussed in chapter 3. Beyond that, however, these ratios indicate the kind of instructional burden and responsibility that teachers carry in various nations, even though the ratios are not directly related to class size.[3]

figure **2.8** | **Student/teacher ratios in elementary and secondary schools, 1994**



NOTE Country statistics appear in descending order based on secondary data. The indicator illustrated is a ratio determined by dividing the number of students enrolled at a given level of education by the number of teachers at that level. Data are unavailable at both levels for Canada, France, Japan, and Korea and at the secondary level for Australia.

SOURCE Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, unpublished tables, 1996.

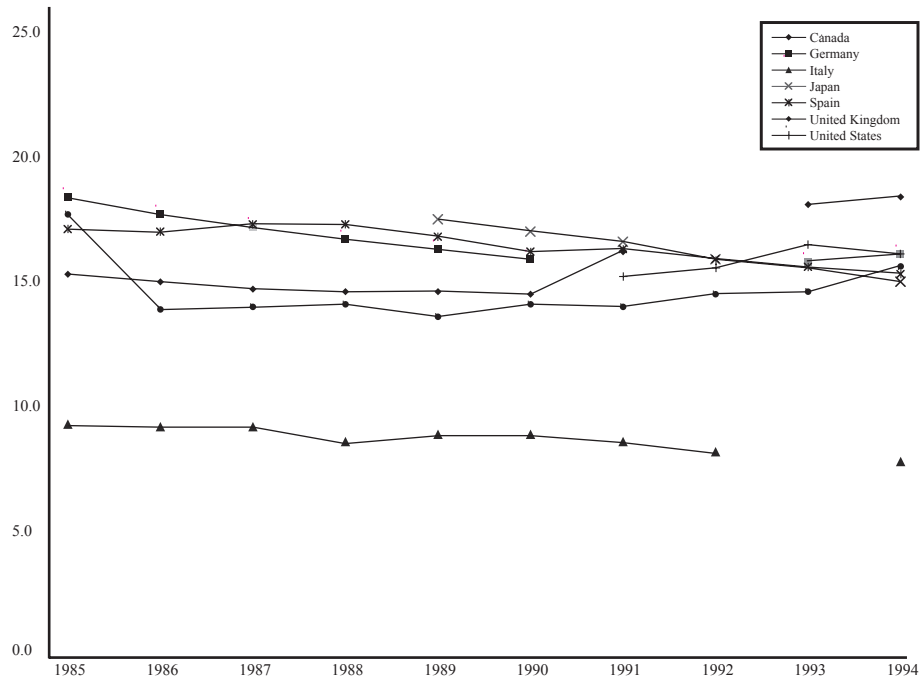
[3]The student/teacher ratio is calculated as student enrollment at a given time divided by the number of full-time-equivalent classroom teachers working at this time. Class size is defined as the number of students a teacher faces during a period of instruction. The differences between these two variables can be explained by the number of classes each teacher teaches and the number of classes each student takes.

In most countries listed in figure 2.8, student/teacher ratios were higher in elementary than in upper secondary school, indicating that students generally have greater access to teachers as the students get older. The most notable exception to this rule is Switzerland, where there are about 15 students to every teacher in elementary schools and about 23 in secondary schools.

The range of student/teacher ratios in various countries was wide at both the elementary and secondary level. At the elementary level, Italy had the lowest student/teacher ratio (9.9) while Spain had the highest (23.2). At the secondary level, Italy again had the lowest (8.6) and Switzerland the highest (23.4). The United States had a medium level student/teacher ratio at both the elementary and secondary level as compared to other industrialized nations.

In almost every country, student/teacher ratios have remained relatively constant or shown small declines from 1985 through 1994, as seen in figure 2.9. While Spain and Germany consistently showed higher student/teacher ratios, their ratios fell slightly between 1985 and 1994. Japan also showed lower ratios in 1994 than in 1989. Italy maintained the lowest ratios over the 10-year time span.

figure **2.9** | **Student/teacher ratio in secondary education, 1985 to 1994**



NOTE | Data are unavailable for Australia, France, Korea, Sweden, and Switzerland. A different data source was used for this figure compared to figure 2.8, which explains why different countries are shown in the two figures.

SOURCE | Organization for Economic Cooperation and Development (OECD), Education Database.

Conclusion

Among the indicators of student, teacher, and classroom characteristics presented in this chapter, countries differed most in terms of student characteristics. For instance, the proportion of children living in low-income families in the United States greatly exceeds that of other countries. These socioeconomic factors influence the types of difficulties or challenges that students bring to the classroom, and consequently the nature of services a school provides. As numerous research studies have indicated, poverty greatly increases children's risk of school failure. The high proportions of students living in low-income families in the United States require schools to fund and provide programs to serve at-risk students. Consequently, urban U.S. schools with high enrollments of poor children are under significant strain. The United States is lower than most other G-7 countries in terms of the percentage of children who usually speak a different language at home than the one spoken at school; however, there are states within the United States where sizable and growing percentages of students have difficulty speaking English.

On the other hand, the data also indicate that teachers form a fairly homogenous group in most industrialized nations. Students in the United States are more frequently taught by female teachers who have about the same amount of schooling as their G-7 classmates, although students in Germany, Japan and Korea are somewhat more likely to be taught by male teachers. The one difference that stands out is the less developed mentoring and training system for new teachers in the United States compared to Germany and Japan.

In terms of classroom structure, on average, students in the United States, France, and Germany spend roughly the same amount of time in school each year, and schools in the United States fall in the middle range in terms of student/teacher ratios. Schools with large student/teacher ratios, especially those with high enrollments of poor students, may provide less individualized attention from teachers, particularly for those students who may require the most assistance.

These distinctions in student, teacher, and classroom characteristics may have implications for student achievement. Chapter 4 will focus on comparisons between the United States and other nations of performance on international tests of mathematics, science, and reading.

3

Educational Resources and Expenditures

Chapter 3 Educational Resources and Expenditures

Recent years have seen an upsurge of interest in international comparisons of education expenditures, partly as a result of strong economic competition among nations. Nations want to ensure that they invest enough resources in their educational systems to create a workforce that is as well-educated and technologically sophisticated as those of their global competitors. Their first concern, then, is whether or not they are spending an adequate amount of money on education relative to the educational investments made by other nations. They measure this relative investment in education by looking at how countries differ with respect to aggregate investment in education, spending per student at each level of the education system, and sources and uses of education funds.

In addition, nations want to ensure that their educational resources are spent wisely and have a real impact on educational outcomes; that is, that they get enough "bang" for their educational "buck." Public officials, the media, and educational researchers thus ask whether more money is needed to produce better student achievement or whether school quality can be improved through the better use of existing resources. In the United States, debate has raged over the extent to which education expenditures are related to educational outcomes. In general, the public believes that money is linked to educational outcomes, although research linking school expenditures to student outcomes is mixed (Hanushek, 1994 and Hedges, Laine, and Greenwald, 1994). Regardless of academic findings, however, legislatures, government officials, and parents hotly debate school budgets.

This debate aside, educational researchers have been working hard in recent years to establish firm methodologies for improving comparisons of national investments in education across countries. At first glance this process seems simple and straightforward. However, compiling accurate and comparable data on international education expenditures turns out to be a complicated task, because of a variety of comparability problems. A number of problems affecting the comparability of expenditures for elementary and secondary education were identified in a recent study for NCES (Barro, 1997; Sherman, 1997). These include:

- **Differences in the boundaries of elementary and secondary education**—In several countries, including the United States, Canada, and Australia, elementary and secondary education generally includes school classes from kindergarten through grade 12. However, "elementary" education in most other developed countries generally begins at grade 1—the first year of compulsory education. At the other end of the spectrum, countries such as Australia and the United Kingdom have institutions that span the boundary between upper secondary education and postsecondary education. And countries such as Germany offer students who have completed their secondary education the opportunity to take other secondary programs of study in their secondary institutions. These differences across countries must be taken into account when comparisons of expenditures for elementary and secondary education are made internationally.

- **Differences in functions or activities that are included in elementary and secondary education**—Countries differ considerably in the functions or activities that are provided through their education systems. In some countries such as the United States, transportation and pupil support services (e.g., counseling, health services, etc.) are provided through school systems; in others, such services may be provided by other national ministries or by local governments. Similarly, in some countries contributions to retirement systems or expenditures for other fringe benefits are made by school systems and are included in countries' education expenditures; in other countries, this is not the case. Again, these differences need to be recognized when comparing education expenditures across countries.

- **Differences in the treatment of private expenditures for education**—Private funding and provision of education represent important dimensions of elementary and secondary education in some countries, but less important dimensions in others. In countries such as the United States, private schools serve about 12 percent of the nation's elementary and secondary school children; in countries such as Australia the proportion is even higher, and in others such as Sweden it is quite small. And in countries like Germany, private firms provide substantial funding for upper secondary education in the form of apprenticeship training.

Comparability problems can potentially lead to erroneous conclusions about how much money countries spend on education. Countries that do not include expenditures for retirement or other fringe benefits because these expenditures are made by the Ministry of Finance or other government agencies may appear to spend less money on education than countries which include these expenditures in figures reported to international agencies. Similarly, countries that do not include expenditures for building maintenance, because these are paid by municipal governments rather than school authorities, may also under-report expenditures on education.

While the expenditure comparability study referred to above did observe numerous differences in countries' reporting of education expenditures to international agencies, it also concluded that these expenditures are generally adequate to make informed judgements about total spending on education for education and most other countries. The study found that the strongest comparisons can be made of public expenditures per student and of public and private expenditures per student and that reasonable comparisons can be made of public expenditures relative to gross domestic product (GDP). On the other hand, comparisons of public and private expenditures relative to GDP were found to be more problematic.

How much does the United States spend on education compared to other major industrialized countries?

These conclusions about the comparability of expenditure data for elementary and secondary education allow U.S. policymakers to assess how much the United States spends compared to other countries. There has never been much question that the United States invests heavily in postsecondary education and that our overall spending for all levels of education combined is quite high by world standards. However, there has not been agreement about whether the United States spends more or less than other leading industrialized countries for elementary and secondary education. Definitive answers depend, however, on the specific measures used to make international comparisons of education spending.

The first key indicator of countries' investment in education is expenditures relative to GDP, defined as education expenditures divided by GDP, where both expenditures and GDP are expressed in each country's national currency. This indicator is often used as a measure of a country's "fiscal effort" in support of education, or, put differently, as a country's financial commitment to education relative to other functions and activities.

The second major indicator used in international comparisons is education expenditures per student. This indicator is a measure of the quantity of resources that a country devotes annually, on average, to each student's education. The indicator is calculated by dividing total expenditures for education in the national currency by the number of full-time-equivalent (FTE) students enrolled at that education level. The result is then converted to U.S. dollars by dividing expenditures by the purchasing power parity (PPP) index between that country's currency and the U.S. dollar.

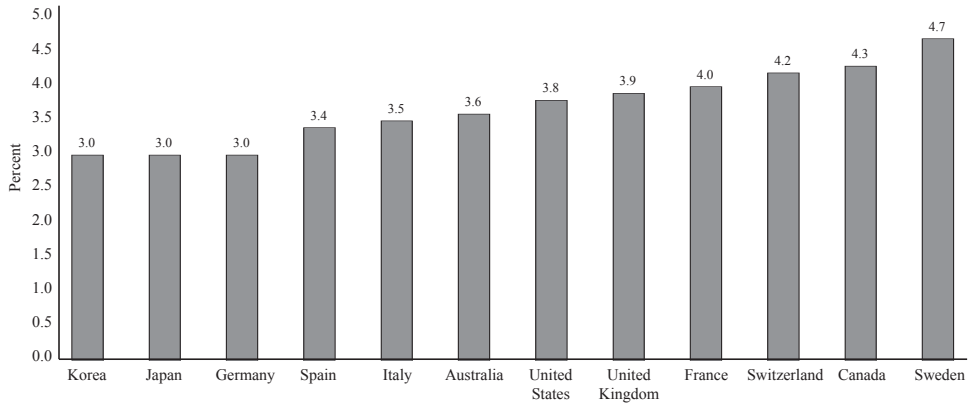
Expenditures Relative to GDP

Public expenditures for elementary and secondary education averaged about 3.6 percent of GDP in the G-7 countries in 1993 and about 3.7 percent of GDP in our sample of 12 countries. However, as seen in figure 3.1, countries' spending ranged from a high of 4.7 percent of GDP in Sweden to 3.0 percent in Germany, Japan, and Korea.

The addition of expenditures from private sources brought the G-7 average to 3.9 percent of GDP and the overall country mean to 4.0 percent.[1] However, Sweden continued to have the highest expenditures on education as a share of GDP at 4.7 percent and Japan's spending remained near the bottom at 3.2 percent, as shown in figure 3.2.

Overall, the United States fell in the middle range in terms of public expenditures for elementary and secondary education as a percentage of GDP, with a rank of fourth among the G-7 countries and sixth in the group of 12 countries analyzed. With 3.8 percent of GDP spent

figure **3.1** | **Public expenditures for elementary and secondary education as a percentage of GDP, 1993**

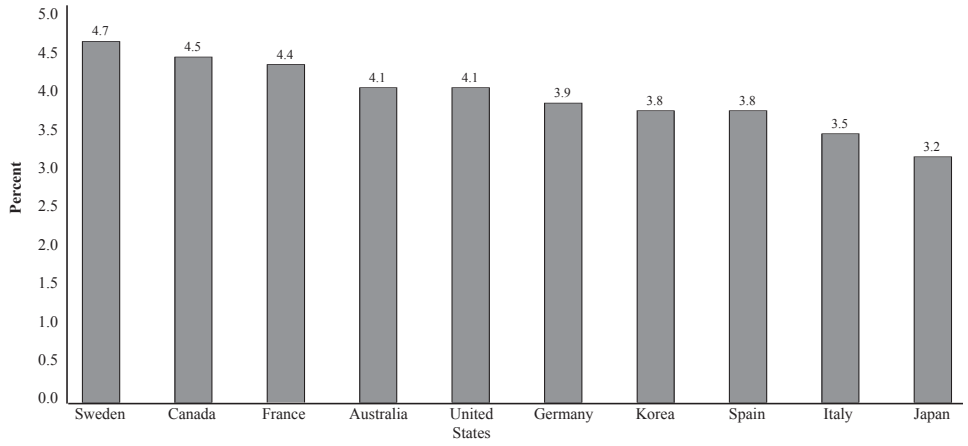


SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

[1]The overall country mean excludes expenditures from public and private sources for Switzerland and the United Kingdom, and the G-7 mean excludes the United Kingdom.

from public funds on elementary and secondary education, the United States ranked below Sweden, Canada, Switzerland, France, and the United Kingdom, and above Australia, Italy, Spain, Germany, Japan, and Korea.

figure **3.2** | **Public and private expenditures for elementary and secondary education as a percentage of GDP, 1993**



NOTE | Data are unavailable for Switzerland and the United Kingdom.

SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

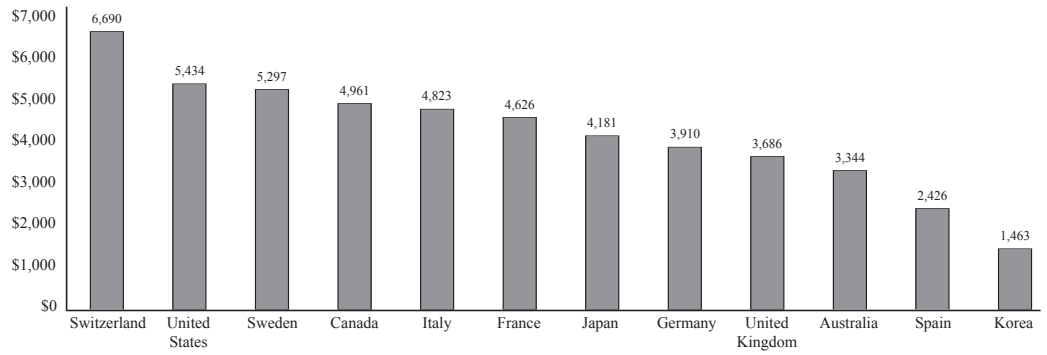
Expenditures Per Student

Public expenditures per pupil averaged about $4,500 in 1993 in the G-7 countries and about $4,200 per pupil in the 12-country group. Among G-7 countries, expenditures per pupil ranged from about $5,400 in the United States to about $3,700 in the United Kingdom. As figure 3.3 shows, the range in per-pupil expenditures among the 12 countries was much wider—from about $6,700 in Switzerland to about $1,500 in Korea.

In contrast with expenditures relative to GDP, where the United States ranked in the middle of the distribution, the United States ranked much higher on expenditures per pupil. With expenditures of about $5,400 per pupil, the United States ranked first among G-7 countries and second, behind only Switzerland, in the 12-country group. Expenditures per pupil in the United States were about 20 percent higher than the G-7 average ($4,516) and nearly 30 percent higher than the 12-country average ($4,237). The inclusion of expenditures from private sources produced similar results.

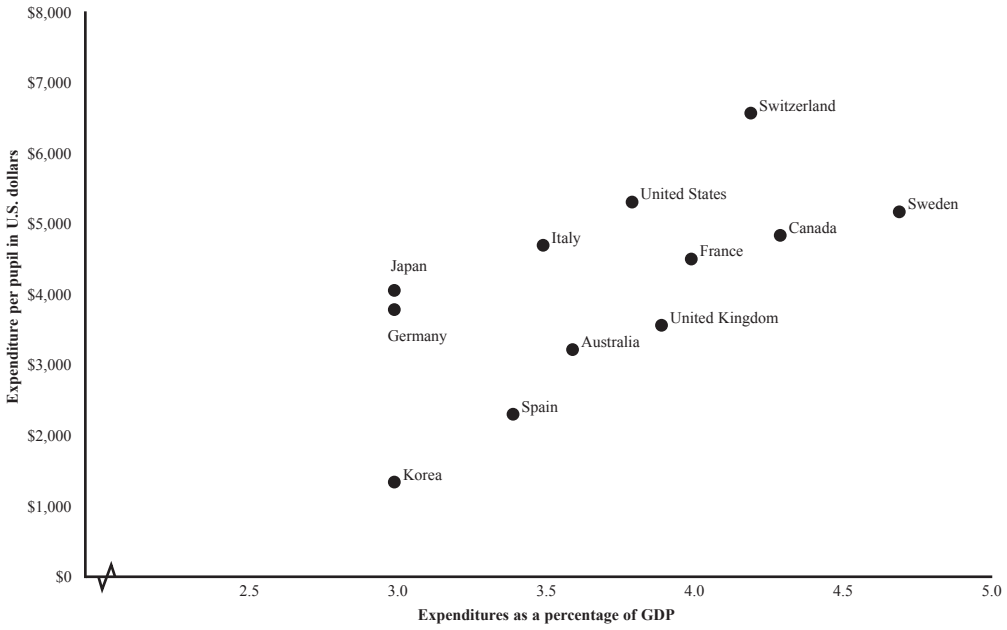
Figure 3.4 demonstrates that in general, there was a positive relationship between countries' expenditures relative to GDP and their level of spending per pupil for elementary and secondary education. Among G-7 countries, Canada ranked high on both measures in 1993, while Germany and Japan were near the bottom of the distribution on them. The United States, in contrast, ranked first in expenditures per pupil, but was in the middle of the rankings in expenditures as a percentage of GDP.

figure 3.3 Public expenditures per pupil for elementary and secondary education, 1993



NOTE Countries' monetary units were converted to U.S. dollars using the PPP index.
SOURCE Organization for Economic Cooperation and Development, Unpublished data, 1997.

figure 3.4 Relationship between public expenditures for elementary and secondary education as a percentage of GDP and public expenditures per pupil, 1993



NOTE Countries' monetary units were converted to U.S. dollars using the PPP index.
SOURCE Organization for Economic Cooperation and Development, Unpublished data, 1997.

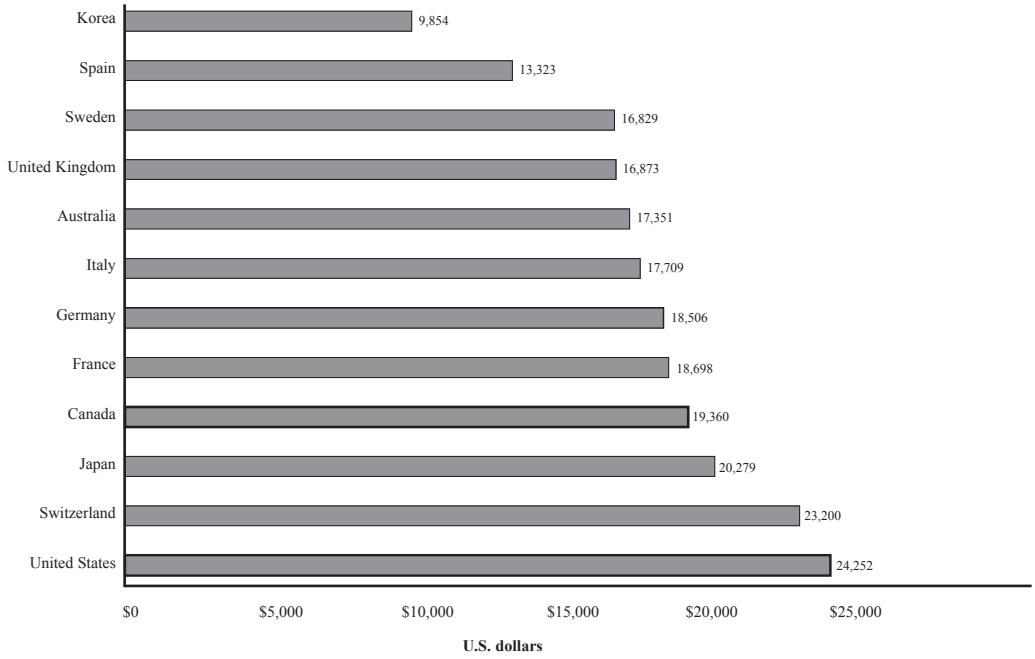
In Sweden and Switzerland, public expenditures as a percentage of GDP and public expenditures per pupil were both relatively high, compared with the other countries analyzed. France ranked near the middle of the distribution on both of these measures, while Spain and Korea fell near the bottom of the group on both expenditures per pupil and expenditures relative to GDP. In contrast, Japan's expenditures per pupil were in the middle of the distribution, but expenditures as a percentage of GDP were relatively low, compared with other countries selected.

How do expenditures for elementary and secondary education relate to countries' capacity to support education?

A long-standing concern in school finance has been the association between the ability to pay for education and education resources. Historically, in the United States, wealthier states and school districts have spent more on elementary and secondary education than their poorer counterparts, largely because of their strong tax bases.

Countries vary substantially in their fiscal capacity to support education, as measured by GDP per capita. In 1993, GDP per capita in the G-7 countries averaged about $19,400, with a range from about $24,300 in the United States to around $16,900 in the United Kingdom. The 12-country average was somewhat lower (about $18,000) and the range considerably wider—from the United States at one end to Korea at the other end of the distribution, as seen in figure 3.5.

figure **3.5** | **Gross domestic product per capita, 1993**



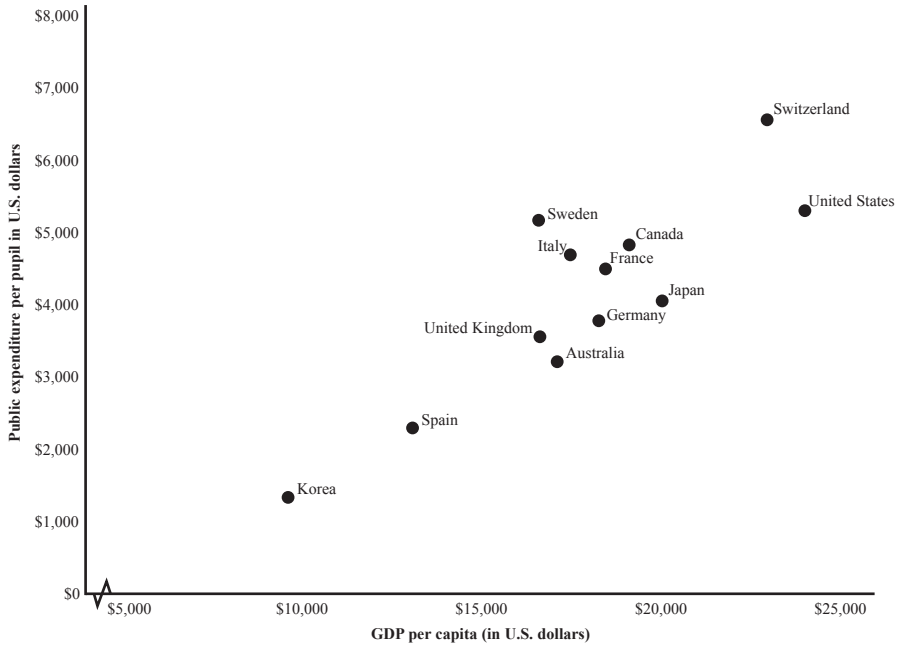
SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

Overall, there was some tendency for wealthier countries to spend more per pupil for elementary and secondary education. Among the G-7 countries, the United States ranked first in 1993 on both GDP per capita and public expenditures per pupil for elementary and secondary education. France ranked fourth, and the United Kingdom ranked seventh on both measures; Canada and Germany also had relatively similar rankings on both measures. Italy showed a relatively lower GDP per capita compared to its per-pupil expenditure. However, table 3.5 in appendix A shows that Italy has a relatively small school-age population compared to the other G-7 countries. Thus, it makes sense that Italy could have a relatively low GDP per capita and a relatively high expenditure per pupil.

The correlation between GDP per capita and public expenditure per pupil for all 12 countries is shown in figure 3.6. The United States and Switzerland had high values on both measures, Canada and France were in the middle of both distributions, while Spain and Korea were at the low end of these two distributions. Sweden, like Italy, reported a relatively low GDP per capita and a relatively high per-pupil expenditure.

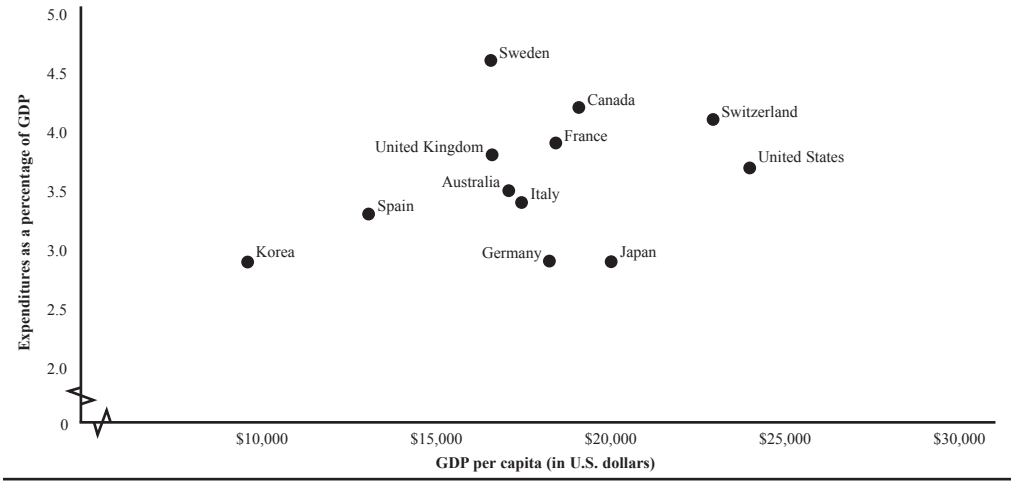
In contrast, there tended to be very little relationship between GDP per capita and education expenditures as a percentage of GDP. Wealthier countries did not consistently spend a higher proportion of GDP on elementary and secondary education than did poorer countries, as shown in figure 3.7. This lack of relationship is best illustrated by three countries—the United States, Sweden, and Japan. In 1993, the United States had the highest GDP per capita of the 12 countries, but ranked sixth in expenditures as a percentage of GDP. Similarly, Japan ranked third on GDP per capita, but was tied with Germany and Korea with the lowest public expenditures

figure **3.6** | **Relationship between gross domestic product per capita and public expenditures per pupil for elementary and secondary education, 1993**



NOTE | Countries' monetary units were converted to U.S. dollars using the PPP index.
SOURCE | Organization for Economic Cooperation and Development, Unpublished data, 1997.

figure **3.7** | **Relationship between GDP per capita and public expenditures for elementary and secondary education as a percentage of GDP, 1993**



NOTE | Countries' monetary units were converted to U.S. dollars using the PPP index.
SOURCE | Organization for Economic Cooperation and Development, Unpublished data, 1997.

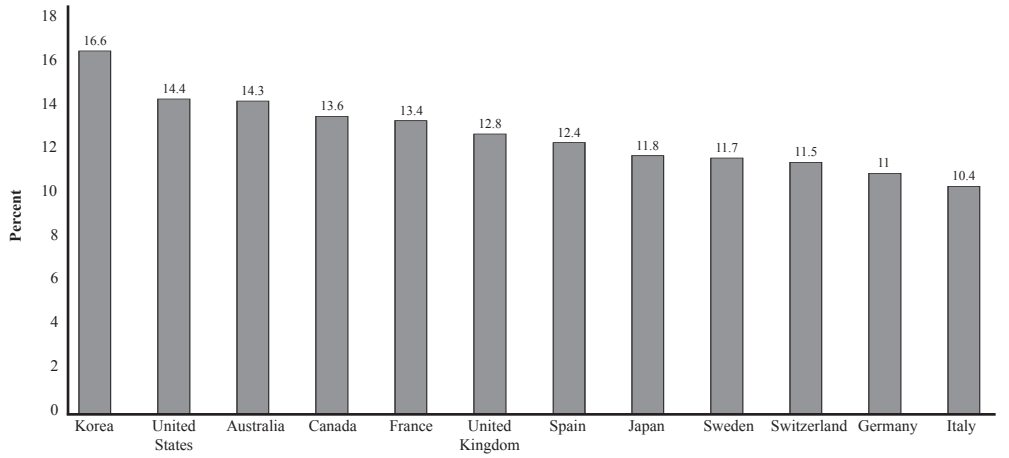
for elementary and secondary education as a percentage of GDP. Sweden, on the other hand, ranked tenth in GDP per capita, but led the 12 countries in expenditures as a share of GDP.

Do countries with large school-age populations spend more on elementary and secondary education than countries with smaller school-age populations?

Countries with large proportions of school-age children might be expected to spend more on elementary and secondary education than countries with relatively small school-age cohorts for a number of reasons. First, a large school-age cohort may create a strong political constituency in favor of higher educational expenditures (i.e., parents of these children). Relatively large expenditures will be needed to maintain per-student funding. Even allowing for higher overall expenditures, a large school-age cohort could result in lower expenditures per pupil, especially if a country lacks the financial resources to support a large student population.
The education system in most OECD countries begins with elementary education at age 5 or 6 and continues through secondary education for a period of 12 to 13 years. The school-age cohort would therefore typically consist of children between the ages of 5 and 17 or 18. As OECD data were not available for enrollment of this age group, the 5-14 age group was used as a proxy for the school-age population.

Among G-7 countries, children aged 5 to 14 comprised, on average, about 12.5 percent of the total population in 1993. As depicted in figure 3.8, the cohort ranged in size from 14.4 percent in the United States to 10.4 percent in Italy. In the wider group of 12 countries, the average size of the cohort was slightly higher (12.8 percent); the cohort was largest in Korea (16.6 percent) and smallest again in Italy.

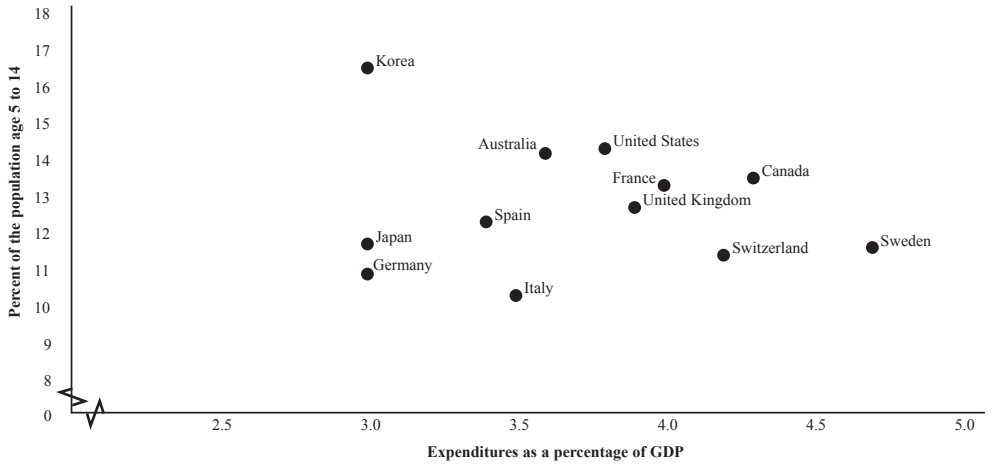
figure **3.8** | **Population age 5 to 14 as a percentage of total population, 1993**



SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

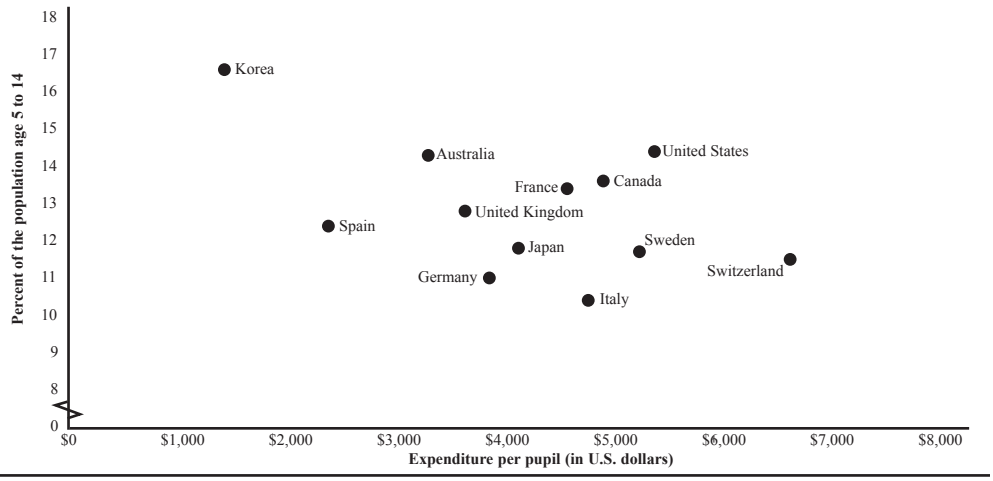
In G-7 countries there does not appear to be a relationship between either the relative size of the school-age population and expenditures per student or the size of the school-age population and expenditures as a percentage to GDP. Although it appears in figure 3.9 that among the 12 countries, the size of the school-age population has a slight negative relationship with expenditures for elementary and secondary education, this association was not statistically significant. Figure 3.10 shows some evidence of a slight negative relationship between the size of the school-age population and per-pupil expenditures.

figure **3.9** | **Relationship between population age 5 to 14 and public expenditures as a percentage of GDP for elementary and secondary education, 1993**



SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

figure **3.10** | **Relationship between the percentage of the population age 5 to 14 and public expenditures per pupil for elementary and secondary education, 1993**



NOTE | Countries' monetary units were converted to U.S. dollars using the PPP index.

SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators,* 1996.

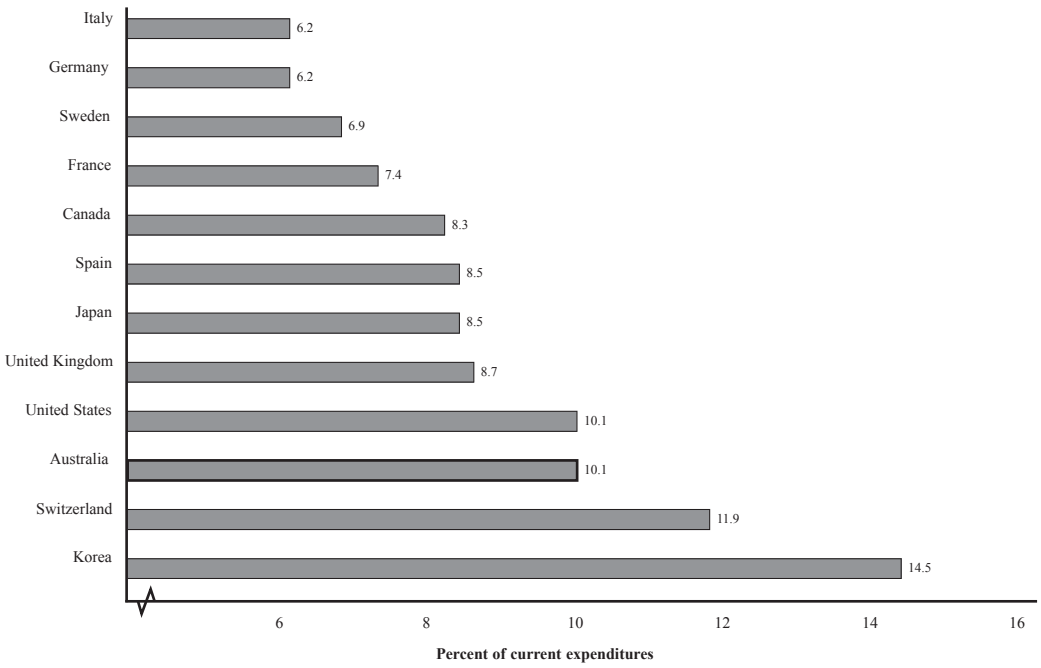
How does the United States compare with other countries in the proportion of total public expenditures spent on elementary and secondary education?

At all government levels in industrialized countries, there is strong competition for public funds to support a broad range of programs and services. The proportion of public funds spent on elementary and secondary education therefore provides some measure of the importance a country attaches to education, compared with other goods and services. It must be recognized, of course, that variations in public expenditures for education as a proportion of total public expenditures may reflect differences in the way countries finance education and the relative size of the public sector. However, the measure still provides a useful perspective on the value a country places on education, relative to the competing demands of other functions such as health, social security, and transportation and the level of spending for defense and national security. The analysis that follows examines this issue by exploring public expenditures for elementary and secondary education as a proportion of total public expenditures.

In 1993, expenditures for elementary and secondary education averaged about 7.9 percent of total public expenditures in the G-7 countries. The United States devoted the highest share of public expenditures to elementary and secondary education at 10.1 percent, while Italy and Germany spent the lowest share at 6.2 percent. The share averaged about 8.9 percent for the broader group of 12 countries shown in figure 3.11, and the range was considerably wider—from 14.5 percent in Korea to 6.2 percent in Italy and Germany.

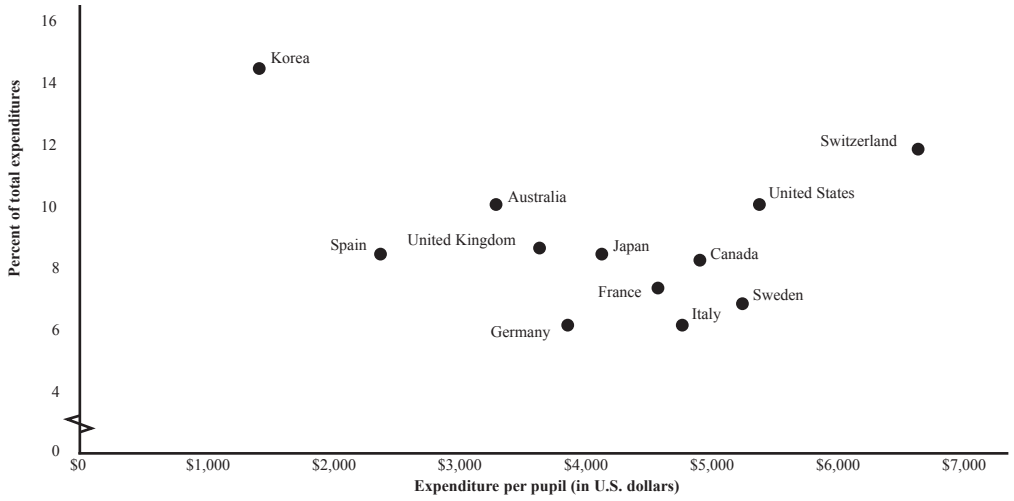
The share of public expenditures spent on elementary and secondary education was not associated with expenditures per pupil or with expenditures as a percentage of GDP either in the G-7 countries or in the group of 12 countries. This lack of relationship is seen in the relatively random distribution of countries in figures 3.12 and 3.13.

figure 3.11 Public expenditures for elementary and secondary education as a percentage of total public expenditures, 1993



SOURCE Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

figure 3.12 Relationship between public expenditures for elementary and secondary education as a percentage of total public expenditures and public expenditures per pupil, 1993

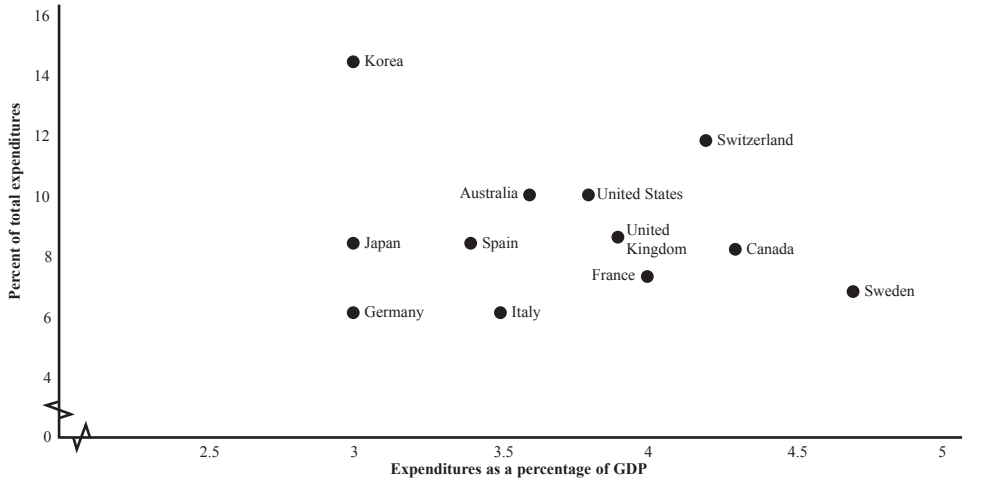


NOTE Countries' monetary units were converted to U.S. dollars using the PPP index.

SOURCE Organization for Economic Cooperation and Development, Unpublished data, 1997.

The lack of relationship between the share of public expenditures spent on elementary and secondary education and the other two measures of investment in education is best exemplified in the 12 countries by Korea and Sweden. Korea, on the one hand, spent the highest share of public expenditures on elementary and secondary education, but had the lowest expenditures per pupil and was tied with Germany and Japan for the lowest expenditure as a percentage of GDP. Sweden, on the other hand, spent a relatively low share of public expenditures on elementary and secondary education, but spent the highest share of GDP on education and reported the third highest expenditures per pupil of the 12 countries analyzed.

figure **3.13** **Relationship between public expenditures for elementary and secondary education as a percentage of total public expenditures and public expenditures as a percentage of GDP, 1993**



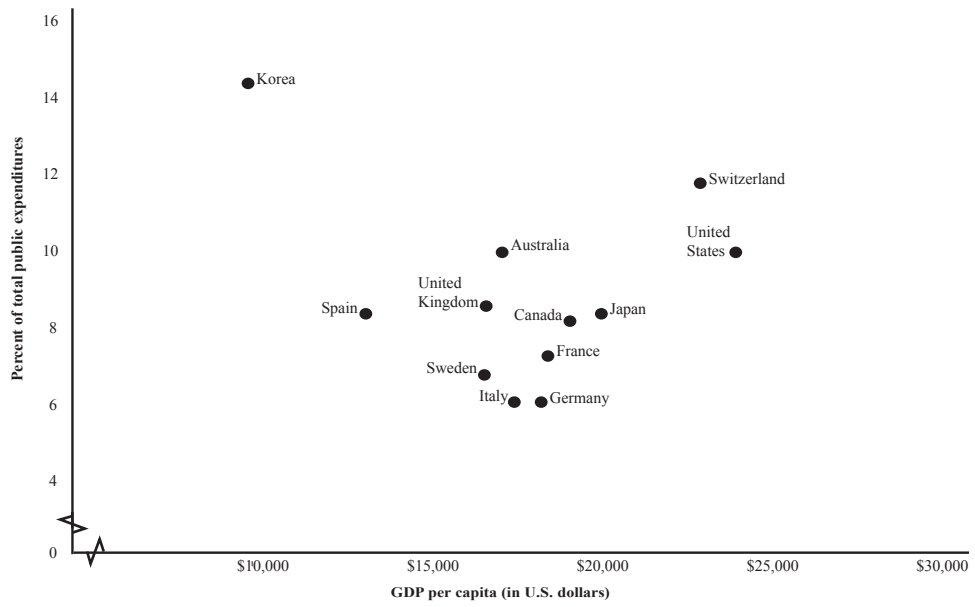
SOURCE Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

What factors may explain the share of public expenditures countries spend on elementary and secondary education?

Among G-7 countries, the share of public expenditures spent on elementary and secondary education shows some evidence of a positive association with a country's wealth, as measured by GDP per capita, but seems to be more strongly related to the size of its school-age population. The United States reported the highest value of the G-7 countries on all three measures while Germany and Italy had very low values on these three measures (see figure 3.14 and 3.15).

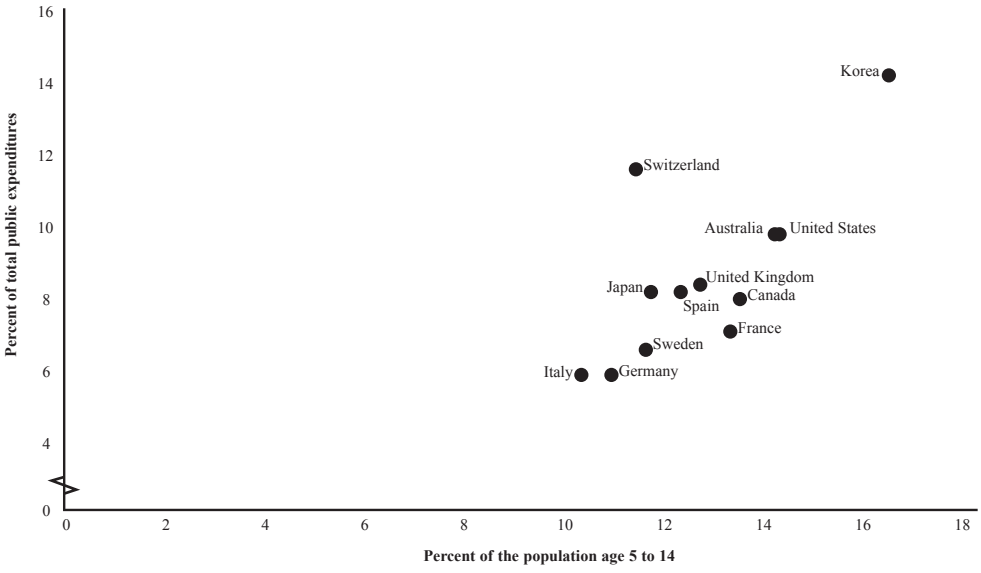
For the 12-country group, however, the share of public expenditures spent on elementary and secondary education is positively associated with the size of the school-age population (figure 3.15), but not with GDP per capita (figure 3.14). Korea's values on these measures highlight the point. In 1993, Korea devoted the highest share of public expenditures to elementary and secondary education of the 12 countries and also had the largest school-age cohort proportion. However, GDP per capita in Korea was the lowest of the 12 countries.

figure **3.14** **Relationship between GDP per capita and public expenditures for primary and secondary education as a percentage of total public expenditures, 1993**



SOURCE Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

figure **3.15** **Relationship between the percentage of the population age 5 to 14 and public expenditures for elementary and secondary education as a percentage of total public expenditures, 1993**



SOURCE Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

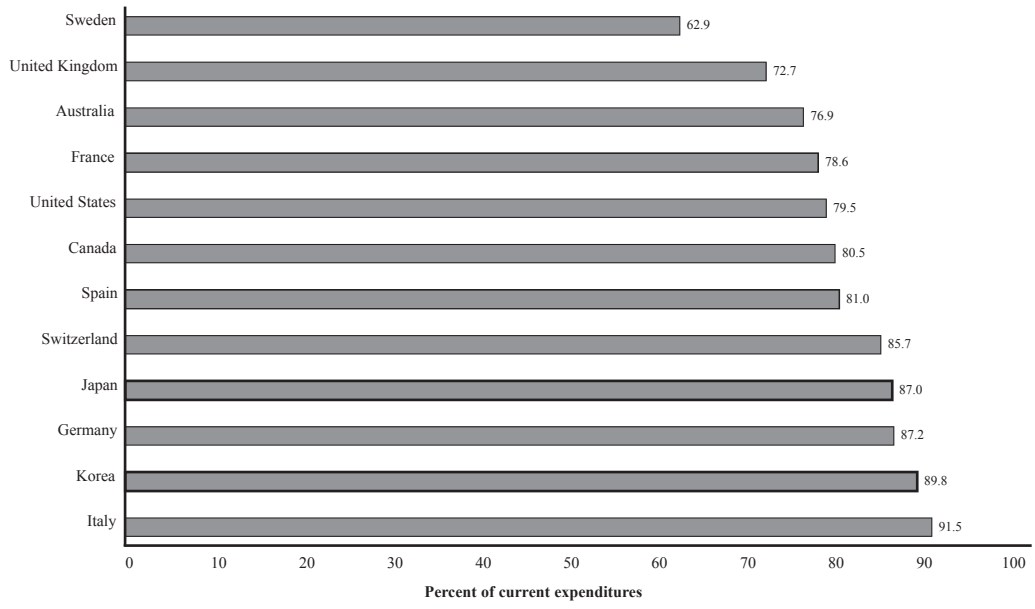
How are education expenditures used in different countries? What do countries purchase with their expenditures for education?

Teachers and other school staff represent the largest component of education expenditures in all countries for which data are available. In 1993, the share of current educational expenditures[2] spent on staff compensation in public and private elementary and secondary schools averaged about 82.4 percent in G-7 countries and about 81.1 percent in the 12-country group. However, the range among countries was fairly large—from 91.5 percent in Italy to 72.7 percent in the United Kingdom and 62.9 percent in Sweden, as seen in figure 3.16. Staff compensation includes both salary and non-salary compensation, such as health care benefits and retirement funds.

The United States fell toward the lower end of the distribution on the percentage of current expenditures spent on staff compensation compared both with other G-7 countries and with the 12-country group. Spending just under 80 percent on staff compensation, the United States ranked below all other G-7 countries except France and the United Kingdom and below 7 of the 11 other countries in the larger group. Only France, Australia, the United Kingdom, and Sweden devoted a smaller percentage of current educational expenditures to staff compensation.

One explanation for the relatively small percentage of expenditures spent on compensation in the United States is that other expenditures include purchased services, some of which involve compensation of staff not directly employed by local schools. One function commonly contracted out in the United States is student transportation. School districts may employ private contractors to take students to and from schools. School building maintenance and food

figure **3.16** | **Expenditures for staff compensation as a percentage of current expenditures in public and private elementary and secondary schools, 1993**



SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

[2] "Current expenditures" is a different measure from "total public expenditures" shown in the previous five graphs. Current expenditures represent educational goods and services whose life span should not, in theory, exceed the current year, such as salaries, supplies, scholarships, minor repairs and maintenance, and administration. Total public expenditures include current expenditures plus capital expenditures, which include buildings, major repairs, major equipment, and vehicles.

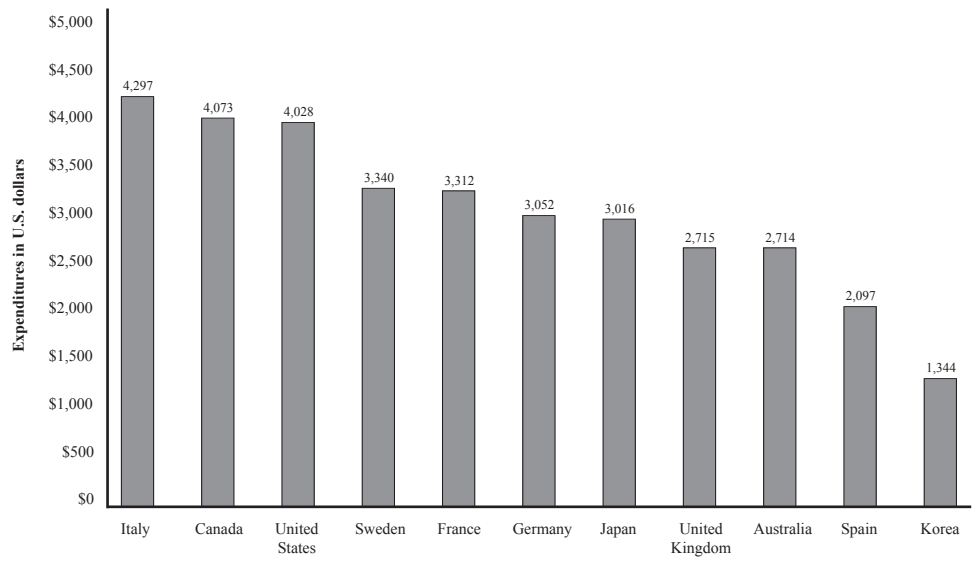
services fall into this area as well; and in some school districts, counseling and other student support services may, on rare occasions, be provided under contract by private companies.

How much do countries spend per pupil on staff compensation?

Expenditures per pupil for staff compensation provide a measure of the amount spent for each student on staff resources. They do not measure individual teacher compensation, since that is a function of staff compensation per pupil, pupil/staff ratios, and the percentage of staff who are teachers.

In 1993, expenditures for staff compensation averaged about $3,500 per pupil in G-7 countries and just under $3,100 per pupil in 11 of the 12 countries for which data were available.[3] The range in G-7 countries extended from about $4,300 in Italy to about $2,700 in the United Kingdom; among the 11 countries shown in figure 3.17, Italy again led the group and Korea was at the bottom of the distribution, spending about $1,350 per pupil (see figure 3.17).

figure **3.17** | **Expenditures per pupil for staff compensation in public and private elementary and secondary schools, 1993**



NOTE | Data are unavailable for Switzerland.

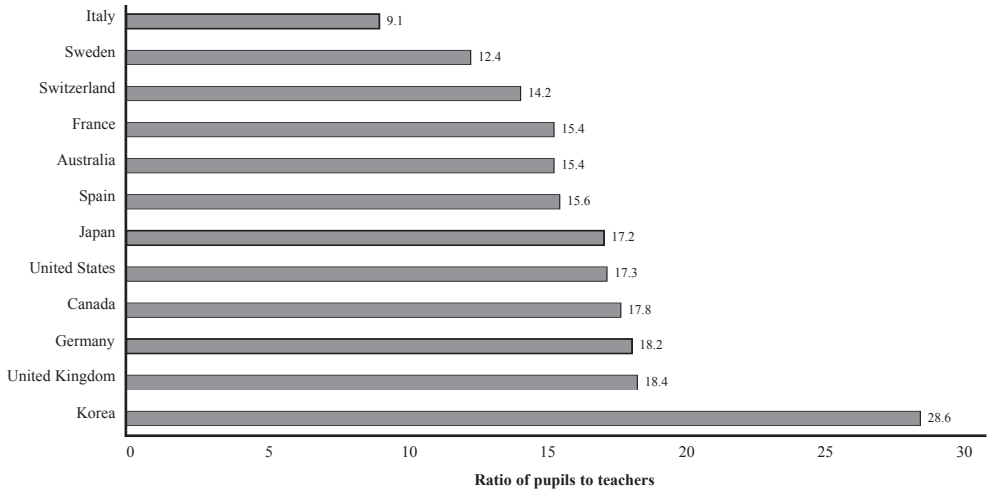
SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators,* 1996.

What intensity of staff resources is provided to children in elementary and secondary schools?

Pupil/teacher ratios are a basic measure of the intensity of services provided to children in schools. While pupil/teacher ratios do not provide a measure of average class size, since they are just ratios and schools employ other teachers outside the classroom to provide services to pupils, they do provide a measure of the access that students have to teachers.[4]

[3]Expenditures for staff compensation include data for all countries except Switzerland.

figure **3.18** | **Pupil/teacher ratios in public elementary and secondary schools, 1994**



SOURCE | Organization for Economic Cooperation and Development, Unpublished data, 1997.

In 1994, pupil/teacher ratios averaged about 16.2 in G-7 countries and about 16.6 in the 12-country group. Countries ranged on this measure from a low of 9.1 in Italy to a high of 28.6 in Korea. However, several countries, including Canada, Germany, Japan, the United Kingdom, and the United States reported pupil/teacher ratios between 17 and 18.5. Italy and Korea were clearly outliers on the distribution of this measure of teacher resources as seen in figure 3.18.

Do countries with higher expenditures per pupil have lower pupil/teacher ratios?

Countries with higher per-pupil expenditures for elementary and secondary education might be expected to provide greater teacher resources for each pupil, as measured by lower pupil/teacher ratios. However, while figure 3.19 shows that there is a negative relationship between per-pupil expenditures and pupil/teacher ratios in public schools, this effect is largely driven by Korea's data. If Korea is removed from the equation, no relationship exists between per-pupil expenditures and pupil/teacher ratios.

How much variation in resources exists across geographical regions within countries?

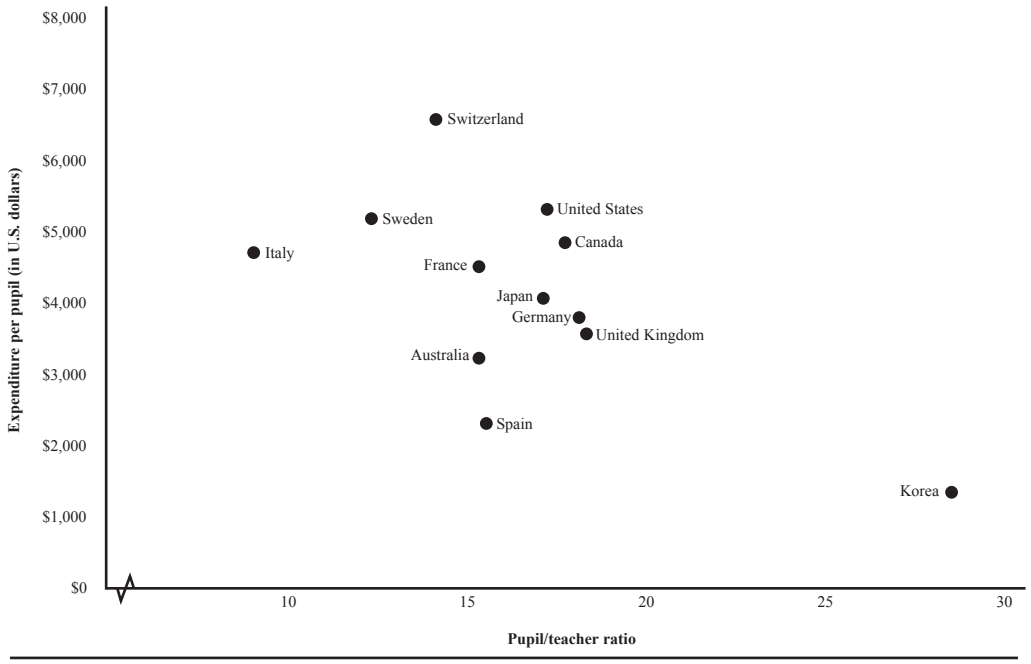
Although national indicators of education resources provide an important perspective on countries' overall commitment to education, they also have their limitations. Most important, national indicators cannot provide information on whether school resources are relatively

[4]The pupil/teacher ratio is also a function of who is counted as a teacher. Only full-time-equivalent teachers are included, but countries vary on whether or not they include head teachers, principals, guidance counselors, or school psychologists in their count. The United States includes only full-time classroom teachers.

uniform within countries, or, put differently, whether resource levels in schools in one geographical region are similar to those in schools in other regions.

The observation of differences in resources across geographical areas within an individual country does not necessarily mean, however, that resources are distributed "inequitably," since

figure **3.19** **Relationship between public expenditures per pupil for elementary and secondary education 1993, and pupil/teacher ratios in public elementary and secondary schools, 1994**



SOURCE Organization for Economic Cooperation and Development, Unpublished data, 1997.

variation in resources may be due to a variety of factors. On the one hand, large variations in resources may be the result of differences in the capacity of local or regional governments to support education and may, in fact, represent real differences in educational opportunities available to children within a country. On the other hand, resource disparities may be an intended effect of government policies that provide additional resources to regions with large concentrations of poor or disadvantaged students to help meet their educational needs. In still other cases, resource disparities among geographical units may simply be an artifact of countries' geographical conditions.

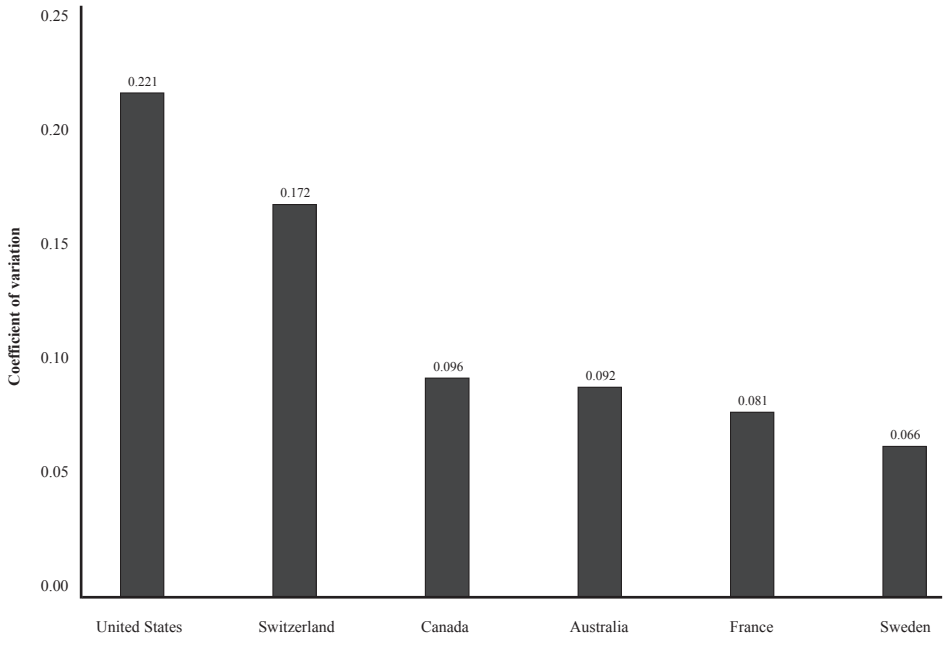
To provide some perspective on the question of geographic variation in educational resources within countries, we draw on developmental work conducted for the OECD on regional resource disparities indicators (Sherman, 1996). As part of this work, indicators of regional disparities were developed for two resource measures: expenditures per pupil and pupil/teacher ratios. The regions used in the indicators were the equivalent of American states in federal countries (i.e., states and territories in Australia, provinces and territories in Canada, Länder in Germany, and cantons in Switzerland) and major administrative units in non-federal countries (régions and académies in France, regioni in Italy, doh in Korea, comunidades autónomos in Spain, and Län in Sweden).

In the six countries for which regional data were available (shown in figure 3.20), the presence of regional variations in expenditures per pupil differed across countries. At one end of the spectrum were France and Sweden, which demonstrated relatively small variation in per-pupil expenditures among regional units. Australia, Canada, and France showed similar levels of variation as Sweden, while Switzerland and the United States showed the largest variation in expenditures per pupil across regions. The statistical measure used for the indicator was the coefficient of variation, a basic statistic that measures the amount of dispersion around the mean in a distribution.[5]

Countries also differed regarding the extent of inter-regional variation in pupil/teacher ratios, although the coefficients of variation for most countries tended to be smaller than those for expenditures per pupil. For the 10 countries for which regional data on pupil/teacher ratios were available (shown in figure 3.21), the variation in pupil/teacher ratios within countries was highest in Switzerland, Korea, and the United States and lowest in France and Sweden. Inter-regional variation of pupil/teacher ratios was in the middle range for Australia, Germany, Canada, Italy, and Spain.

In contrast with expenditures per pupil, there does not appear to be any relationship between either a country's wealth or its level of spending and the level of inter-regional variation in pupil/teacher ratios (figures 3.22 and 3.23). Although Switzerland and the United States, wealthy countries with relatively high expenditures, had high levels of inter-regional variation in pupil/teacher ratios, so did Korea with the lowest values on both GDP per capita and expenditures per pupil. Other factors besides national wealth and a country's average level of

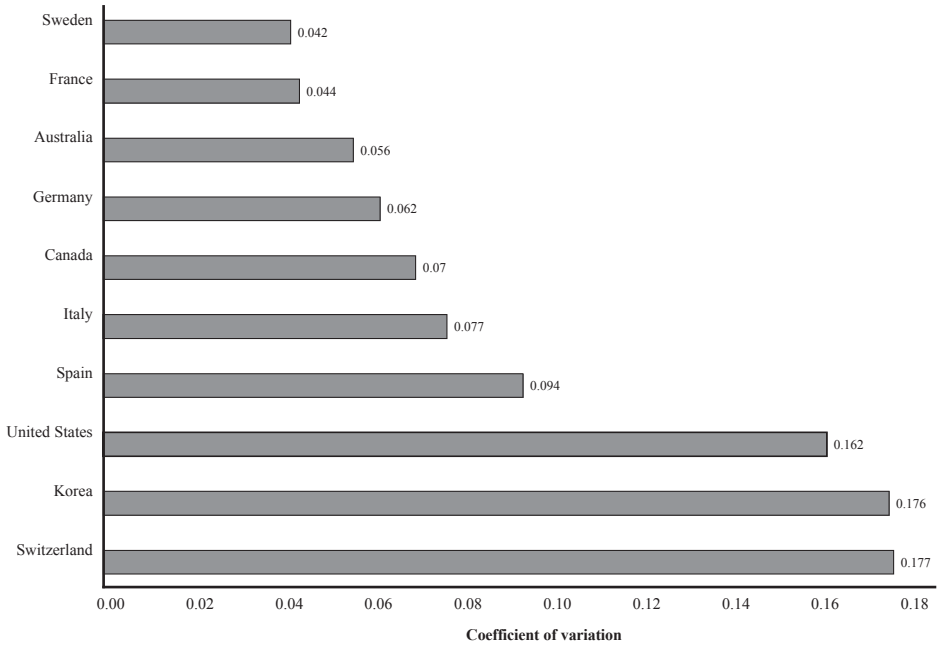
figure **3.20** | **Regional variation in expenditures per pupil for public elementary and secondary schools, 1993**



NOTE | Data are unavailable for Germany, Italy, Japan, Korea, Spain, and the United Kingdom.
SOURCE | Organization for Economic Cooperation and Development, Unpublished data, 1997.

[5]Specifically, the indicator is calculated by dividing the standard deviation by the mean of the distribution; higher coefficients of variation are associated with greater "disparity" in education resources. Regional variation is not directly related to the number of regions, as the number of regions in the countries portrayed in figure 3.20 are as follows: United States–51, Switzerland–26, Canada–12, Australia–8, France–22, and Sweden–24.

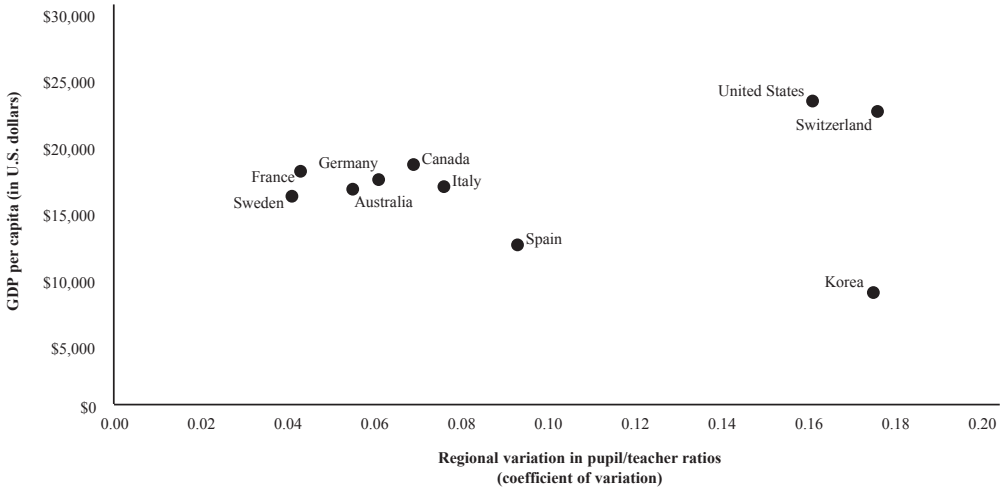
figure 3.21 Regional variation in pupil/teacher ratios in public elementary and secondary schools, 1993



NOTE The number of regions in each country are as follows: Sweden—24, France—22, Australia—8, Germany—16, Canada—12, Italy—20, Spain—18, United States—51, Korea—15, and Switzerland—26. Data are unavailable for Japan and the United Kingdom.

SOURCE Organization for Economic Cooperation and Development, Unpublished data, 1997.

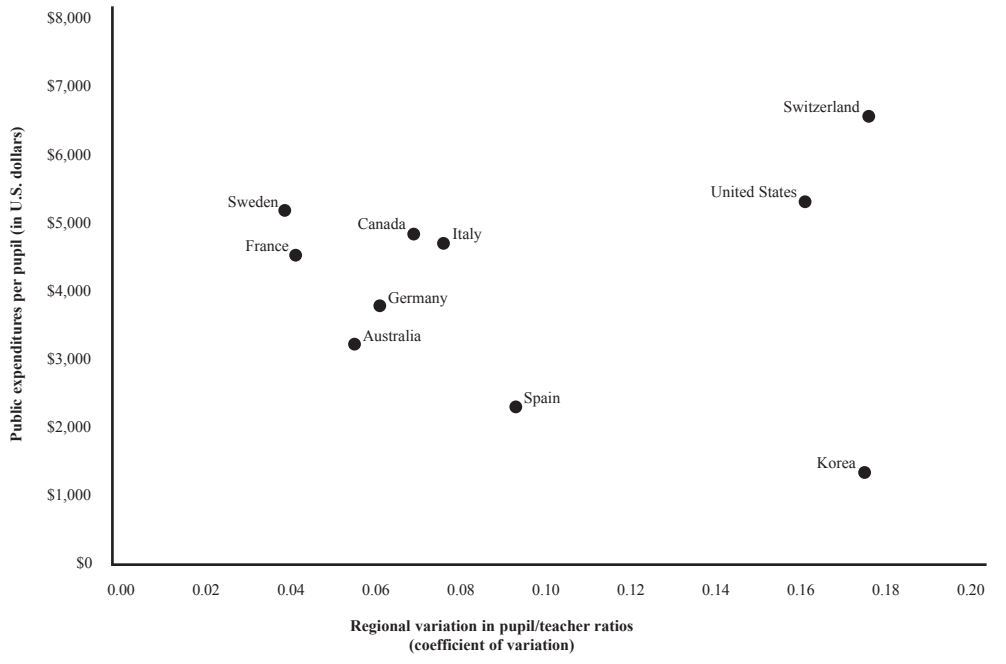
figure 3.22 Relationship between GDP per capita and regional variation in pupil/teacher ratios in public elementary and secondary schools, 1993



NOTE The number of regions in each country are as follows: Sweden—24, France—22, Australia—8, Germany—16, Canada—12, Italy—20, Spain—18, United States—51, Korea—15, and Switzerland—26. Data are unavailable for Japan and the United Kingdom.

SOURCE Organization for Economic Cooperation and Development, Unpublished data, 1997.

figure **3.23** | **Relationship between public expenditures per pupil and regional variation in pupil/teacher ratios in public elementary and secondary schools, 1993**



NOTE The number of regions in each country are as follows: Sweden—24, France—22, Australia—8, Germany—16, Canada—12, Italy—20, Spain—18, United States—51, Korea—15, and Switzerland—26. Data are unavailable for Japan and the United Kingdom.

SOURCE Organization for Economic Cooperation and Development, Unpublished data, 1997.

spending for education are related to the amount of variation in resources available to pupils in different parts of a country.

Where do the public funds for education come from?

The preceding discussion focused primarily on the resources available to pupils in elementary and secondary education in different countries, not on the sources of funding for education. Public education funding is provided at different government levels in the countries included in this report. Some countries finance elementary and secondary education mainly at the national level, while others rely more heavily on regional or local governments. These differences in the sources of funding for education are examined below.

For the 10 countries for which data on public sources of funding for education were available, an average of just over one-fourth (27 percent) of the funding came from central governments. Another one-fourth (26 percent) came from local governments, and just under half the funding (46 percent) came from regional sources (the equivalent of state governments in the United States). The picture is, however, very different for federal and non-federal countries. In the five federal countries (Australia, Canada, Germany, Switzerland, and the United States), funding from central governments represented about 9 percent of the total in 1993, compared with 46 percent in the five non-federal countries (France, Italy, Japan, Spain, and the United Kingdom). In contrast, regional governments represented the primary source of funding in federal governments, providing over 63 percent of school revenues, but represented a less important source of funding in non-federal countries (about 29 percent of total funds). Finally, local governments provided about one-fourth of total funds for education in both federal and non-federal countries.

Even within these two groups of countries, there are some noteworthy differences in sources of funds for elementary and secondary education (as shown in figure 3.24). Among the federal countries, Australia stands out in terms of the share of funding it receives from central government sources, with the Commonwealth government in Australia providing about one-fourth of total funds. The regional-local balance in funding tilts more heavily in the regional direction in Australia, Canada, and Germany, but more balanced between regional and local governments in Switzerland and the United States. Of the five federal countries, the regional share in 1993 was lowest in the United States, with 48 percent of total revenues from state governments, and only slightly higher in Switzerland at 53 percent of total funds.

Among the non-federal countries, the United Kingdom stood out with its small share of funds from central government sources (7.5 percent) and its large share of funds from local sources (92.5 percent). Japan also had a smaller share of funds from central government sources (24.1 percent), but a large share of funding from regional sources (76 percent).[6] Finally, Spain was unusual in its relatively close balance in funds from central and regional sources (41 and 53 percent, respectively). This balance may reflect Spain's movement toward a more decentralized system of education governance, with regional governments called "autonomous communities" taking on responsibilities for education that were formerly carried out by the national ministry of education.

Do countries that finance a higher proportion of education expenditures from local sources exhibit greater geographic variation in education resources than countries with greater financing from national and regional sources?

In debates about school finance, it is frequently assumed that more localized funding of education results in more geographical variation in education resources than funding systems that rely more heavily on more centralized revenues. The data available to examine this issue are quite limited. However, a preliminary review of the relationship between the share of funding from local sources and inter-regional variation in pupil/teacher ratios in eight countries (Australia, Canada, France, Germany, Italy, Spain, Switzerland, and the United States) provides some support for this position (see figure 3.25).

For example, both the United States and Switzerland report a relatively large proportion of education funding from local sources (44 and 43 percent, respectively) and also report the largest variation in student/teacher ratios. Conversely, France reported one of the smallest interregional variations in student/teacher ratios and also had a relatively low proportion of

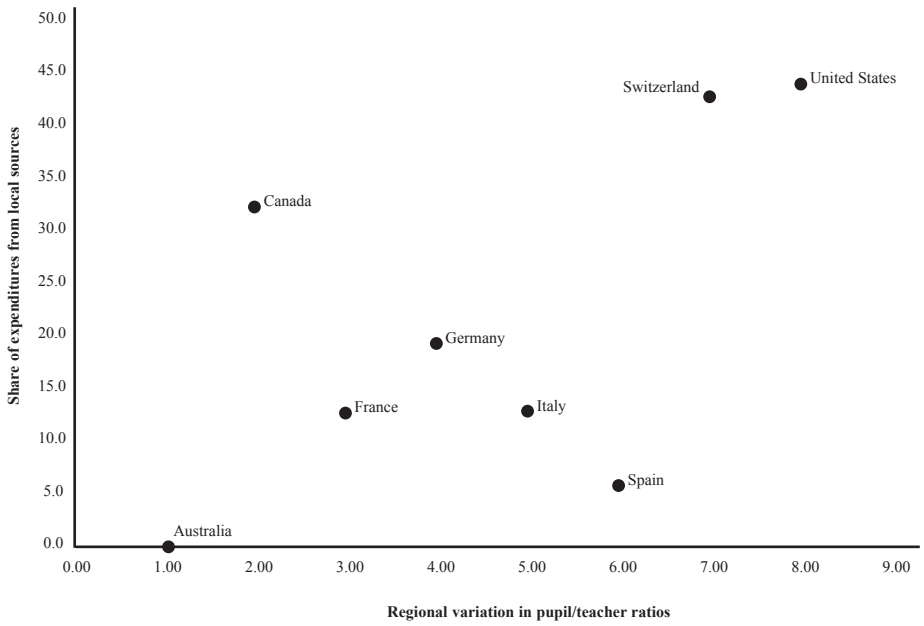
[6]Central governments in many OECD countries, including Japan, often provide general-purpose revenue sharing funds to regional or local governments, which then get counted as regional or local sources of funding for education.

figure 3.24 Public expenditures for elementary and secondary education, by source of funds, 1993

	Funding source		
	Central	Regional	Local
Australia	25.0	75.0	0.0
Canada	3.5	63.9	32.6
France	75.7	11.3	13.0
Germany	3.5	76.9	19.6
Italy	83.1	3.6	13.2
Japan	24.1	75.9	0.0
Spain	40.9	53	6.1
Switzerland	3.7	53.2	43.1
United Kingdom	7.5	0.0	92.5
United States	7.9	47.7	44.3

NOTE Data are unavailable for Korea and Sweden.
SOURCE Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators,* 1996.

figure 3.25 Relationship between the share of public expenditures from local sources and regional variation in pupil/teacher ratios in public elementary and secondary schools, 1993



NOTE Data are unavailable for Japan, Korea, Sweden, and the United Kingdom.
SOURCE Organization for Economic Cooperation and Development, Unpublished data, 1997.

funding (13 percent) from the local level; over three-quarters of educational funding come from national sources in France. There are exceptions, however; Spain reports the least amount of funding from local sources (6 percent), yet has a relatively higher amount of variation in student/teacher ratios. Spain does, however, distribute the majority of educational funding through regional sources (53 percent) rather than national sources.

It should of course be noted that other factors (the number of regions within countries, differences in the size and wealth of regions, as well as the specifics of countries' finance arrangements) would be expected to have a significant influence on the amount of inter-regional resource variation observed within countries. Nonetheless, the finding presented here provides at least preliminary support for the position that more centralized funding of education may be associated with smaller resource inequalities across geographical areas within countries.

Conclusion

An overall assessment of the United States' investment in elementary and secondary education depends, in part, on the measure of spending used in the comparisons. When judged based on public spending relative to GDP, the United States falls in the middle of the rankings, both in relation to other G-7 nations and to the group of 12 countries reviewed in this study. Based on expenditures per pupil, however, the United States ranks highest among the G-7 countries and second only to Switzerland in the larger group.

In general, wealthier countries like the United States tend to spend more per pupil for elementary and secondary education than poorer countries, but they do not consistently devote a higher proportion of their national wealth to school spending. A phenomenon that has been observed domestically appears to occur internationally as well: wealthy countries can spend at relatively high levels per pupil without taxing themselves as heavily as poor countries. Their resource bases are sufficiently large to sustain high levels of spending per pupil with relatively modest levels of fiscal effort.

A third measure of a country's commitment to elementary and secondary education is the proportion of total public expenditures spent on elementary and secondary education. As with expenditures per pupil, the United States appears to rank relatively high on this measure of education spending—highest among G-7 countries and behind only Switzerland and Korea among the group of 12 countries. The share of public expenditures countries devote to elementary and secondary education does not, however, appear to be related to a country's wealth, but does appear to be related to the size of its school-age population. Countries like the United States and Korea, with relatively large school-age populations, tend to spend a higher proportion of public expenditures on elementary and secondary education than countries like Italy and Germany, which have relatively few children of school age. However, other factors not examined in this report also need to be taken into account to explain a country's share of public spending on elementary and secondary education.

Although overall spending levels for education are of paramount interest to policy makers, the way school funds are used has taken on increasing importance in recent years. This study examined a number of indicators that are typically used to compare countries on this dimension of education, including the share of current expenditures spent on teacher and staff compensation, overall levels of teacher and staff compensation, and pupil/teacher ratios.

Overall, the United States compares favorably with other countries on one of these measures—expenditures per pupil for staff compensation—but less favorably on two others—pupil/teacher ratios and the share of current expenditures spent on staff compensation. On expenditures per pupil for staff compensation, the United States ranked third, behind only Italy and Canada; on pupil/teacher ratios, the United States ranked eighth, behind Italy, Sweden, Switzerland, France, Australia, Spain, and Japan. The United States also ranked eighth in the distribution of the percentage of current expenditures spent on staff compensation. However, in contrast with other countries, the United States tends to contract out many services that would be provided by school systems elsewhere. Although a large majority of expenditures for contracted services are for staff compensation, they do not get accounted for as such in school systems' financial records.

In addition to overall spending for education and the use of school funds, policy makers have had a long-standing interest in differences in spending levels across geographical areas and among different groups in society. This report provided some perspective on the issue of spending disparities through its review of two indicators of regional variation in school resources—expenditures per pupil and pupil/teacher ratios. States and their equivalents in other countries were the regional units used in this analysis for federal countries; large political or administrative units were used for this purpose in non-federal countries.

Compared with the other countries in this study, the United States showed relatively large variation in both expenditures per pupil and pupil/teacher ratios across states. Variation on both of these measures was in the middle range in Australia and Canada and relatively low in France and Sweden. Although a variety of factors may contribute to differences in inter-regional variation in expenditures and pupil/teacher ratios across countries, one factor that appears particularly noteworthy is the share of spending from central versus local sources.

In the eight countries for which data were available, a higher proportion of education funding from local sources was associated with higher inter-regional variation in pupil-teacher ratios. While hardly conclusive, this finding is consistent with the domestic school financial literature, which generally finds greater disparity in expenditures per pupil in states with higher shares of funding from state sources (Odden & Picus, 1992).

4

Student Achievement

Chapter 4 Student Achievement

This chapter examines ways to compare U.S. student achievement with that of other countries. Specifically, direct comparisons will be made of student achievement in mathematics, science, and reading at different ages or grade levels across a number of countries.

As a measure of what students learn in school, student achievement is of great interest to educational researchers and national policy makers, because it is so closely correlated with the productive skills students eventually bring to the labor market (U.S. Department of Education, NCES, 1996a). Countries that can build a highly literate and technologically skilled workforce will possess a competitive advantage in the global marketplace. Thus, international comparisons of student achievement are a way to evaluate nations' competitive outlook. They aid policy makers in setting realistic expectations for schools and in monitoring school quality.

Of course, student achievement is influenced by the resources invested in students within national educational systems, defined as educational "inputs" in the first two chapters of this report. For example, the number of hours spent in school, the amount of homework assigned, the home environment, the quality of curricula and classroom practices can all affect levels of student achievement. Comparing the impact that these "investment decisions" have on student achievement around the world provides national policy makers with valuable information about educational variables that could be modified to maximize student achievement.

Available data allow us to measure achievement in mathematics, science, and reading in two basic ways. The first method simply compares achievement of students in the same age groups, among various countries, as measured by scale scores, which are the average percentage of questions students have answered correctly. Most available data in this category measure achievement at both the fourth- and ninth-grade level, although sometimes achievement is reported by age (usually ages nine and fourteen) rather than by grade level. The second way of comparing achievement is to examine changes in test scores between two educational grade levels as a way of gauging the relative progress students make. The possible correlation between these two types of achievement measures is also explored.

This chapter also examines the issue of gender gaps in educational achievement as a way of measuring the gender equity of national educational systems. These data shed light on whether or not gender gaps exist in each country and whether they are more prevalent in certain countries than others. In addition, they illuminate whether gender differences have changed over time, and whether they are larger in some age groups and some subject areas than others.

Finally, characteristics of both home life and school that support achievement will be examined. Students in all countries spend most of their time either at home and or at school, each providing different motivators and obstacles to learning. Students' home lives can provide various degrees of support and encouragement toward education, just as different structures and processes of schooling can allow for different opportunities and expectations for young people.

This chapter analyzes data from three primary sources to provide a comparative picture of student achievement in the United States and other countries. The source used most frequently is the Third International Mathematics and Science Study (TIMSS), which was conducted by the International Association for the Evaluation of Educational Achievement (IEA) during the 1995 school year. The main purpose of TIMSS was to investigate national educational policies, practices, and outcomes in order to enhance mathematics and science learning within and across systems of education. Toward this end, TIMSS tested the mathematics and science knowledge of a half-million students from 41 nations at five different grade levels.

Of the G-7 countries, only Italy does not have TIMSS data for the eighth-grade level. Several countries did not participate in TIMSS at the 4th- or 12th-grade level. In addition, TIMSS results are presented for England, rather than for the United Kingdom, since Northern Ireland and Wales did not participate in the test, and Scotland did not satisfy the sampling guidelines for participation in the TIMSS.

The International Assessment of Educational Progress (IAEP) represents the second major source of data for this report. In 1990-91, a total of 20 countries used this international examination to assess the mathematics and science achievement of 13-year-old students, and 14 of the 20 countries used the IAEP to assess the achievement of 9-year-olds in these same subjects. Although these data are not as current as the TIMSS data, they allow us to compare scores of two different age groups. In addition, the relative standing of the United States in the 1995 TIMSS assessment can be broadly compared to the U.S. standing in 1991. Since the two surveys had some substantive and methodological differences and sampled different sets of countries, specific comparisons between countries over time cannot be made. However, general and tentative conclusions about changes in the relative position of specific countries can be drawn.

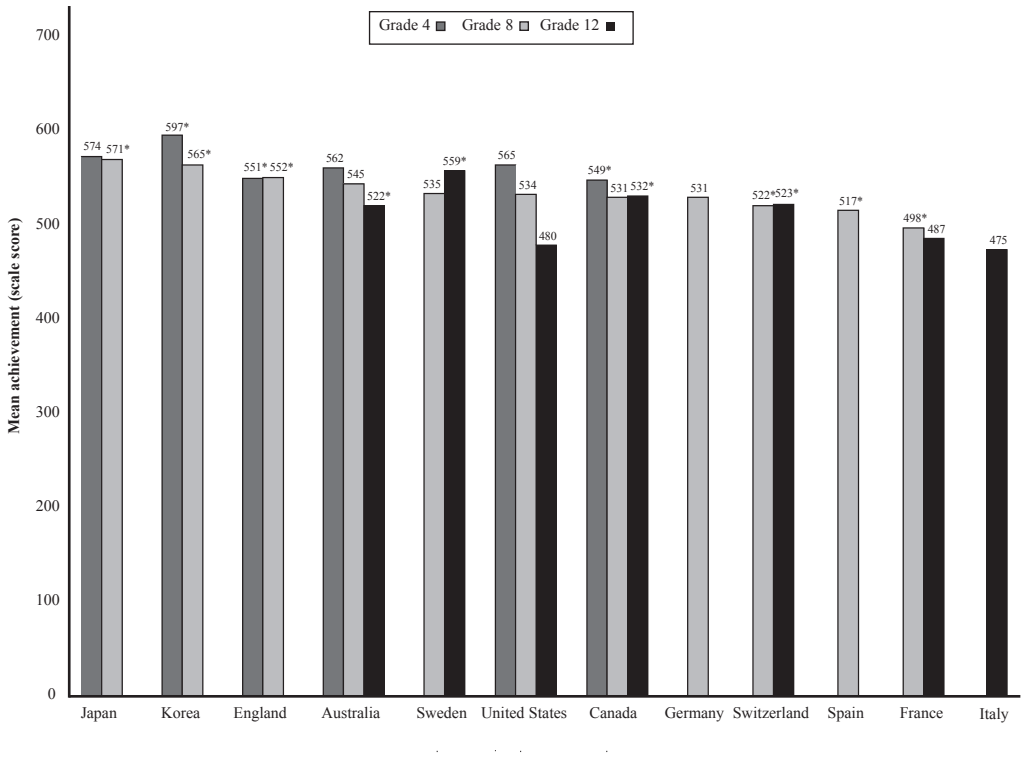
Finally, the reading data presented come from the IEA Reading Literacy Study, conducted during the 1990-91 school year. This study describes the literacy profiles of 9- and 14-year-olds, as well as their reading habits, and the home, school, and societal factors associated with reading.

How do students in the United States compare with their international counterparts in science?

The performance of U.S. students relative to other countries varied, depending on grade level. U.S. students performed relatively well at the fourth-grade level, about average at the eighth-grade level, and below average at the twelfth-grade level.[1] At the eighth-grade level, scale scores ranged from 571 in Japan to 498 in France. For the 11 countries shown in figure 4.1, the average score in science was about 536; the United States score of 534 was roughly equivalent to this international mean. Four other countries (Sweden, Canada, Germany and Australia) had scores roughly equivalent to that of the United States,[2] while three significantly outperformed the United States (Japan, Korea, and England). Fewer countries participated in TIMSS at the fourth-grade level; scores ranged from 549 in Canada to 597 in Korea for the six countries with available data included here. At 565, U.S. fourth-graders scored higher than fourth-graders in England and Canada and scored similarly to fourth-graders in Japan and Australia. Only Korean fourth-graders outperformed U.S. fourth-graders in science. Seven of the referenced countries participated in TIMSS at the end of secondary school. Scores for these older students ranged from 475 in Italy to 559 in Sweden, with an average score of 512 for these seven countries. The

[1] To be more precise, the last grade in secondary school was tested. In the United States, this corresponded to grade 12, but other grades were tested in other countries.
[2] When we analyzed all 41 countries tested, the U.S. eighth-graders scored slightly above the international average of 527.

figure **4.1** | **Achievement in science at grades 4, 8, and 12, 1995**



*Indicates that difference from the United States is significant.

NOTE Data are unavailable at the grade 4 level for Sweden, Germany, Switzerland, Spain, France, and Italy and at the grade 12 level for Japan, Korea, England, Germany and Spain.

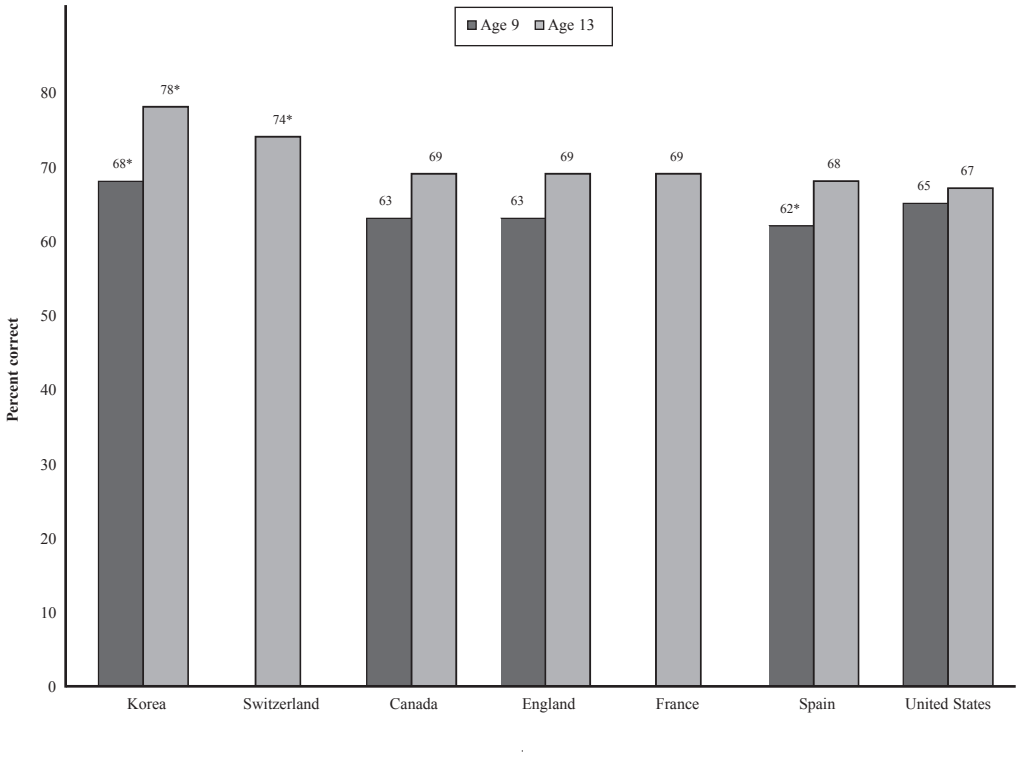
SOURCE IEA's Third International Mathematics and Science Study, *Science Achievement in the Middle School Years*, and *Science Achievement in the Primary School Years*, 1996, and *Mathematics and Science Achievement in the Final Year of Secondary School*, 1998.

United States' score of 480 fell below this average and below the scores of Australia, Canada, Sweden, and Switzerland; however, it was at the same level as in France and Italy.

The 1994 science data showing U.S. students achieving at a level as high or higher than that of their international peers in these countries at grades 4 and 8 suggest a slight improvement over the relative performance of U.S. students in 1991. For example, in 1994, U.S. 13-year-olds performed right at, or slightly above, the international average, while in 1991 they performed at or slightly below the average. Figure 4.2 shows the percentage of IAEP science questions answered correctly in 1991 at age 9 in five countries and 13 for students in seven countries in 1991. At age nine, U.S. students were competitive, outperformed only by Korea of the countries depicted in figure 4.2 and performing similarly to Canada and England. The average percent of questions answered correctly by 9-year-olds in the U.S. was 65, roughly equivalent to the mean of 64 for the five countries shown.

At age 13, however, the performance of students in the United States in 1994 seemed to slip relative to that of students in other countries in 1991. Thirteen-year-olds in the United States

Figure **4.2** | **Percentage of science questions answered correctly at age 9 and age 13, 1991**



* Indicates that difference from the United States is significant.

NOTE | Data are unavailable at age 9 for Switzerland, France, Australia, Germany, Italy, Sweden and the United Kingdom and at age 13 for Australia, Germany, Italy, Sweden, and the United Kingdom.

SOURCE | Educational Testing Service, International Assessment of Educational Progress, *Learning Science*, 1991.

answered an average of 67 percent of science questions correctly, slightly below the seven-country average of 71 percent.

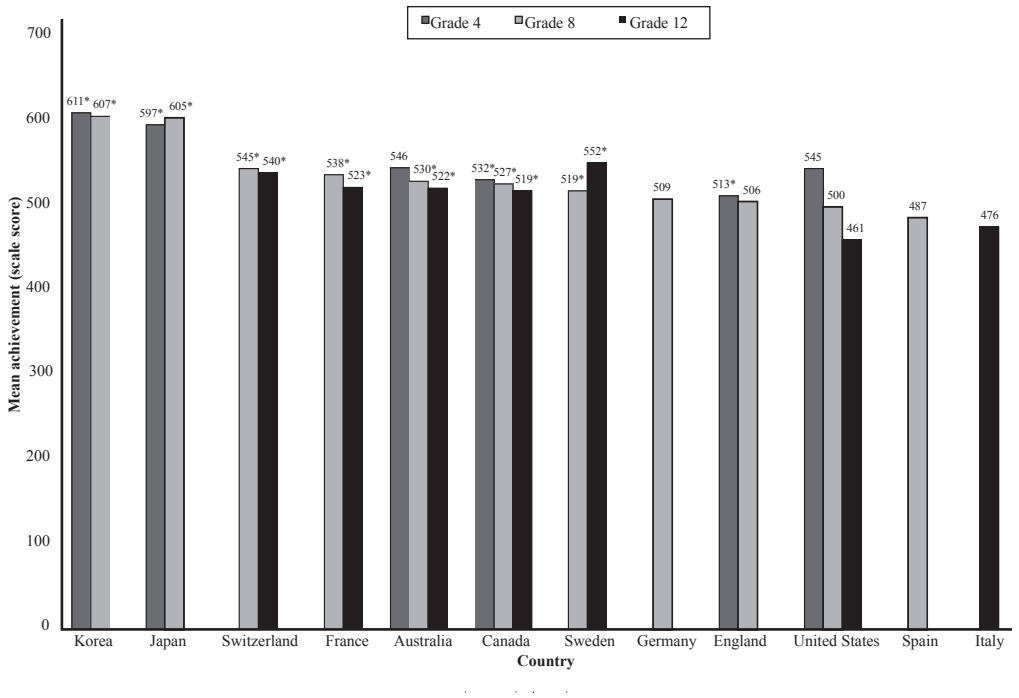
How do students in the United States compare with their international counterparts in mathematics?

Overall, U.S. students did not perform as well in mathematics as their peers in many other industrialized nations, particularly at the upper grade levels. Only six of the focus countries other than the United States participated in TIMSS at the end of secondary school level. Five of them outperformed U.S. 12th-graders, and Italy's scores were similar to those of the United States.

In mathematics in 1994, eighth-grade students in the United States, on average, also performed at a lower level than their peers in many other countries. Of the 11 countries shown in figure 4.3, the United States had a scale score of 500, well below the 11-country average of 534.[3] Spain, England, and Germany had scores similar to those of the United States, while the other countries

[3]When we analyzed all 41 countries tested, the U.S. eighth-graders also scored below the international average of 527.

figure **4.3** | **Achievement in mathematics at grades 4, 8, and 12, 1995**



* Indicates that difference from the United States is significant.

NOTE Data are unavailable at grade 4 for Switzerland, France, Sweden, Germany, Spain, and Italy; at grade 8 for Italy; and at grade 12 for Korea, Japan, Germany, England, and Spain.

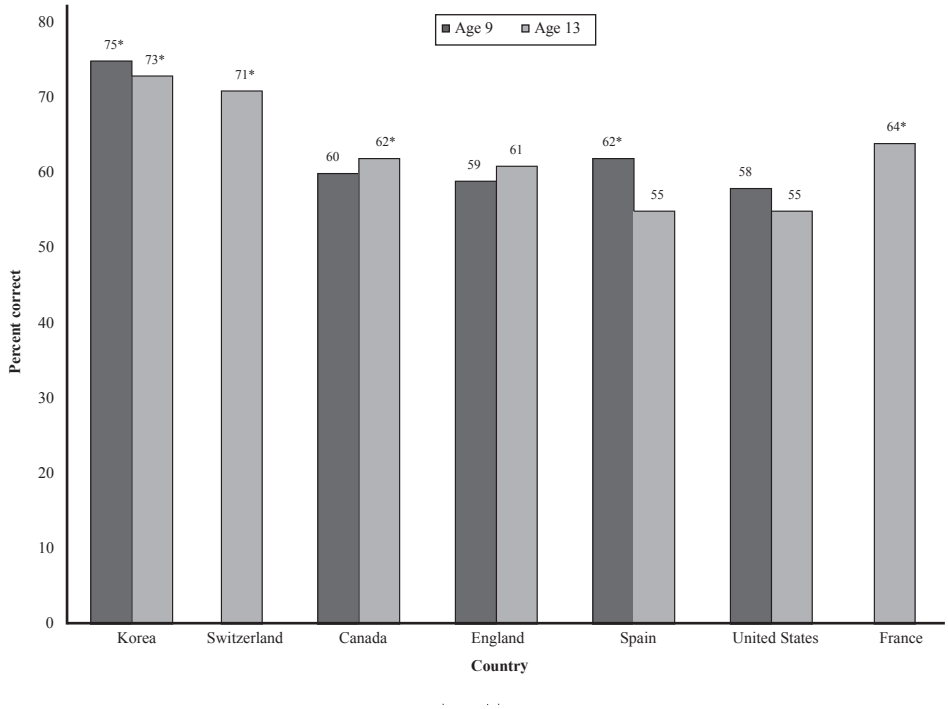
SOURCE IEA's Third International Mathematics and Science Study, *Mathematics Achievement in the Middle School Years*,and *Mathematics Achievement in the Primary School Years*, 1996, and *Mathematics and Science Achievement in the Final Year of Secondary School*, 1998.

pictured in figure 4.3 scored significantly higher. At the fourth-grade level, scores ranged from 513 in England to 611 in Korea. U.S. fourth-graders scored higher than fourth-graders in England and Canada, similarly to those in Australia, and lower than those in Korea and Japan.

Data from the IAEP survey conducted in 1991 paint a similar picture (figure 4.4). At age nine, students in the United States answered 58 percent of all questions correctly. Students in the United States performed similarly to those in England and Canada, but less well than those in Spain and Korea. Korean students scored the highest of those in any nation surveyed, answering 75 percent of mathematics questions correctly on average. At age 13, students in the United States answered 55 percent of questions correctly on average, about 8 percentage points below the average of students in the other countries shown. Once again, Korea's scores were high, averaging 73 percent, as were those of students from Switzerland, with average scores of 71 percent.

Overall, available data suggest that students in the United States performed on par with or below most of their international counterparts in mathematics at both ages 9 and 13. Moreover, they showed little improvement in performance between 1991 and 1994.

figure **4.4** | **Percentage of mathematics questions answered correctly at age 9 and 13, 1991**



*Indicates that difference from United States is significant.

NOTE Data are unavailable at age 9 for Switzerland, France, Australia, Germany, Italy, Japan, and Sweden; and at age 13 for Australia, Germany, Italy, Japan and Sweden.

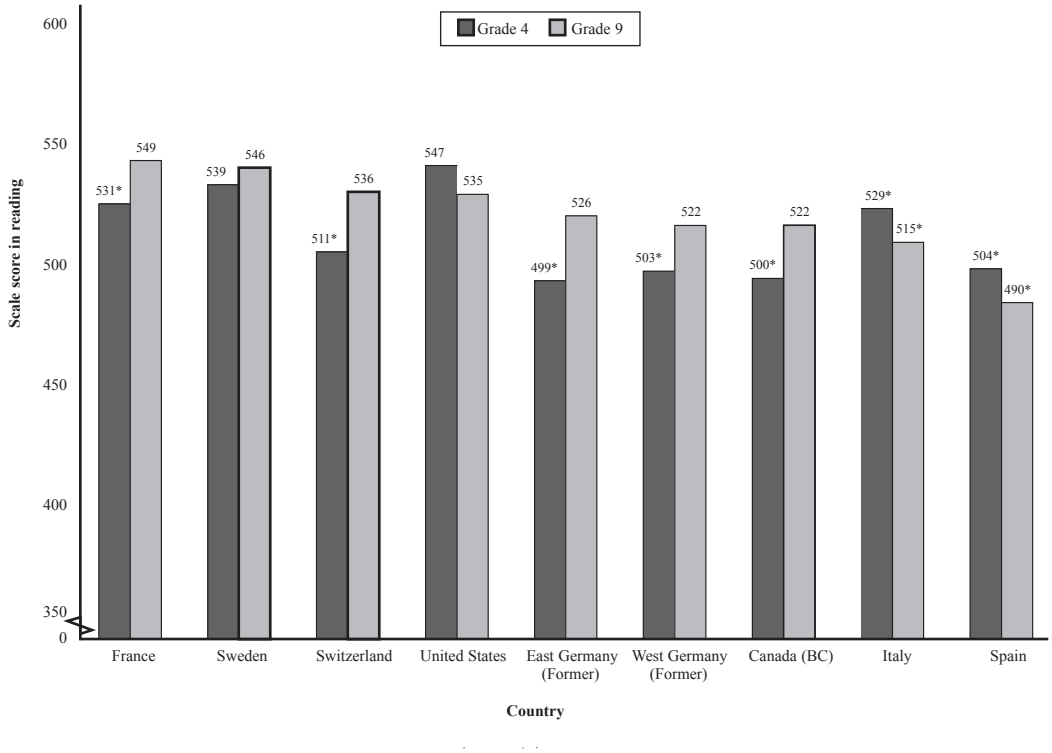
SOURCE Educational Testing Service, International Assessment of Educational Progress, *Learning Mathematics*, 1991.

How do students in the United States compare with their international counterparts in reading?

In 1991, fourth-grade students in the United States excelled in reading, scoring roughly 29 points over the mean score for students in the eight countries presented in figure 4.5. Scores of U.S. students were comparable to those of students in Sweden, and higher than those of students from the other countries presented.

Students in the United States continued to show high levels of reading literacy in ninth grade, as evidenced by the 1991 IEA data, although their relative performance compared to this set of countries was not as high as that of their fourth-grade counterparts. Scores of students in the United States were roughly equivalent to those of students in France, Sweden, Switzerland, the former West and East Germany, and Canada and higher than those of students in Italy and Spain. Students in Spain scored lower in reading than those in all the countries for which data are presented at the 9th-grade level.

figure **4.5** | **Average scale score in reading at grades 4 and 9, 1991**



*Indicates that difference from United States is significant.

NOTE Data are unavailable for Australia, Japan, Korea, and the United Kingdom.

SOURCE U.S. Department of Education, National Center for Education Statistics, *Reading Literacy in the United States: Findings from the IEA Literacy Study*, 1996

It is interesting to note that in none of the G-7 nations did students perform significantly above the others in all three of the academic disciplines analyzed. The only country that achieved a high relative standing in all three subject areas was Switzerland and even there, the 4th-grade reading scores were no higher than average. Similarly, no G-7 country was significantly below the average in achievement in all three subject areas. Spain was the only country to score significantly below the international average in mathematics, science, and reading.

How does achievement among boys and girls in the United States compare to that in other countries?

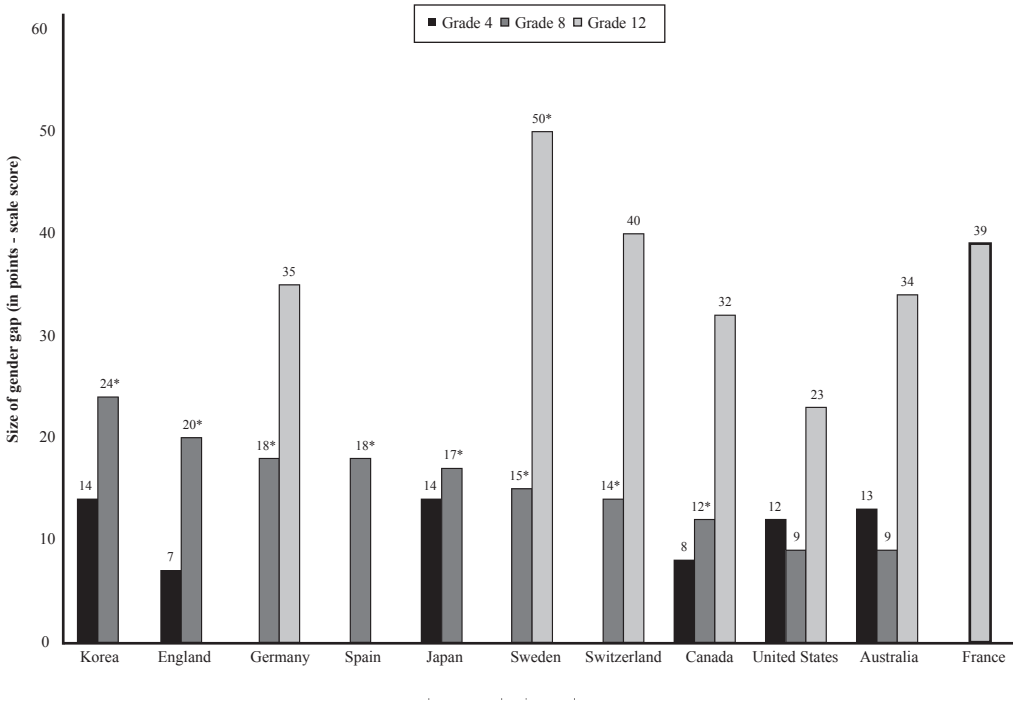
Traditionally, females have not usually had the same opportunities to enter the labor force and compete successfully with males and have been paid lower wages. Gender gaps in education are a continuing concern in attempting to eradicate these differences. This section examines the relative achievement of boys and girls around the world in mathematics, science, and reading. These relationships are examined in four ways: a comparison of the achievement of boys and girls across countries; a comparison of the gap in achievement scores between girls and boys within

individual countries; an analysis of changes in the size of these gaps at different educational levels; and an exploration of differential student attitudes about gender and participation in mathematics and science and the possible influence of those attitudes on achievement.

In general, the relative standing of boys and girls in different countries was consistent with the relative standing of all students. In the case of the United States, this means that compared to boys and girls in other countries, U.S. boys and girls performed at a higher level in reading, slightly above the average in science, and at a lower level in mathematics. The data also demonstrate that, in general, there was more variation among boys and girls across countries than between boys and girls within a single country. This finding holds true across all subjects and ages. Finally, it is interesting to note that in nearly every country where gender gaps existed, they favored boys in mathematics and science and girls in reading.

In 1995, all countries showed significant gender gaps in science at grade 12, 8 out of 11 countries showed significant gender gaps at grade 8, and 4 out of 6 countries showed significant gaps at grade 4 (figure 4.6). On average, among these first eight countries, eighth-grade boys scored about 7 points

figure **4.6** **Gender gaps in achievement favoring boys in science in 4th, 8th, and 12th grade, 1995**

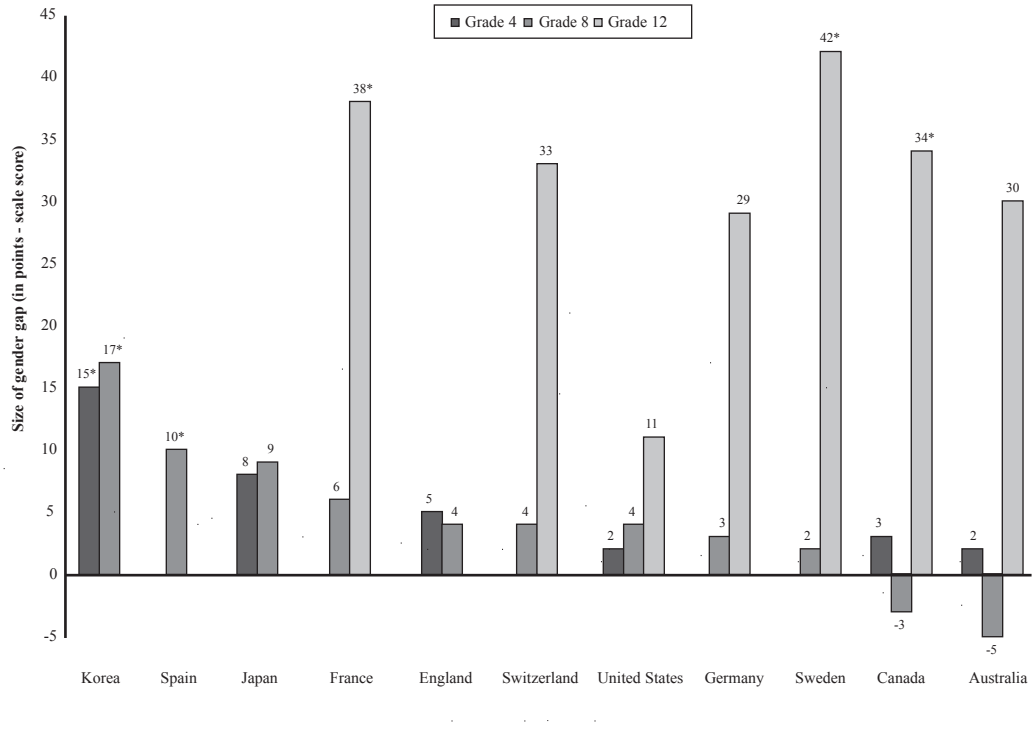


* Indicates that gender difference is significant.

NOTE Data are unavailable at grade 4 for Germany, Spain, Sweden, Switzerland, France, and Italy; at grade 8 for France and Italy; and at grade 12 for Korea, England, Spain, Japan, and Italy.

SOURCE IEA's Third International Mathematics and Science Study, *Science Achievement in the Middle School Years*, and *Science Achievement in the Primary School Years*, 1996, and *Mathematics and Science Achievement in the Final Year of Secondary School*, 1998.

figure **4.7** | **Gender gaps in achievement favoring boys in mathematics in 4th, 8th, and 12th grade, 1995**



*Indicates that gender difference is significant.

NOTE Data unavailable at grade 4 for Spain, France, Switzerland, Germany, Sweden, and Italy; at grade 8 for Italy; and at grade 12 for Korea, Spain, Japan, England, and Italy.

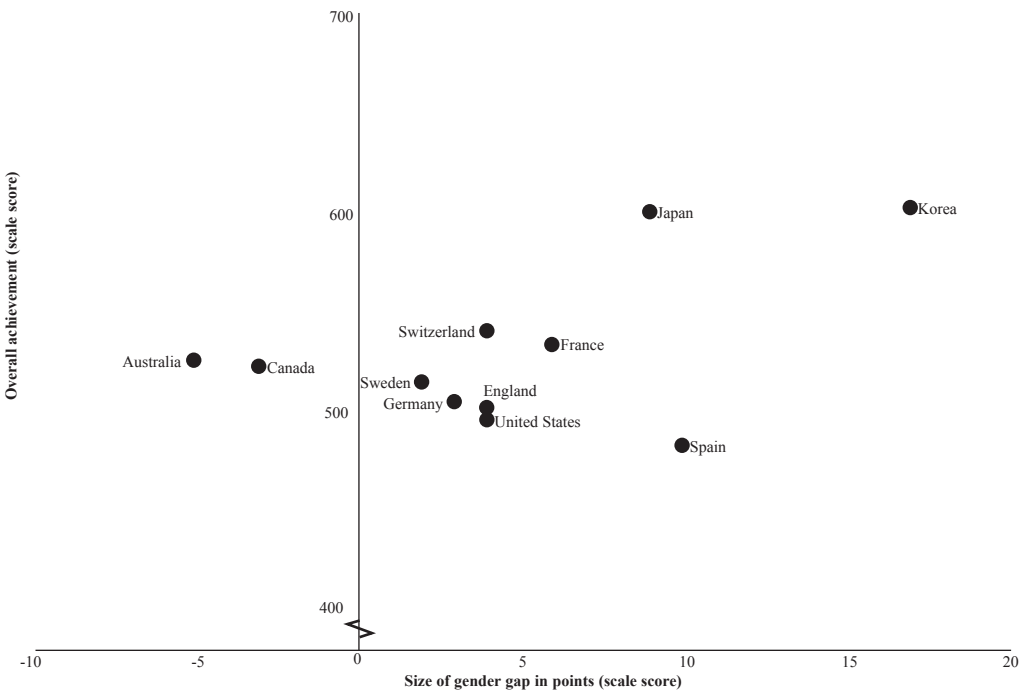
SOURCE IEA's Third International Mathematics and Science Study, *Science Achievement in the Middle School Years*, and *Science Achievement in the Primary School Years*, 1996, and *Mathematics and Science Achievement in the Final Year of Secondary School*, 1998.

higher than eighth-grade girls in science. In mathematics, 6 out of 7 countries showed significant gender differences at grade 12, but only Korea and Spain showed significant differences at the eighth-grade level and only Korea and Japan at the fourth-grade level (figure 4.7). The United States did not show a significant gender gap in mathematics at any grade or in science at 8th grade.

While there was a great deal of variation in the size of the gender gap in mathematics and science among countries, there did not appear to be any relationship between the size of this gap for individual countries and their relative academic achievement rankings, as illustrated in figure 4.8. For example, Korea and Spain showed two of the largest gender gaps in science at grade 8. However, Korea had relatively high science achievement, while Spain's was much lower. Conversely, while both the United States and Switzerland reported no gender gap in mathematics, students in Switzerland scored an average of 45 points higher than U.S. students in mathematics.

As stated earlier, in nearly every nation studied in 1991 in which gender gaps in reading existed, they favored girls rather than boys. At age nine, Sweden and the former East Germany's girls scored significantly higher than boys in reading (13 and 19 points, respectively) while the

figure **4.8** | **Size of gender gap favoring boys and achievement in mathematics at grade 8, 1995**



NOTE Data unavailable for Italy.

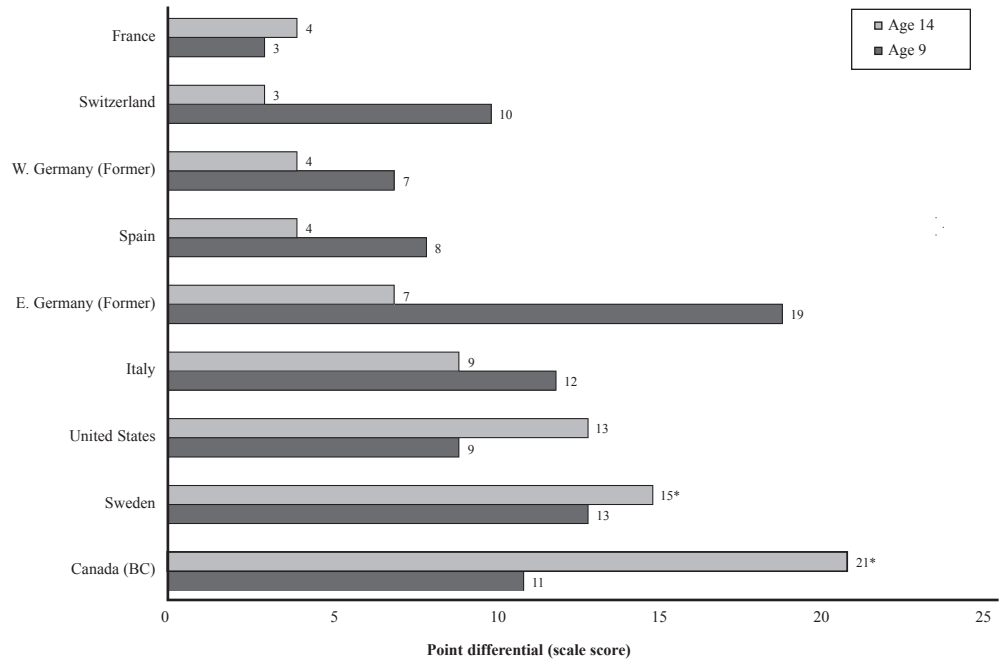
SOURCE IEA's Third International Mathematics and Science Study, *Mathematics Acheivement in the Middle School Years,* 1996.

remaining seven countries analyzed showed no significant difference in achievement. At age 14, girls scored an average of 8 points higher in reading than boys, although only Canada and Sweden showed statistically significant gender gaps (21 and 15 points, respectively) (figure 4.9).

Another interesting point in the study of gender differences is how students feel about the importance of mathematics and science education across countries. The 1991 IAEP survey asked 13-year-olds in seven countries whether they thought that the study of mathematics and science was "equally appropriate" for boys and girls (figure 4.10). With the exception of Korea, between 90 and 100 percent of students in all countries responded affirmatively. In Korea, 62 percent of students thought mathematics was equally appropriate for boys and girls, and 56 percent thought the same of science. In contrast, in England, Canada, and Spain, between 96 and 97 percent of students felt that both mathematics and science education was equally appropriate for both genders.

There is little evidence to suggest a correlation between students' attitudes about the importance of mathematics and science education for both genders and overall achievement in those subjects. While 56 percent of students in Korea reported that they felt that mathematics education was

figure **4.9** | **Gender gap favoring girls in reading at ages 9 and 14, 1991**



*Indicates that gender difference is significant.

NOTE Data unavailable for Australia, Japan, Korea, and the United Kingdom.

SOURCE Elley, Warwick B. *How in the World do Students Read?* The Hague: International Association for the Evaluation of Educational Achievement, 1992.

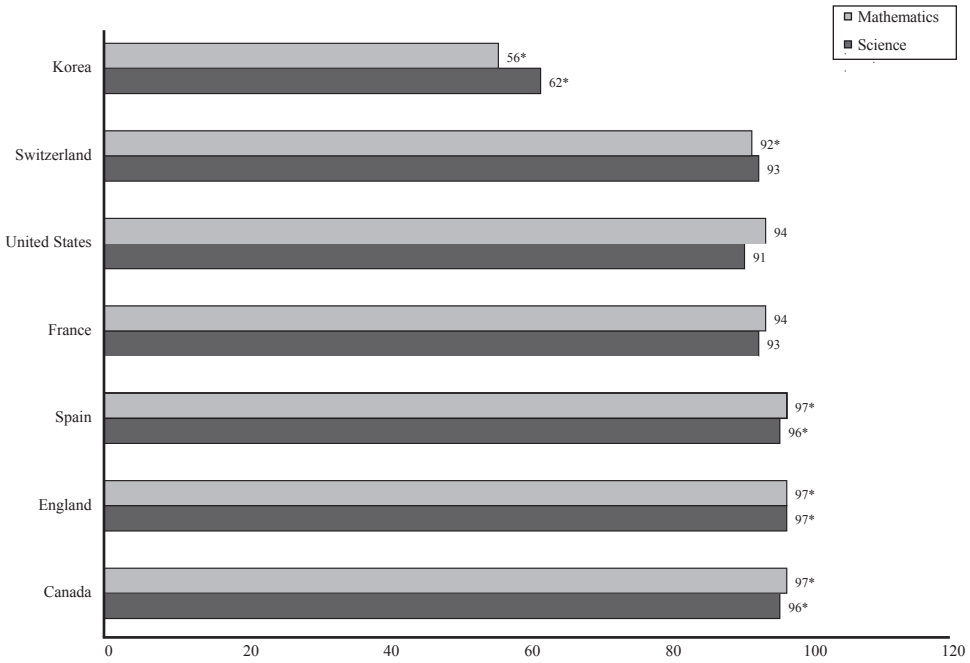
equally important for boys and girls, 13-year-old Korean girls still scored higher in mathematics than girls in any other country, and as well as or better than boys in most countries.[4] There is also no relationship between attitude and the size of the gender gap within countries.

What characteristics of the home environment support achievement in schools in the United States and abroad?

There are several aspects of students' home life that may have some impact on their educational performance. For example, one might expect that students who have greater access to information resources and technology, more highly educated parents, or more schooling at an early age would achieve at a higher level than those who do not. Clearly, home influences play a critical role in the education of any child, but which home characteristics are associated with achievement in different countries? This section examines one characteristic—time spent on homework—that may be correlated with student achievement for which comparative international data are available. Homework is analyzed in two ways: the amount of time spent on homework, both overall and on specific subjects, and the amount of assistance received on homework. Assistance received is measured as the percentage of students who reported receiving some help on homework assignments.

[4] See supplemental tables 4.20 and 4.21.

figure **4.10** | **Attitudes about gender at age 13, mathematics and science, 1991**



*Indicates that difference from United States is significant.

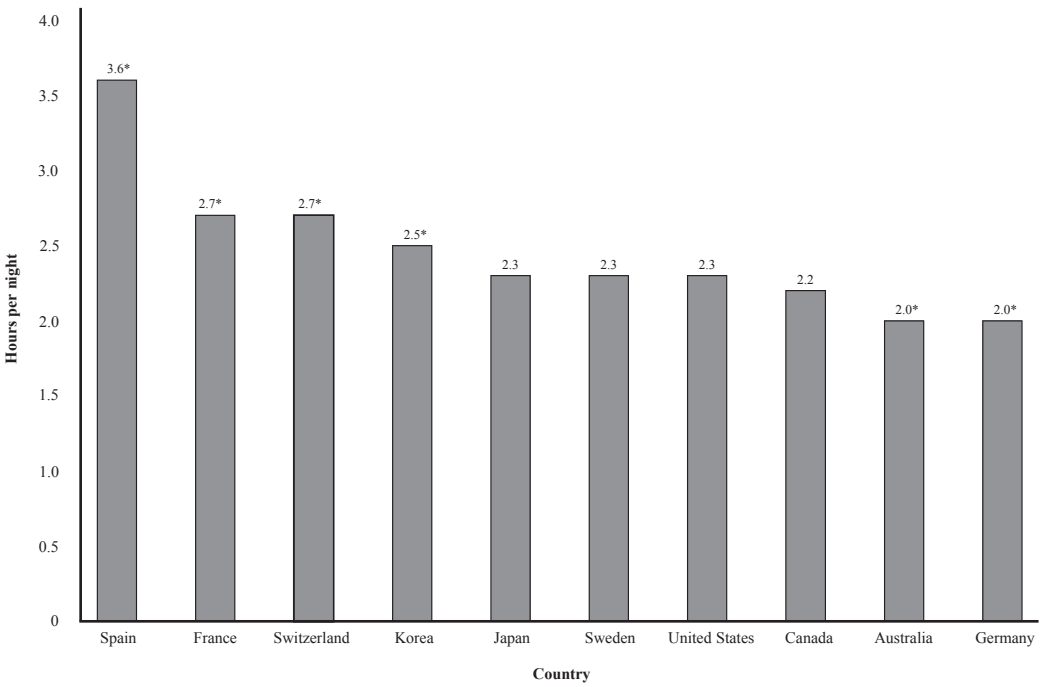
NOTE | Data are unavailable for Australia, Germany, Italy, Japan, and Sweden.

SOURCE | Educational Testing Service, International Assessment of Educational Progress, *Learning Mathematics*, and *Learning Science*, 1991.

As displayed in figure 4.11, eighth-grade students in the United States in 1994 spent an average of 2.3 hours per night on homework and studying for all subjects combined. The U.S. figure fell slightly below the 10-country average of 2.5 hours per night, and was lower than the figure for Spain (3.6 hours per night), France (2.7), Switzerland (2.7), and Korea (2.5). U.S. eighth-graders spent more time on homework than their peers in Australia and Germany, where students spent about 2 hours per night, while students in Japan, Sweden, and Canada all spent roughly the same amount of time on homework as did U.S students.

While there is considerable variation in the amount of time students spent on homework across countries, there does not seem to be a correlation between time spent on homework and achievement. In mathematics, students spent anywhere from .6 hour (Germany) to 1.2 hours (Spain) per night on homework in 1994. U.S. students spent an average of .8 hour per night on mathematics homework, roughly equal to the 10-country mean, yet they were near the bottom of these countries in mathematics achievement. Mathematics students in the two highest achieving countries, Korea and Japan, both averaged the same amount of time spent on homework as those in the United States, while students from Spain spent larger amounts of time on homework and scored lower.[5]

figure **4.11** | **Average hours per night spent on homework in all subjects at grade 8, 1994**



*Indicates that difference from United States is significant.

NOTE Data are unavailable for Italy and Spain.

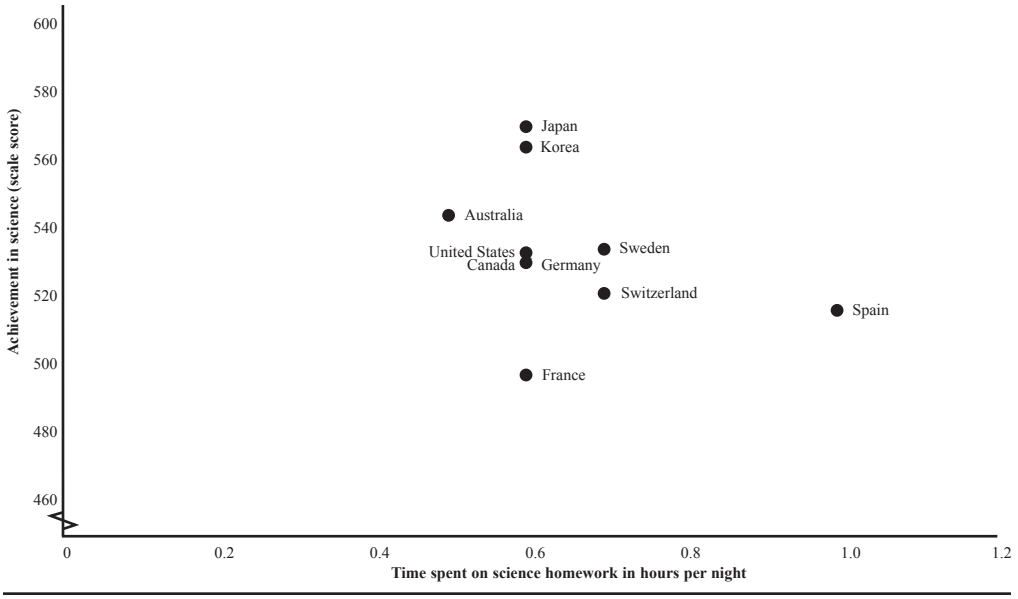
SOURCE International Association for the Evaluation of Educational Achievement TIMSS International Study Center, *Mathematics Achievement in the Middle School Years*, IEA's Third International Mathematics and Science Study, 1996.

In science, the range of time spent on homework across countries was slightly smaller. Students in the United States spent an average of .6 hour per night on science homework in 1994, roughly equal to the time spent by students in Canada, France, Germany, Japan, and Korea. Students in Spain spent the most amount of time on science homework (about 1 hour per night) while those in Australia spent the least, at .5 hour per night. Once again, there does not appear to be any relationship between spending more time on science homework and higher achievement. As seen in figure 4.12, in the top three science achieving countries for which data on homework are available—Japan, Korea, and Australia—students spent roughly the same amount of time on homework in science as students in the United States, which ranked sixth out of the 10 countries analyzed overall in science achievement. Students in Spain, who spent the greatest amount of time on science homework, had relatively low achievement.[6]

[5] See supplemental table 4.22.

[6] See supplemental table 4.22.

figure **4.12** | **Time spent on homework and achievement in science at grade 8, 1994**



NOTE | Data are unavailable for Italy and the United Kingdom.

SOURCE | International Association for the Evaluation of Educational Achievement IEA[1] Third International Mathematics and Science Study, *Science Achievement in the Middle School Years,* 1996.

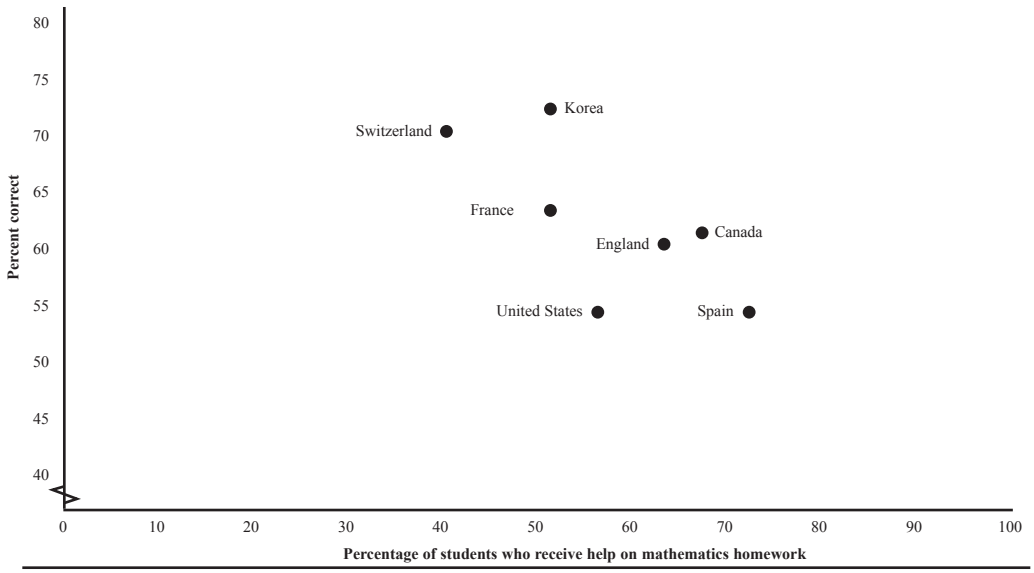
In general, U.S. eighth-grade students who reported spending one hour per night or less on homework averaged a scale score of 512 in science. This was considerably lower than the average score for students who spent one to two hours per night on homework (534), two to three hours per night (540), or more than three hours per night (533). There was no significant difference in achievement among students who reported spending one to less than two hours per night on homework, compared with those reporting spending more than three hours per night. Roughly 42 percent of U.S. students spent from one to less than two hours per night on homework in all subjects. Seventeen percent reported spending between two and three hours per night, and 24 percent said they spent more than three hours per night on homework.[7]

An analysis of data from 1991 shows that students in the United States received more help with homework than students in most other nations. In mathematics, more students in the United States received help on homework than in five of the six other countries studied. In science, only Spain reported a larger percentage of students receiving assistance with homework.

It might be assumed that assistance with homework activities is a positive influence on student learning, but the data do not support this theory. In science, about 47 percent of students in seven countries reported receiving some help on homework assignments. In the United States, 53 percent of students reported receiving help. However, there was no significant relationship between achievement between countries in which more students received help compared and those in which fewer did.

[7] See supplemental table 4.23.

figure **4.13** | **Assistance with homework and achievement in mathematics at age 13, 1991**



NOTE | Data are unavailable for Australia, Germany, Italy, Japan, and Sweden.

SOURCE | Educational Testing Service, International Assessment of Educational Progress, *Learning Mathematics*, 1991.

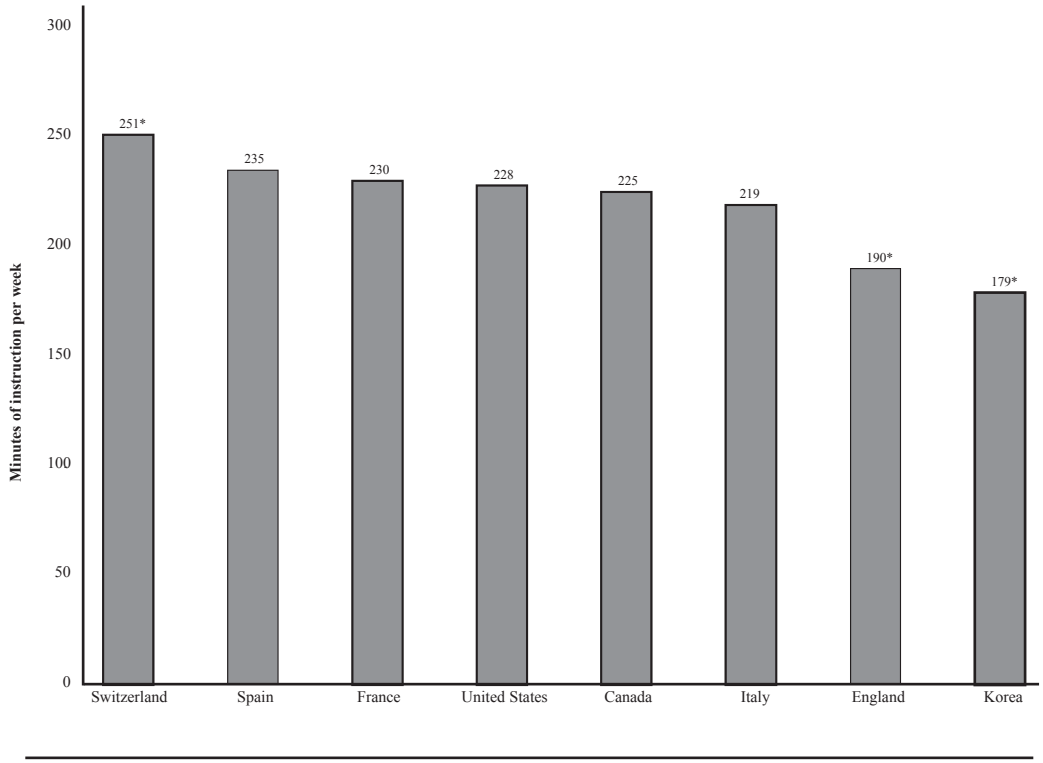
In mathematics, as well, receiving more assistance in homework was not related to higher achievement, as shown in figure 4.13. On average, 59 percent of students across the eight countries studied reported receiving help on homework. The four countries reporting the lowest percentage of students receiving help (Italy, Switzerland, Korea, and France) averaged six percentage points higher in student achievement, as measured by test scores (with score averages of 60 to 66), than the four countries with the highest percentages of students receiving help.

What are the common characteristics of schools across nations that support student achievement, and how does the United States compare to other countries in this respect?

This section analyzes two of the educational characteristics that are frequently mentioned as having a large influence on student achievement around the world: time invested in education and the methods of classroom instruction used in schools.

Chapter 1 outlined the number of hours spent in school per year in each of the focus countries. Recall that in 1994, 14-year-old students received over 1,000 hours of instructional time in France and Italy, between 900 and 1,000 hours in the United States, Germany, and Spain, and just over 800 hours in Sweden. There does not appear to be a direct correlation between time spent in school and mathematics and science achievement. U.S. scores in science were slightly above an 11-country average, comparable to those in Germany and Sweden, and higher than those in

figure **4.14** | **Weekly instructional time in mathematics for 13-year-olds, 1991**



*Indicates that difference from United States is significant.

NOTE Data are unavailable for Australia, Germany, Japan, and Sweden.

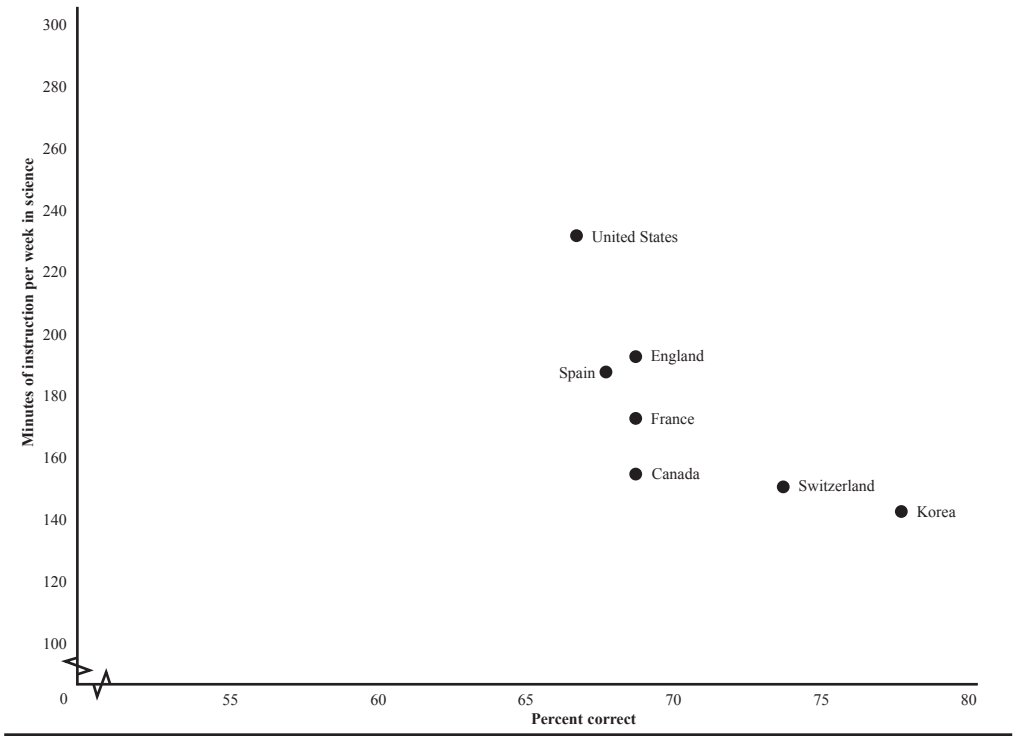
SOURCE Educational Testing Service, International Assessment of Educational Progress, Learning Mathematics, 1991.

Spain and France, despite the fact that U.S. students spent an equal or fewer number of hours in school than their peers in these other countries. In mathematics, U.S. scores were below the 11-country average, but still higher than those in Spain and comparable to those in Germany, where students received roughly the same amount of instructional time. Both France and Sweden had higher scores than the United States did in mathematics, despite the fact that students in Sweden spent significantly less time in school.

In addition to total instructional time, the amount of mathematics and science instruction received by students in different countries has been measured in minutes of instruction per week. These data provide some indication of how much time students are actually spending on a subject, and whether that additional time is associated with better results.

In 1991, students in the United States received more science instruction per week than in any other of these nations for which data were available. Students in the United States received 233 minutes (nearly four hours) of instruction in science per week, well above the seven-country average of 177 minutes per week (just under three hours). At the same time, students in

figure **4.15** | **Instructional time and achievement in science at age 13, 1991**



NOTE | Data are unavailable for Australia, Germany, Italy, Japan, and Sweden.

SOURCE | Educational Testing Service, International Assessment of Educational Progress, *Learning Science*, 1991.

Switzerland received 152 minutes per week, one of the lowest amounts of instructional time in any country. While U.S. eighth-graders scored slightly higher than eighth-graders in Switzerland, no strong overall correlation between the amount of science instruction and science scores existed. Students in Korea, with one of the highest average country science scores, received about 189 minutes of science instruction per week, well below that of the United States.

Students in Switzerland received the most instruction of any nation in mathematics at 251 minutes per week as demonstrated in figure 4.14. Students in the United States ranked in the middle in this category, receiving 228 minutes per week of instruction—roughly equal to the seven-country average of 220 minutes per week. Switzerland's students scored slightly above U.S. students in mathematics, but again the relationship between time spent in mathematics instruction and mathematics scores was not consistent. Thirteen-year-olds in Korea, who again had the highest overall mathematics achievement in 1991 of those in the eight countries studied, averaged 179 minutes of instruction per week, one of the least amounts of instructional time of any nation studied.

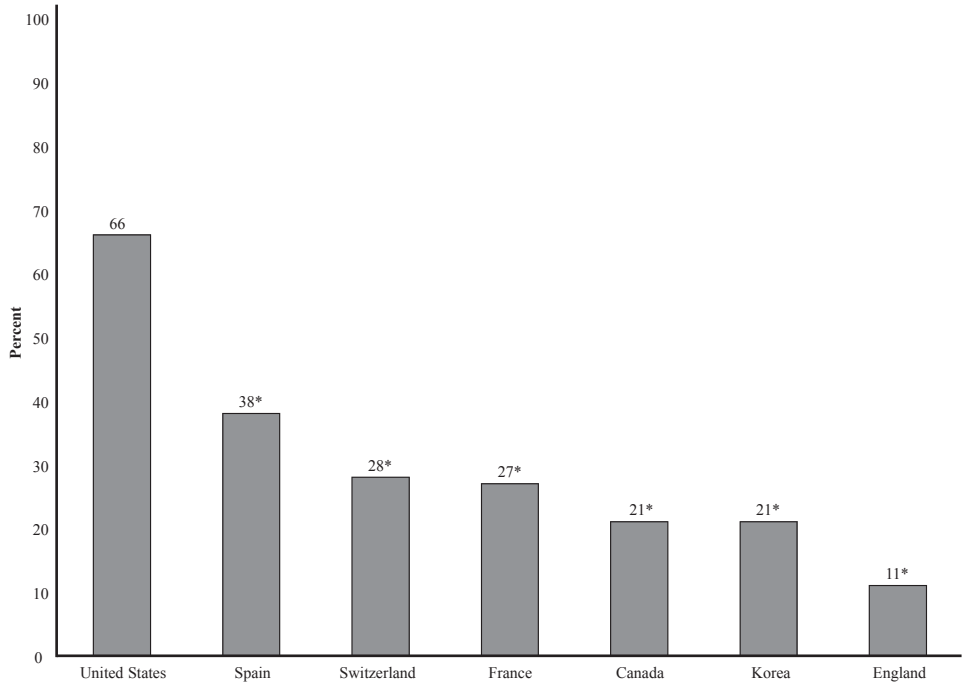
In summary, as demonstrated in figure 4.15, quantity of instruction in science varied widely among countries in 1991, but did not appear to have a direct relationship with achievement. Students in Korea received far less formal classroom instruction in both mathematics and science than most of their international peers, yet they achieved at a relatively higher level.

Of course, data on quantity of instruction provide information on how much time students spend learning different subjects, but they do not reveal anything about how that time is being used. Classroom practices determine the way that educational information is presented and define the roles of teacher and student in the classroom setting. For example, learning may proceed in very different ways and at different rates in classrooms that focus on working in small groups, versus those in which teachers lecture to the whole class. Such classroom practices vary a great deal from country to country, and an interesting question is whether certain practices contribute to or detract from student achievement.

Three classroom characteristics were selected for this study: frequency of lessons in particular subject areas, use of ability-based classes, and the types of educational activities conducted in class. Frequency of lessons was measured as the percentage of students who listen to a lesson in a given subject every day. These data, like those concerning percentage of total instruction devoted to a particular subject, can be regarded as an indication of the priority nations assign to various subjects. Beyond that, these data can provide information on how material is presented in various subject areas. In some countries, students may receive relatively few, lengthy lessons in a given subject area, while in others, students may participate in more frequent, but shorter, classes.

Thirteen-year-old students in the United States received lessons in mathematics and science more frequently than students in any other country for which data are available. On average, 78 percent of U.S. 13-year-olds listened to a mathematics lesson daily, compared to 52 percent of 13-

figure **4.16** | **Percentage of students who listen to science lessons daily at age 13, 1991**



*Indicates that difference from United States is significant.

NOTE | Data are unavailable for Australia, Germany, Italy, Japan, and Sweden.

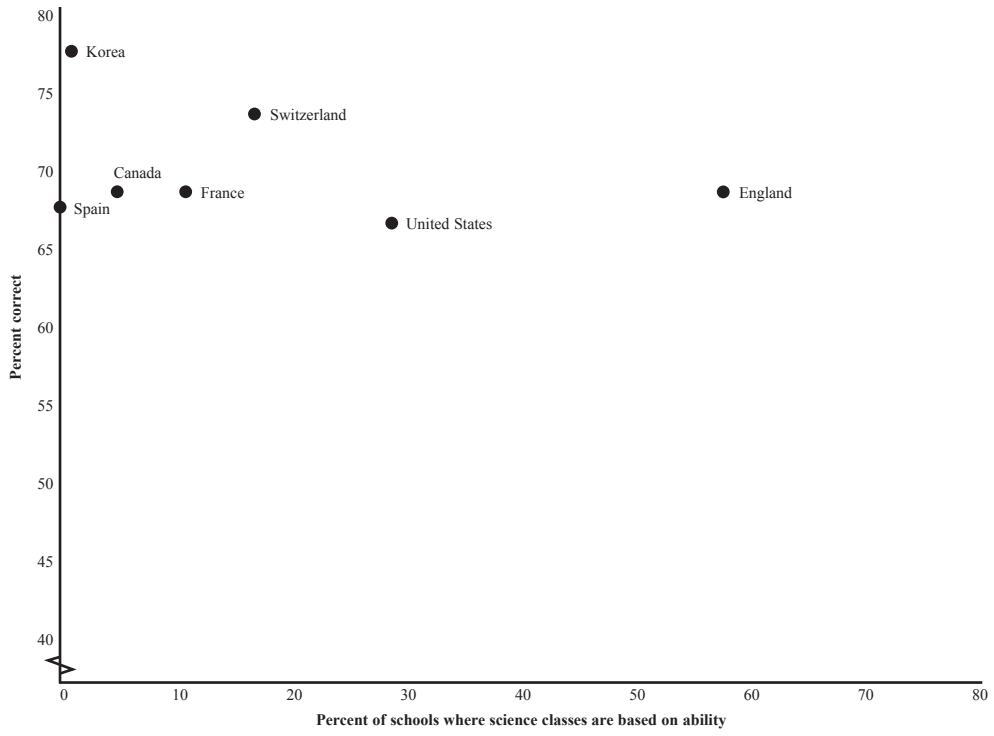
SOURCE | Educational Testing Service, International Assessment of Educational Progress, *Learning Science*, 1991.

year-olds in the seven other countries surveyed in 1991. Seventeen percent of students from England, who scored higher than U.S. students in mathematics, reported having daily lessons. Switzerland and Spain reported that 60 and 58 percent of students respectively received daily mathematics instruction.

In science, on average, about 30 percent of 13-year-old students in all countries surveyed had daily lessons. The figure was much higher in the United States, where 66 percent of students had daily science classes. Of the seven countries depicted in figure 4.16, England showed the lowest percentage of students who attended science classes daily (11 percent).

Arguments have long existed about whether organizing classes by ability level, often referred to as "tracking" in the United States, is a help or a hindrance to students. In some countries, tracking is commonplace, whereas in others, it is nonexistent. In the United States in 1991, about 56 percent of schools reported grouping mathematics classes for 13-year-olds based on ability, and 29 percent reported grouping science classes by ability. At the international level, the percentage of schools where classes were based on ability varied widely from country to country. In England, for instance, 92 percent of all mathematics classes, and 56 percent of all science classes, were based on ability. In Korea, on the other hand, no mathematics classes and only 1 percent of science classes were based on ability. In the majority of countries, a greater percentage of schools organized mathematics classes around ability levels than science classes.

figure **4.17** | **Ability grouping and achievement in science at age 13, 1991**



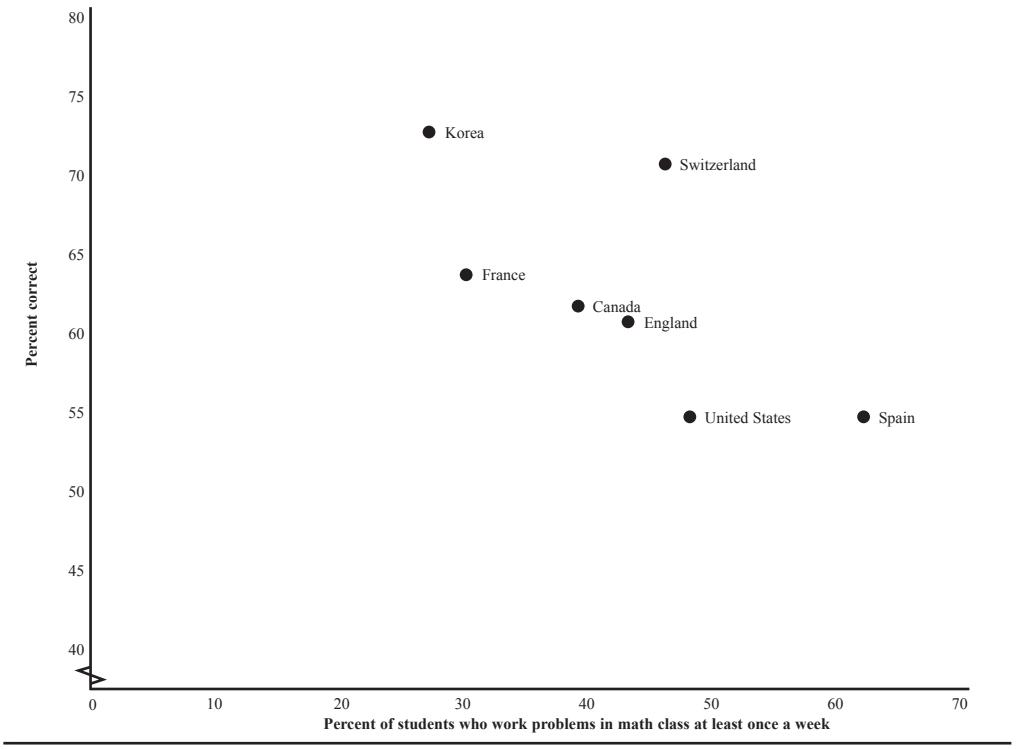
NOTE | Data are unavailable for Australia, Germany, Italy, Japan, and Sweden.

SOURCE | Educational Testing Service, *Learning Science*, International Assessment of Educational Progress, 1991.

However, comparative international data on frequency of lessons and ability-based grouping of classes do not seem to show any direct relationship to student achievement. Students in the United States received lessons in science and mathematics more frequently than did students in any other country, yet their achievement in science and mathematics still fell well below those of many of their peers in countries where students received lessons less frequently. Korea demonstrated relatively high achievement in mathematics, and reported one of the lowest percentages (32 percent) of students receiving daily mathematics lessons. The percent of students who listened to mathematics lessons every day varied widely across countries and generally did not show a correlation with achievement.

In the case of ability-based classes, the range of "tracking" practices among countries was even greater, but there is no evidence to show that tracking is either positively or negatively related to student achievement. For example, in both Spain, where students scored relatively low in mathematics in an 11-country comparison, and in Korea, where students scored relatively high, classes were grouped by ability in a relatively low percentage of schools. As seen in figure 4.17, 58 percent of science classes for 13-year-olds in England were grouped by ability, compared to 29 percent in the United States and 5 percent in Canada, yet 13-year-olds in all three countries answered approximately the same proportion of science questions correctly.

figure **4.18** | **Group work and achievement in mathematics at age 13, 1991**



NOTE | Data are unavailable for Australia, Germany, Italy, Japan, and Sweden.

SOURCE | Educational Testing Service, International Assessment of Educational Progress, *Learning Mathematics*, 1991.

Although little relationship was found between either frequency of lessons or ability grouping and achievement, at least one very specific type of classroom activity did appear to be related to achievement: the percentage of students who worked mathematics problems in groups at least once a week. The relationship between group work and achievement seemed to be a negative one, as illustrated in figure 4.18. Students in countries who worked more frequently in groups actually achieved at a lower level, on average, than their peers in countries who worked less frequently in groups. From the standpoint of the United States, these results were somewhat striking. In 1994, 49 percent of U.S. students worked problems in groups, a similar or higher percentage of students than in all other countries studied, with the exception of Spain, yet they scored either similarly or below their peers in the other countries examined. This relationship does not necessarily mean that group work caused lower achievement, however. Other characteristics of countries or schools where group work was prevalent (such as student/teacher ratios or the nature of the non-group activities) also may have had an impact on achievement.

Finally, certain types of school resources were examined in various countries to see if they were correlated with achievement. Previous research has shown, for example, that reading scores are related to the percentage of schools within countries that report having libraries. (IEA, 1992) While no data were available for a corresponding study of mathematics-oriented school resources, international information on science laboratories did allow for investigations of the relationship between achievement and school-based science resources (measured as a percentage of schools that have science labs).

In 1991, 76 percent of schools in the United States had science laboratories for 13-year-olds, a figure close to the average for all 7 countries studied. England reported that 100 percent of its schools at this age level had laboratories, while at the other end of the scale, 48 percent of schools in Switzerland reporting having them. With the notable exception of Switzerland, a relationship seemed to exist between countries whose students achieved relatively highly in science and those with a relatively large percentage of schools with science labs. Students in Switzerland counter this trend, however, scoring better, on average, than all other students except those from Korea, in spite of living in a country with one of the lowest percentages of schools with accessible laboratories.

Conclusion

Overall, in 1994, students in the United States achieved at a relatively higher level in reading, at a level close to or slightly above the average in science, and at a relatively lower level in mathematics than did their peers in a number of other developed countries. Data suggest that U.S. student performance in science at the middle school level may have improved between 1991 and 1994 relative to this set of countries.[8]

In general, there were some significant differences in achievement between boys and girls around the world. Specifically, the gender gap tended to favor girls in reading and boys in mathematics and science. More countries showed a gender gap in science than in either mathematics or reading except in 12th grade where 6 out of 7 countries shared significant gender difference in mathematics; gender differences in the United States only existed in science.

No home characteristic and few school characteristics examined were strongly associated with achievement.

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[8] This note must be interpreted with caution. 1991 and 1994 data come from distinct surveys and may have substantial differences in terms of the ways that data were collected and processed. This result is interesting mainly because the relative standing of U.S. students in science at age 13 in 1994 is considerably higher than in 1991.

Schools in the United States provided a relatively larger number of hours of mathematics and science instruction per year, as compared to the 12-country average. Thirteen-year-old students in the United States received more instruction in science in 1991 than did students in any other country studied, while schools in Switzerland provided the greatest amount of instruction in mathematics. In general, mathematics instruction made up a larger amount of instructional time than did science instruction in almost all countries. Time spent on instruction did not appear to be related to achievement in any subject.

Classroom instructional methods varied widely from country to country. Most characteristics examined, such as frequency of lessons in particular subject areas, did not seem to have a definite relationship with student achievement. The practice of organizing classes around student ability ranged from prevalent in countries like England to nonexistent in Spain and Korea. Surprisingly, the one instructional method that yielded a clear correlation with achievement was classroom group work. Students in countries that spent more time working in groups in class consistently scored lower than those in countries that spent less time working in groups. In mathematics, for instance, 8th-grade U.S. students spent more time working in groups than in any other country, and achieved at a comparatively lower level in mathematics.

In summary, the relationship between educational inputs and student outcomes is a complicated one. However, there appears to be a clear indication that quantity of instruction itself is not a determining factor in student achievement. Quality of instructional effort—a more elusive factor—may be assumed to play a more pivotal role. Yet, no one input appears to be directly related to student achievement. Rather, a combination of factors involving teachers, class sizes, instructional time and methods, resources, and the home environment may be at work in determining levels of student achievement within developed countries.

5

Labor Market and Other Outcomes

Chapter 5 Labor Market and Other Outcomes

Academic achievement is only one measure of the success of countries' elementary/secondary school systems, but one with the distinct advantage of allowing for periodic assessment. However, many policy makers would argue that the most important measure of an educational system's success is its final product—namely young people who have mastered the skills necessary for full participation in society, and specifically in the workforce. International comparisons of adult literacy, labor market participation, unemployment rates, and salaries provide some indication of the success countries have in preparing students for their ultimate destination—the world outside of school.

Chapters 2 and 3 of this report described inputs and characteristics of the education systems of the G-7 and other competitive nations, including characteristics of teachers, schools, and students, as well as financial resources devoted to each education system. Chapter 4 addressed one major educational outcome measure: student achievement. This chapter attempts to examine the broader outcomes of elementary and secondary education, including:

- school completion rates,
- student progression to higher education levels,
- levels of adult literacy, and
- labor market outcomes.

In all of the developed nations analyzed, completion of an upper secondary education, the equivalent of U.S. high school graduation, is a critical goal of elementary and secondary education. When assessing the quality of an education system, one crucial measure obviously is the percentage of students completing secondary education. Progression to tertiary (higher) education also provides an indication of the value a society places on higher education, higher-order thinking skills, and the development of specialized knowledge. These measures of persistence in the education system comprise the first visible outcomes of the elementary/secondary education system.

Another immediate and measurable outcome of elementary and secondary schools is the degree to which they prepare students to become literate adults. Literacy is currently viewed as one of the fundamental tools for successful economic performance in industrialized societies. The ability to understand and use printed information in developed nations is becoming increasingly important due to structural changes in the economies of many countries that place greater demands on literacy and analytic skills (OECD, 1997). Because many students choose not to pursue tertiary education, the literacy skills of adults who complete elementary and secondary education is an important measure of the effectiveness of countries' school systems. Other important indications of the relative effectiveness of school systems include labor market

outcomes. Upon completing an upper secondary education, many students elect to enter the labor force immediately. Their success rates in finding employment and earning a competitive salary are measures of both the importance of the skills and the depth of the knowledge they have gained in elementary and secondary school. Whether the skills they learn are sufficient for them to compete in the labor force is reflected in their unemployment rates and in their respective earnings. Comparisons of these measures for people with different levels of educational attainment indicate the amount of relevant knowledge and skills gained at each education level. However, relative economic situations influence overall comparisons from country to country.

The data reported in this chapter on enrollment and completion rates, as well as on labor market outcomes, were collected primarily through OECD, although some of the U.S. data come from large-scale surveys conducted by NCES. The adult literacy data were gathered from the International Adult Literacy Survey (IALS), a collaborative effort among 12 governments and three intergovernmental organizations to report literacy skills of a sample of 1,500 to 1,800 adults per country. In 10 countries, the survey was conducted in the national language; in Canada, respondents were given a choice of taking the survey in either English or French. In Switzerland, respondents in French-speaking and German-speaking cantons responded to survey questions in their own languages.

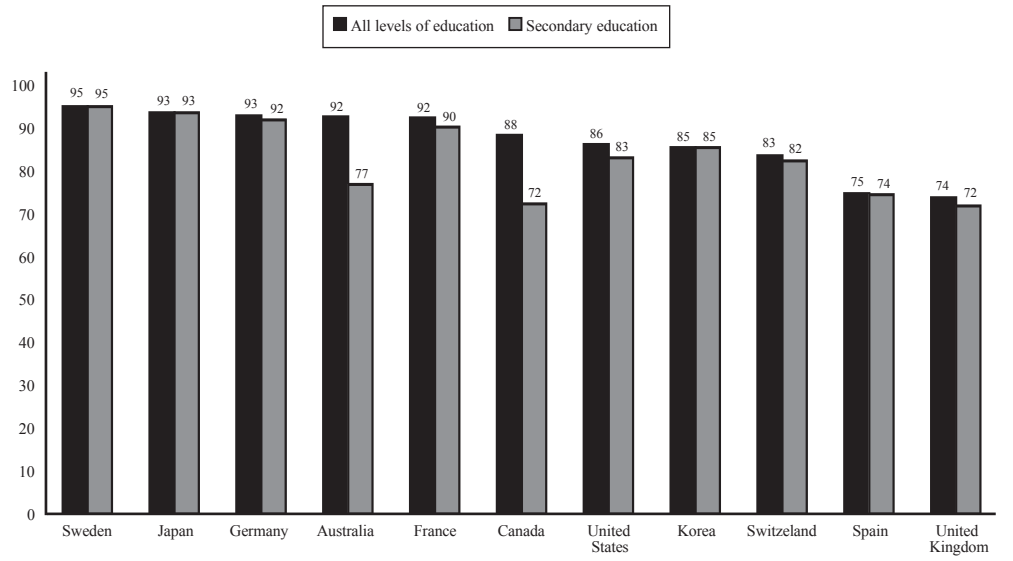
The data examined here first detail the percentage of students in each country who remain in school past the age of compulsory education and who go on to complete an upper secondary education, and then focus on the percentage of students who continue on to tertiary education. In addition, adult literacy levels are examined across countries by levels of educational attainment to determine how well elementary and secondary schools in different countries help students to develop the literacy skills needed as adults. Finally, we explore the ability of students with no more than an upper secondary education to compete in the labor market, become employed, and earn favorable salaries.

What percentage of students is enrolled in secondary education at the age of 17?

The final year of compulsory education ranges from age 14 in Italy and Korea to age 18 in Germany; the modal final age of mandatory attendance among the 12 countries examined here is age 16. The percentage of 17-year-olds—who are at least one year beyond compulsory education in all countries except Germany and some states in the United States—enrolled in education indicates the value that students place on education, its relative importance in society, and the accessibility of education beyond the age at which compulsory education ends. In many countries, the years of compulsory education are free of charge, but beyond that, students must pay to further their education. For example, Japan charges tuition after the period of compulsory education is over for students wishing to complete their upper secondary education and continue on to higher education. The United States also charges tuition for its higher-education programs, although public elementary and secondary education is free to students, regardless of whether they have passed the mandatory age of attendance.

Figure 5.1 shows both the percentage of 17-year-olds enrolled in upper secondary education and the percentage enrolled at any level. In 1994, the percentage of 17-year-olds enrolled in secondary school varied somewhat, ranging from 72 percent in the United Kingdom and Canada to 95 percent in Sweden. Sweden, Japan, France, and Germany all reported secondary

figure **5.1** | **Percentage of 17-year-olds enrolled in secondary education and all levels of education, 1994**



NOTE | Data are unavailable for Italy.

SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

enrollment rates of 17-year-olds above 90 percent. Although the numbers were much lower in Canada, this is due primarily to the fact that 16 percent of Canadian 17-year-olds were already enrolled in postsecondary education. Thus, 88 percent of Canada's 17-year-olds were enrolled in some level of education. Australia also showed a much larger percentage of 17-year-olds enrolled in all levels of education than in secondary education. Again, as in Canada, about 16 percent of 17-year-olds in Australia were already enrolled in higher education.

Fewer 17-year-olds in the United Kingdom were enrolled in secondary education than in any other country. Furthermore, fewer were enrolled in any level of education. The typical age of graduation for secondary school in the United Kingdom is 16, so the relatively low number of 17-year-olds in upper secondary school may be due to the fact that many of them have already graduated and entered the labor force. At the high end, Sweden reported that 95 percent of its students were enrolled at some level of education, and virtually all of these were enrolled in secondary school; Japan and Germany reported that 93 and 92 percent of their 17-year-olds were enrolled in some level of education, respectively. The United States reported that 83 percent of its 17-year-olds were enrolled in secondary school and 2 percent were enrolled in university education. Some 17-year-olds, however, had completed secondary school and were not enrolled in any postsecondary program, and about 2 percent were enrolled in non-university programs.

What percentage of the population completes upper secondary education?

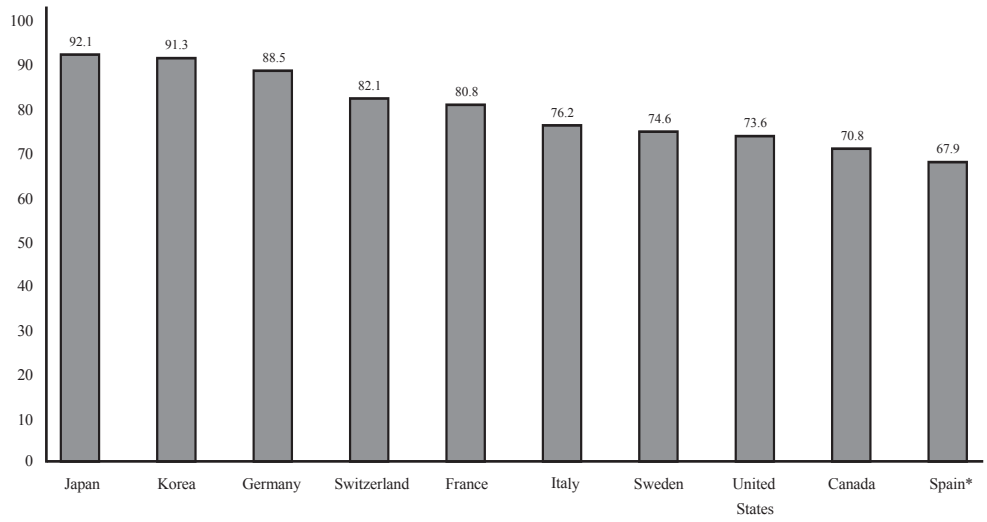
The percentage of students who not only continue in school beyond the age of compulsory education, but also remain long enough to complete upper secondary education is an indication of the relative effectiveness of countries' education systems. This measure can also be used to gauge a country's capacity for sustained economic growth and competitiveness. It again indicates the importance of education to the public and the government, and provides and indirect measure of a nation's supply of citizens with a specified amount and kind of knowledge and skills.

Completion of upper secondary education is measured as the ratio of upper secondary graduates to the population at the typical age of graduation. For example, in the United States this ratio would be the number of high school graduates divided by the number of 17-year-olds in the population. It is important to remember, however, that these figures do not represent exact graduation rates, as they are only ratios. They do not, for example, take into account the students who complete upper secondary education in an atypical program. In the United States, for example, a moderate percentage of the population does not receive a standard high school diploma by graduating from high school, but instead takes the General Education Development (GED) examination. The GED is a high school equivalency examination taken either at the typical age of graduation or, more often, later in adulthood. These completers are not counted as regular high school graduates. Many adults who have dropped out of school take this test later in order to obtain the equivalent of a high school diploma. For example, in 1994, about 480,000 GED credentials were issued in the United States, a number that continues to increase, and over half of these GEDs went to those between the ages of 17 and 25 (U.S. Department of Education, NCES, 1996g). Including these non-traditional graduates could significantly increase the U.S. graduation ratio.

As seen in figure 5.2, Japan and Korea had the highest ratios of upper secondary graduates — over 90 percent — followed by Germany at 89 percent. Spain reported the lowest ratio of 68 percent. The United States reported a ratio of 74 percent of upper secondary completions to graduation-age population, a figure higher than that of only Canada and Spain.

Several countries show significant gender differences in graduation ratios, with some favoring men and others favoring women. For example, in Canada, 66 percent of men at the typical age of graduation completed their secondary education in 1994, compared to over 75 percent of women. Likewise, in Spain, 61 percent of men graduated upper secondary school compared to 75 percent of women, and in Italy, 73 percent of men graduated compared to 80 percent of women. In the other direction, almost 87 percent of men in Switzerland were upper secondary graduates at the typical age of graduation compared to 77 percent of women. The differences in graduation ratios between genders were smaller in the United States, France, Germany, and Sweden, and virtually non-existent in Korea (see table 5.7 in appendix A).

figure **5.2** | **Ratio of upper secondary graduates to population at typical age of graduation, 1994**



*1993 data.

NOTE Data are unavailable for Australia and the United Kingdom.

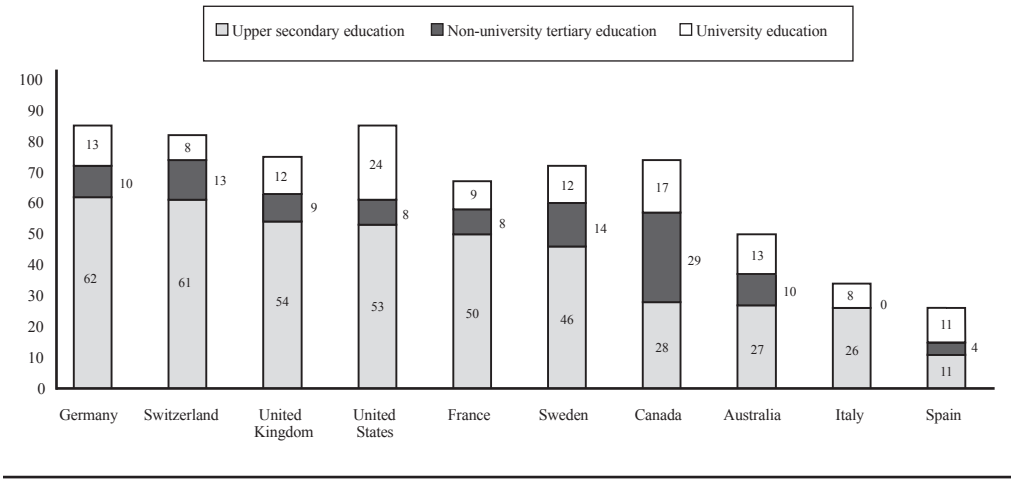
SOURCE Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

What are the education attainment levels of adults in the various countries?

The length of time that adults spent in school is an indicator of the amount of knowledge in a country's labor force, the availability of education there, and the country's commitment to the education of its population. One way to measure attainment levels is to examine the proportion of a population that has completed at least an upper secondary education. In 1994, 85 percent of the population in the United States age 25 to 64 had attained at least a high school diploma. This is the highest percentage of adults completing an upper secondary education of the 10 countries examined. The United States is followed by Germany (84 percent), Switzerland (82), Canada (74), the United Kingdom (74), Sweden (72), and France (67). Italy and Spain reported the lowest percentage of the population attaining at least an upper secondary education (33 and 26 percent, respectively).

The percentage of a population that has attained an education level higher than upper secondary may indicate the percentage of the work force with specialized knowledge and skills in advanced subjects. In the United States, 32 percent of the population completed some tertiary education—more than that in any other country except Canada (46 percent). In Sweden, 26 percent of the population attained some tertiary education, compared to 21 percent in the United Kingdom and Switzerland and 19 percent in Germany.

figure **5.3** | **Percentage of population age 25-64 by highest level of education completed, 1994**



NOTE | Data are unavailable for Japan and Korea.

SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

Figure 5.3 provides a composite picture of the level of education adults possess in each country. Differences between the graduation ratios for 17-year-olds in a country and the percentage of adults completing secondary education are partially a reflection of the strength of the adult education system in that country as well as the availability of alternate means of completing secondary school. Adult education provides an avenue for acquiring new knowledge and upgrading workers' skills. As an example, in 1995, 40 percent of adults in the United States participated in adult education activities, up from 32 percent in 1991 (U.S. Department of Education, NCES, 1996h). Adult education may provide further education as the job market or an individual's interests change; it is not, however, a reflection of the success of a country's elementary and secondary school system.

The next important question to ask regarding a country's educational outcomes is "What do people do with an upper secondary education?" Potentially, graduating students could:

- continue on to higher education,
- enter the labor force and become employed,
- enter the labor force and be unemployed, or
- neither continue with education nor enter the labor force.

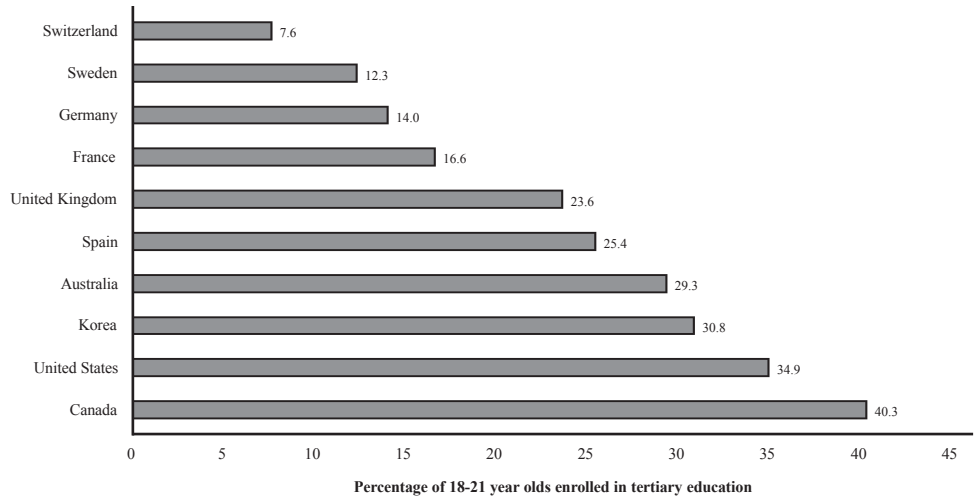
The last three options are also available to those who never complete an upper secondary education. It is thus important to examine participation rates in higher education within each country, as well as to look at labor market participation and earnings for those with an upper secondary education compared to those with higher or lower levels of education.

Are completers of a secondary education prepared and able to continue their studies in higher education?

A portion of students elect to remain in school following completion of upper secondary school. They may either continue with a junior college type of education or enter a four-year university. The type of education provided by technical or trade schools or the equivalent of a U.S. junior or community college provides occupationally oriented programs that prepare students for a specific job or career. University education provides students with broader experiences and knowledge and may prepare them for a wider variety of careers. Rates of enrollment in both non-university and university education provide an indication of access to higher education and of the need for higher knowledge and specialized skills in the workplace. A high rate of enrollment in tertiary education reflects both a demand for high-level abilities and the value placed on educational attainment in a particular country. Ideally, we would like to examine the percentage of secondary school completers who continue on to higher education. However, data are not available for this analysis. Instead, we will look at the percentage of students enrolled in higher education at various ages.

The traditional age of enrollment in higher education varies between countries. Historically, enrollment in higher education has tended to immediately follow completion of secondary school. In France and the United States, for example, more than three-quarters of all first-time entrants in higher education were age 20 or younger in 1994. In other countries, the transition is more prolonged, allowing for more flexibility in work and supplemental studies. In Sweden, for example, more than half of first-time entrants were over the age of 21. So, different completion ages at the secondary level as well as variation in the length of time students work or take preparatory classes before entering higher education may both influence the typical age of

figure **5.4** | **Enrollment in public and private tertiary education for persons 18-21 years of age, 1994**



NOTE | Data are unavailable for Italy and Japan.

SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators,* 1996.

enrollment in a country. At all ages, however, enrollment rates in higher education vary tremendously across countries. At age 19, for example, enrollment rates in 1994 ranged from 3 percent in Switzerland to 29 percent in Canada. These differences may reflect varying degrees of access to higher education or differences in perceived benefits of a higher education.

To minimize the effects of late starting ages, 18- to 21-year-olds are examined as a group in this analysis. As seen in figure 5.4, in 1994, Canada had the highest proportion of 18- to 21-year-olds in tertiary education, followed by the United States, at 40 and 35 percent, respectively. Switzerland had the lowest proportion of 18- to 21-year-olds in tertiary education—fewer than 10 percent.

How have these trends in enrollment changed over time?

The previous discussion focused on the most current enrollment and completion rates. However, changes in enrollment or completion rates may reflect public policies aimed at improving access to education, shifts in societal perceptions of the desirability of advanced education, or a combination of the two. Trends may also help educators and economists predict future patterns of enrollment and completion. Because the countries we are focusing on provide universal access to education at least between the ages of 7 and 14, enrollment at these ages is at nearly 100 percent in all of the 12 countries (OECD, 1996). Therefore, the more interesting comparisons among nations concern the trends in educational participation rates for older students.

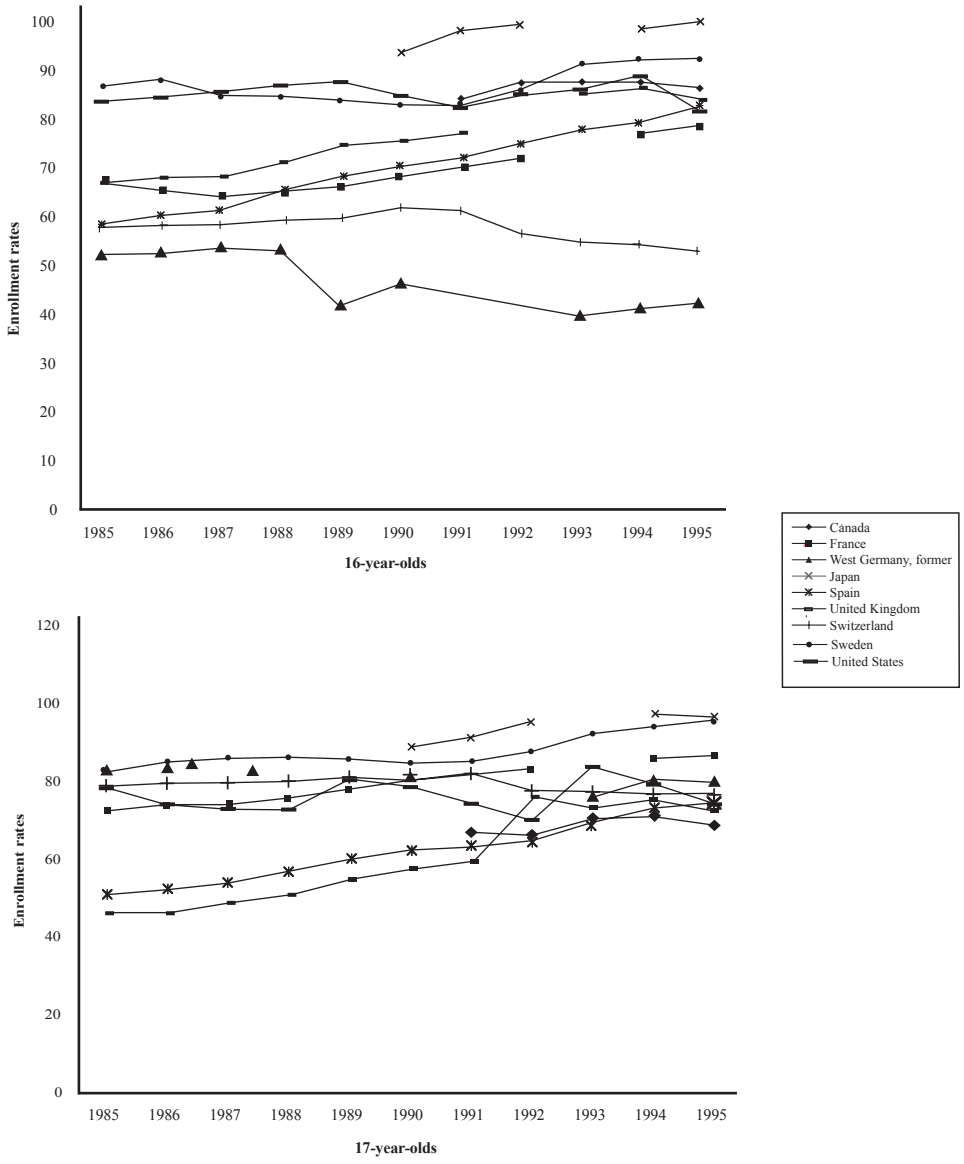
Many countries have had policies to broaden access to education, particularly to non-compulsory secondary education, and to encourage completion. Changes in participation rates therefore represent a measure of the success of education systems in retaining students in school through the upper secondary level. For example, as seen in figure 5.5, between 1985 and 1995, the percentage of 16-year-olds enrolled in secondary education increased by 24 percentage points in Spain, and by 17 percentage points in the United Kingdom, both of which set their age of mandatory attendance at age 16. Increased participation of the older age groups in education may indicate both a stronger emphasis on educational attainment and greater access to appropriate schooling. Indeed, enrollment rates of 17-year-olds increased between 1985 and 1995 in many OECD countries, most notably in Spain and the United Kingdom.

Overall, enrollment rates for upper secondary education drop off at ages 18 and 19, although several countries have seen rate increases over a nine-year period in the percentage of students enrolled in school at these ages. In France, enrollment rates for 18-year-olds increased by 19 percentage points between 1985 and 1995. Rates also increased in Sweden (nearly 42 percentage points) and Spain (16 percentage points), and in several other countries to a lesser extent. The largest increases in 19-year-old enrollment between 1985 and 1995 were seen in France (19 percentage points), Sweden (13 percentage points), and Spain (12 percentage points). Both the United Kingdom and Sweden showed large jumps in enrollment at all ages 16–19 between 1991 and 1994.[1]

As mentioned earlier, progression to higher education is only one possible outcome of upper secondary education for individual students. Another more general measure of secondary outcomes is the literacy levels of graduates. The ability to communicate effectively is critical for further attainment and labor force outcomes and is another measure of the success of the elementary/secondary school system.

[1]Some of these increases could be due to definitional changes rather than true increases in enrollment.

figure **5.5** | **Secondary enrollment rates of 16- and 17-year-olds, 1985–95**



NOTE | Data are unavailable for Australia, Italy, and Korea.

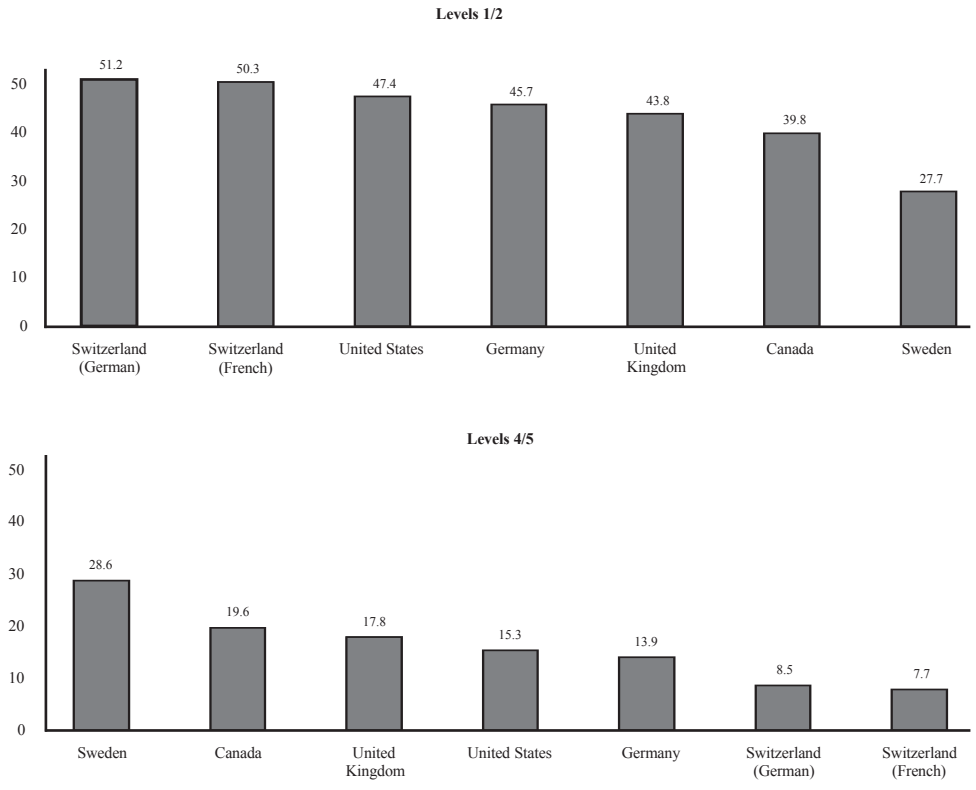
SOURCE | Organization for Economic Cooperation and Development (OECD), Education Database; U.S. Department of Commerce, Bureau of Census, International Database.

How do literacy levels of adults vary with educational attainment?

Adult literacy among citizens in 12 countries[2] was measured along three dimensions:

- Prose literacy measures the knowledge and skills required to understand and use information from texts, including editorials, news stories, poems, and fiction.
- Document literacy measures the knowledge and skills required to locate and use information contained in various formats, including job applications, payroll forms, transportation schedules, maps, tables, and graphics.
- Quantitative literacy measures the knowledge and skills required to apply arithmetic operations, either alone or sequentially, to numbers embedded in printed materials. These operations might include: balancing a checkbook, figuring a tip, completing an order form, or determining the amount of interest on a loan from an advertisement.

figure **5.6** | **Proportion of the adult population age 25-64 that has completed upper secondary education, by prose literacy level, 1994**



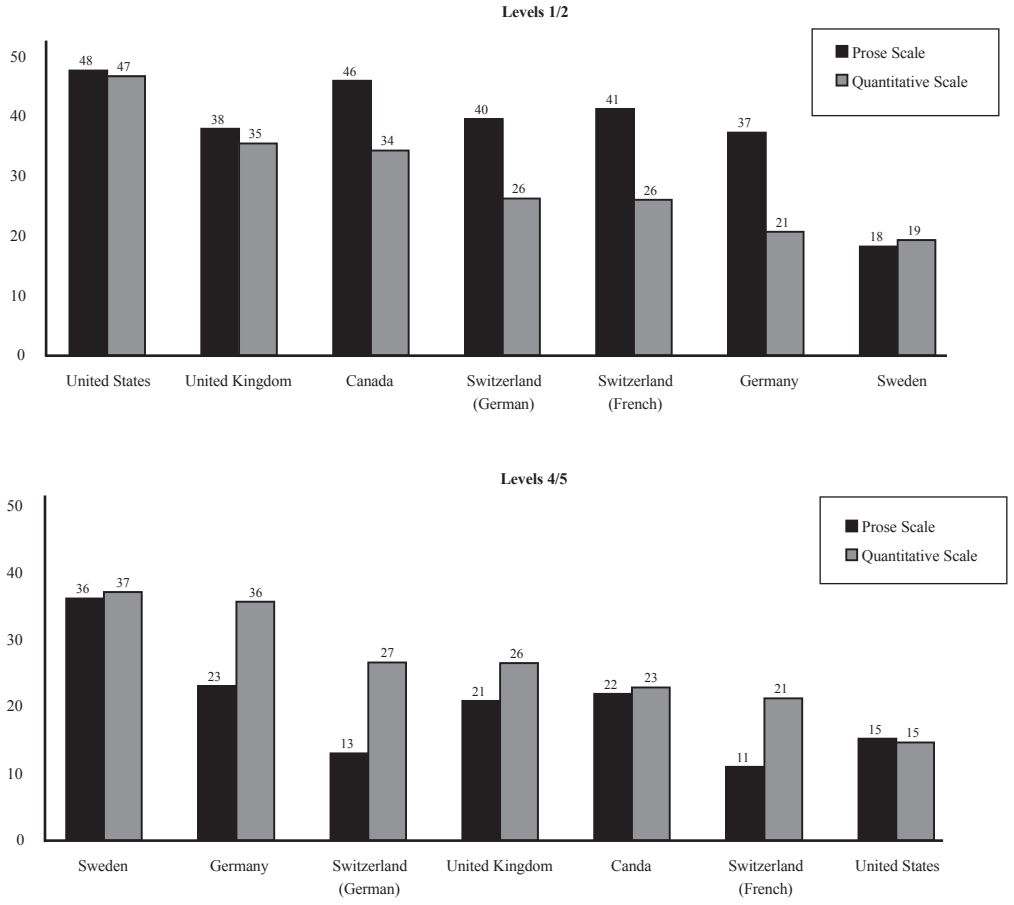
NOTE | Data are unavailable for Australia, France, Italy, Japan, Korea, and Spain.

SOURCE | Organization for Economic Cooperation and Development, *Literacy Skills for the Knowledge Society*, 1997.

[2]Literacy scores will be discussed for only six countries; scores for Belgium, the Netherlands, Ireland, New Zealand, and Poland are included in the appendix, but are not discussed in this section. Australia also participated in the IALS, but has asked us not to report on their scores.

Each scale was divided into five levels based on specific criteria, with level 1 representing the lowest level of literacy, and level 5 the highest level. Adults with higher literacy levels, as measured by scores on each of these three scales, may function more competently in society and obtain better jobs than those with lower scores.

figure **5.7** | **Distribution of the adult population age 26-35 that has completed upper secondary education, by prose and quantitative literacy level, by country, 1994**



NOTE | Data are unavailable for Australia, France, Italy, Japan, Korea, and Spain.

SOURCE | Organization for Economic Cooperation and Development, *Literacy Skills for the Knowledge Society*, 1997.

U.S. adults with no more than a high school diploma had weaker literacy skills than their counterparts in other major, industrialized countries with equivalent levels of education. In all countries focused on here except the United States, 10 percent or less of adults who completed an upper secondary education scored at the lowest level of literacy.[3] In the United States, between 17 and 21 percent of adults with a high school diploma did not display skills above literacy level 1. In other words, about one-fifth of U.S. high school graduates with no postsecondary education were able to perform only routine tasks involving simple documents, and some were unable to respond even to a written survey. Moreover, about 50 percent of U.S. adults who had completed high school scored at the two lowest levels on each literacy scale (see figure 5.6 for prose literacy). While a larger proportion of secondary school completers in Switzerland scored at the lowest two levels on the prose literacy scale, about one-third of

[3]See appendix B for an explanation of the different literacy levels.

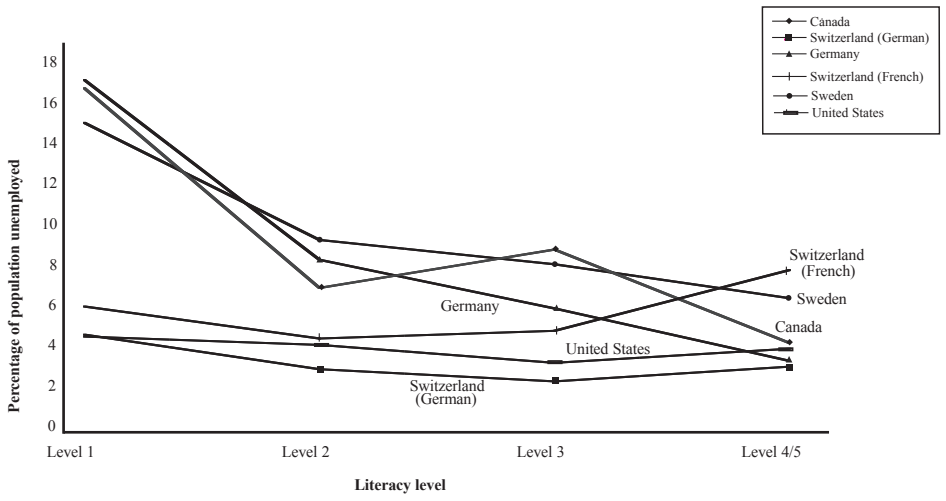
them scored at the lowest level on the document and quantitative scales. U.S. adults scored consistently low on all three scales.

On the other hand, few U.S. adults demonstrated skills associated with the highest levels of literacy, and 18 percent or less of U.S. adults who finished high school reached the highest levels on any scale. In contrast, about one-fourth of Canadian and German adults and about 36 percent of Swedish adults who completed secondary school reached literacy levels 4/5 on the document scale (see figure 5.7).

In every country, more education was associated with higher literacy levels. Very large differences in literacy performance between those with the highest level of education and those with less education were seen in the United States: 5 percent of U.S. adults with at least a four-year degree performed below literacy level 2, while 48 percent of these adults attained the highest literacy levels for prose literacy. Likewise, with the exception of Sweden, no more than 2 percent of the population of any country with only a elementary school education achieved literacy levels of 4 or 5 on either the prose or the document scale.

When we focus only on younger adults, those who completed elementary and secondary school most recently, we find that, in general, younger secondary school completers score slightly better than the entire population of secondary school completers. For example, about 14 percent of all German adults with a secondary school education achieved at the top prose literacy levels, but about 23 percent of 26- to 35-year-old Germans who completed a secondary school education did so. In Sweden, about 29 percent of all adults with a secondary school education achieved at the highest levels of prose literacy compared to 36 percent of younger adults. The United States was an exception to this rule: about the same percentages of U.S. 25- to 64-year-olds as U.S. 26- to 35-year-olds with a high school diploma reached levels 4 and 5 on the quantitative literacy scale. Overall, however, U.S. 26- to 35-year-old secondary completers demonstrated lower literacy levels than their international peers in most of the countries.

figure **5.8** | **Percentage of the population age 16-65 at each literacy level who are unemployed, 1994**



NOTE | Data are unavailable for Australia, France, Italy, Japan, Korea, Spain, and the United Kingdom.
SOURCE | Organization for Economic Cooperation and Development, *Literacy Skills for the Knowledge Society*, 1997.

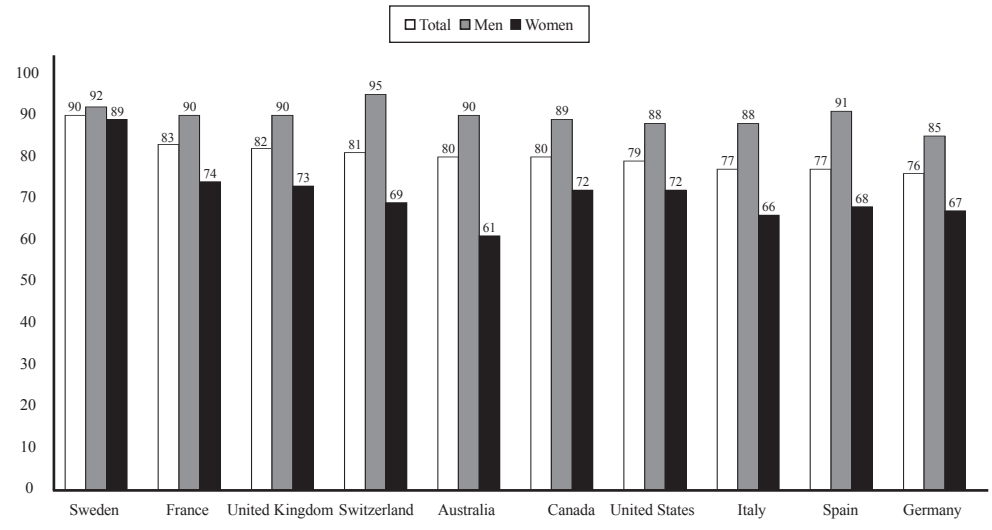
Among secondary school completers, those with higher literacy levels are less likely to be unemployed. For example, 16 percent of German secondary school completers who achieved level 1 on the prose literacy scale were unemployed, compared to 3 percent who achieved at levels 4 or 5. In Canada, over 10 percent of secondary school completers who scored at the lowest level on the prose scale were unemployed compared to less than 5 percent who scored at the highest levels. This trend was less apparent, however, in countries that had low rates of unemployment overall. U.S. high school graduates, for example, showed almost no variation in employment rates among the different literacy levels. About 3 to 5 percent of the population with only a high school diploma were unemployed, regardless of literacy score. On the quantitative scale, however, U.S. adults scoring at level 1 were slightly more likely to be unemployed than those scoring at the higher levels.

In short, a connection is generally evident between literacy and employment, as seen in figure 5.8. This connection raises a related question of how well an upper secondary education prepares students for entry into the labor force. This question can be addressed by looking at labor force participation rates, unemployment rates, and relative salaries of secondary school graduates.

What percentage of upper secondary graduates are in the labor force?

The success of an elementary and secondary school system can be judged partially on the ability of its graduates to enter the labor force. This analysis explores the proportion of students who completed an upper secondary education and obtained a job, thus measuring labor force participation as an outcome of upper secondary education. Ideally, we would like to examine the percentage of secondary school completers immediately entering the labor force, or at least focus

figure **5.9** | **Labor force participation rates of population age 25-64 with an upper secondary education, by gender, 1994**



NOTE | Data are unavailable for Japan or Korea.

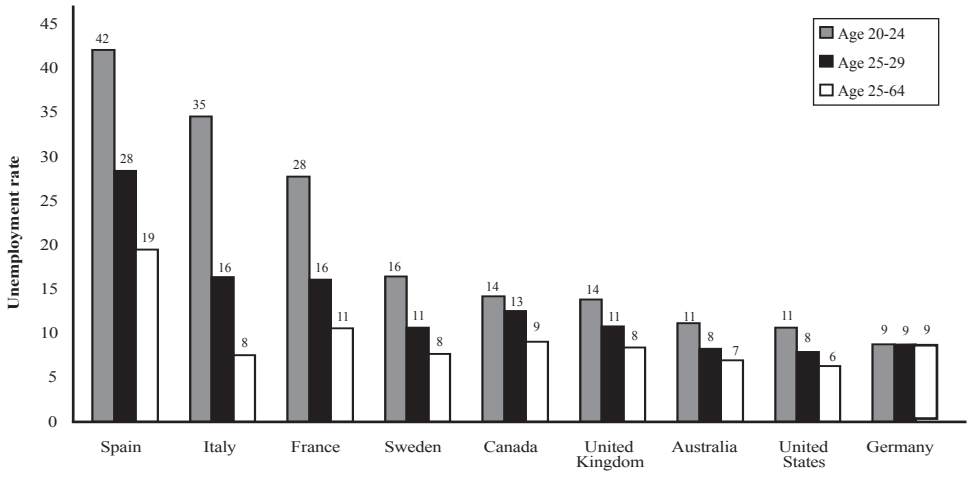
SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators,* 1996.

on labor force participation rates of a younger age cohort, such as 25- to 34-year-olds. However, data are not available for these analyses, so we look at the overall adult population, age 25 to 64. Over three-fourths of 25- to 64-year-olds with an upper secondary education participated in the labor force in all countries. Figure 5.9 shows that participation ranged from 76 percent in Germany to 90 percent in Sweden. With a 79 percent participation rate, the United States fell in the low to middle range of the countries studied. Overall, participation rates for those who completed upper secondary education were much higher than for those with less than an upper secondary education. The differences in participation rates between these two groups were especially large in the G-7 countries and in Spain. Less of a difference in participation rates existed between those with an upper secondary education and a university education.[4] For example, in 1994 in the United States, 79 percent of those who completed an upper secondary education participated in the labor force, compared to 58 percent of those with less education and 88 percent of those with a university education. Sweden was one country that showed very little difference in labor force participation rates among citizens with different educational attainment levels. Recall, as well, that Swedish adults also demonstrated the highest levels of literacy of all countries studied regardless of education level.

? *What percentage of those with an upper secondary education are unemployed?*

Although most of those with an upper secondary education enter the labor force, the percentage of these labor force participants that are actually employed compared to completers of other

figure **5.10** | **Unemployment rates of persons with an upper secondary education, 1994**



NOTE | Switzerland is not shown in this figure because data are available only for 25- to 64-year-olds and not for the younger age groups. Data are also unavailable for Japan and Korea.

SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators,* 1996.

[4] See appendix table 5.19 for details.

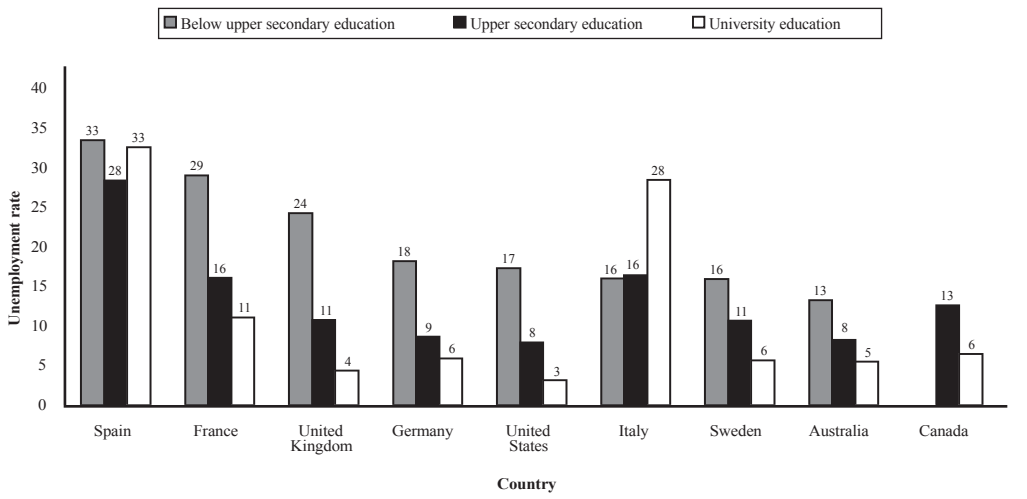
levels of educational attainment indicates the real employment potential of an upper secondary education. Comparison across levels within a country rather than across countries can help to compensate for different general economic conditions. This statistic indicates the relative importance of completing an upper secondary education, as opposed to leaving the formal educational system earlier or continuing with higher education. We will focus first on unemployment rates for the overall population of secondary school completers in the labor force, in order to learn about the general state of countries' economies, and then examine how the younger cohort of secondary school completers fares in terms of unemployment.

Across all the countries with available data analyzed, between 3 and 19 percent of 25- to 64-year-olds in the labor force with an upper secondary education were unemployed in 1994, with Switzerland reporting the lowest rate of unemployment and Spain reporting the highest. In the G-7 countries, the range fell between 6 and 11 percent. The United States had one of the lowest rates of unemployment for this population at 6 percent.

When focusing on 20- to 24-year-olds alone who have attained an upper secondary education, the unemployment rate ranged from 9 percent (Germany) to 42 percent (Spain) for the nine countries analyzed. Once again, the unemployment rate in the United States was relatively low—11 percent. Looking at 25- to 29-year-olds, we see similar patterns across the countries, although overall the unemployment rate is lower (see figure 5.10).

It is important to keep in mind, however, that unemployment rates reflect both the education level of individuals and the health of the nation's economy as a whole. When making comparisons across countries, nations' relative wealth has more of an impact on relative unemployment rates than do individual education levels, but within each country, a correlation

figure **5.11** | **Unemployment rates by level of attainment for adults age 25-29, 1994**



NOTE | Data are unavailable for Japan, Korea, and Switzerland.

SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators,* 1996.

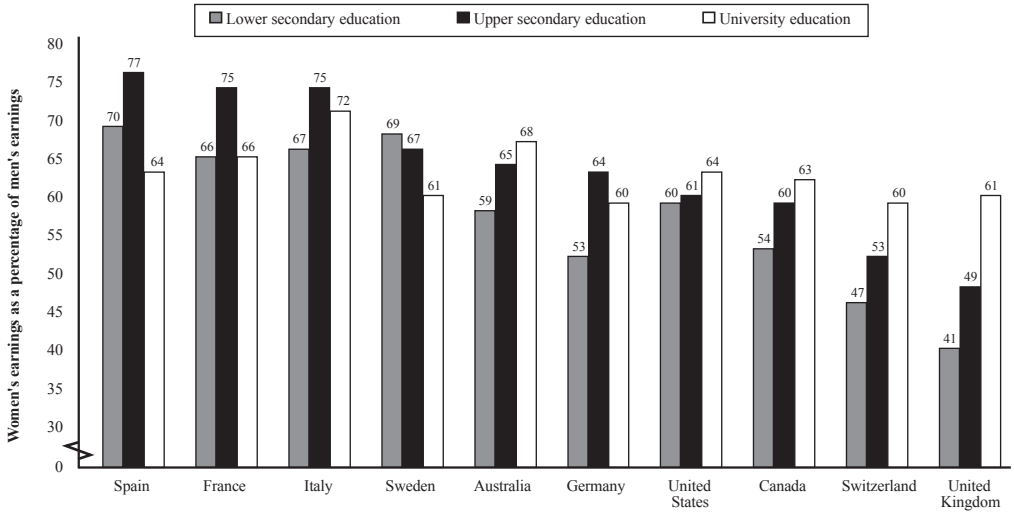
can be established between education and unemployment; specifically, unemployment rates decrease as education levels increase. Within each of the nine countries shown in figure 5.11, people with upper secondary education had lower levels of unemployment than those with lower secondary education or less, and higher levels than those with at least some tertiary education. The biggest educational effects on employment for 25- to 29-year-olds were observed in the United States, France, Germany, and the United Kingdom. For example, in the United States, the unemployment rate of 25- to 29-year-olds with less than an upper secondary education was 17 percent, compared to 8 percent for those with an upper secondary education and 3 percent for those with a university education.

With the exception of Italy and Spain, 25- to 29-year-olds with an upper secondary education reported much lower unemployment rates than those with less education, and a slightly higher rate than those with a university education.

Does secondary education produce graduates who are capable of earning good wages?

Salary differences among people with different levels of educational attainment provide another indication of the value society places on education. Salary differences observed among different education levels indicate that more education leads to higher-paying careers. For example, in the United States, it requires more than eight years of education beyond high school to become a physician—one of the highest-paying careers in that country.

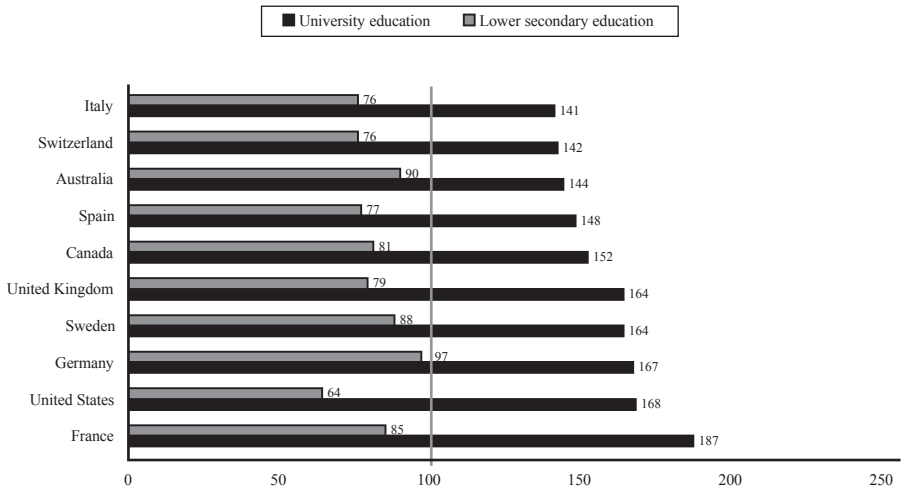
figure **5.12** | **Earnings of women as a percentage of earnings of men, by educational attainment, 1993 and 1994**



NOTE The most recent data are shown here. For some countries, 1993 was the most recent year of data; other countries have provided 1994 data. Data are unavailable for Japan and Korea.

SOURCE Organization for Economic Cooperation and Development, Education at a Glance: OECD Indicators, 1996.

figure **5.13** | **Relative earnings of men by educational attainment (upper secondary education = 100), 1994**



NOTE | Dashed vertical bar indicates 100 percent reference for those with an upper secondary education. The most recent data are shown here. For some countries, 1993 was the most recent year of data; other countries have provided 1994 data. Data are unavailable for Japan and Korea.

SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators,* 1996.

In all countries studied, more education was associated with higher average salaries. In addition, annual earnings of women were consistently below those of men across all countries, regardless of education level. Figure 5.12 shows that women's salaries were below 100 percent of those of men in all countries at all education levels. For example, in the United States, women with an upper secondary education earned, on average, 61 percent of the salary that men earned with the same level of education. This difference was particularly noteworthy in the United Kingdom, where women earned less than half the salary of men when both had completed an upper secondary education. In many countries, however, relative standing improved with education (including the United States, Canada, and the United Kingdom), meaning that the salary differential between men and women decreased at higher levels of education. Because their salaries are different, and education appears to have differential effects for men and women, their earnings are examined separately here.

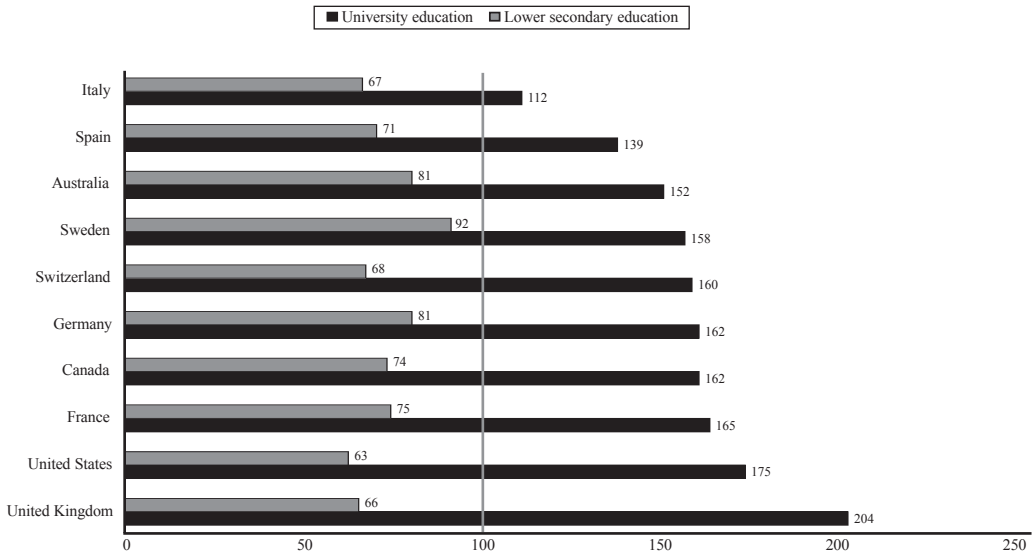
Educators, policymakers, and individuals are concerned about the earnings advantage that completing upper secondary education confers, since this level of education is supported and in many cases required. For men, the biggest differences between the earnings of those with an upper secondary education and those with less education were found in the United States. As shown in figure 5.13, U.S. men who had a lower secondary education (less than high school) earned about two-thirds of what those who possessed the equivalent of a high school diploma earned in 1994. The next largest salary differences for men with different levels of education were found in Italy, Switzerland, Spain, and the United Kingdom, where the earnings disadvantage for not completing upper secondary education was reported around 25 percent.[5] Most other countries also reported some earnings advantage for completing an upper secondary education, with one exception; very small salary differences were found in Germany between those who had and had not completed an upper secondary education.

[5]The term "earnings advantage" refers to the percent difference received in average salary for higher levels of education. For example, if the earnings advantage of attaining a high school diploma versus not completing high school is 24 percent, this means that, on average, people with a high school diploma have salaries that are 24 percent higher than people without a high school diploma.

How much of an improvement in earnings does a university degree offer over an upper secondary diploma?

In general, a larger salary difference was observed between those earning a university degree and those earning an upper secondary degree than between those earning an upper secondary degree and those with even less education. The biggest salary differences between those with upper secondary versus those with higher education were reported in France, where the earnings advantage of a four-year degree for men was 87 percent, followed by the United States

figure **5.14** | **Relative earnings of women, by educational attainment (upper secondary = 100), 1994**



NOTE | Dashed vertical bar indicates 100 percent reference for those with an upper secondary education. Data are unavailable for Japan and Korea.

SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators,* 1996.

and Germany, where the earnings advantage was 68 and 67 percent, respectively. The lowest earnings advantages were reported in Italy and Switzerland, at 41 and 42 percent, respectively. Thus, although completing an upper secondary education provided some earnings advantage, obtaining a university education increased observed earnings to even greater degree.

The same general trends were observed for women (figure 5.14); however, women experienced even greater earnings disadvantages for not completing secondary education. For example, in Canada and the United Kingdom, women with a lower secondary education earned 26 and 34 percent less, respectively, in 1994 than those with an upper secondary education, while men with the same education earned only 19 and 21 percent less, respectively. This implies that a greater earnings incentive exists for women to complete upper secondary school than for men. In addition, in the United Kingdom women reaped a larger earnings advantage for completing a four-year degree than did men (104 versus 64 percent).

Conclusion

Education attainment levels reported for the populations of the various countries studied indicated that most people in each of these nations completed an upper secondary education. The two exceptions were Italy and Spain, where less than 50 percent of 25- to 64-year-olds had attained at least an upper secondary education in 1994. In recent years, most students in all the countries participated in upper secondary education, and more then three-quarters of them completed it. The United States had one of the lowest high school completion rates, but these rates did not account for those people who choose to receive GED credentials instead of a high school diploma.

Less than half of those at the theoretical starting age for tertiary education actually enroll in a higher education program in any country studied. About one-third of 18-year-olds in the United States enrolled in a four-year college in the United States in 1992. In all countries, many students chose to enter a junior college or technical school, and the majority entered the labor force. The United States reported one of the lowest unemployment rates for those who have completed an upper secondary education. In all countries, however, unemployment status was directly related to educational attainment: the more education one had, the less likely he or she was to be unemployed. Likewise, salaries were also directly correlated with educational attainment: workers with a lower secondary education or less earned no more than two-thirds of the salaries earned by those with an upper secondary education. Those with a university education earned 40 to 100 percent more than those with only an upper secondary education. These relationships held true for both men and women.

In addition, across countries, literacy levels were related to both educational attainment and unemployment status. Generally, within countries, the more educated people are more literate and are more likely to be employed.

In conclusion, important educational outcomes appear to be strongly related to levels of educational attainment. This chapter highlights the importance, in all countries, of completing at least an upper secondary education in order to be more competitive in the labor market. In terms of literacy, unemployment, and salary, those with an upper secondary education fare better than those with less education, but on average fare less well than those with a university education. Despite lower literacy levels obtained by U.S. high school graduates, they function relatively well in the marketplace compared to other countries in terms of finding employment, indicating the important interaction between education, literacy, and employment with the overall economy. Germany and Sweden stand out as two countries whose population with an upper secondary degree has both low rates of unemployment and relatively high literacy levels.

6

Discussion

Chapter 6 Discussion

In response to increasing concern regarding the academic standing of U.S. students relative to students in other countries, this report analyzed both the achievement levels of students currently enrolled in elementary and secondary schools in mathematics, science, and reading and the lifetime outcomes of completers of secondary education in the United States and 11 other major industrialized nations. These lifetime outcomes included literacy rates, labor force participation rates, and unemployment rates. Furthermore, this report provided a framework to understand these educational outcomes by examining inputs into the education system such as characteristics of students, teachers, and classrooms, as well as the financial and human resources of countries' education systems. This framework allowed us to make comparisons between these educational inputs and outputs.

Research has shown that certain student characteristics such as language proficiency and poverty levels are associated with academic performance. In the United States, non-English-speaking students demonstrate lower school performance and are more likely to drop out before graduating (Bennici and Trang, 1995; Bradby, Owings, and Quinn, 1992; and Baker and de Kanter, 1983). Similar results are found for children living in low-income families (Duncan, 1994; 1993; Zill, 1991; and Jencks & Mayer, 1990). We might, therefore, hypothesize there would be a correlation between the proportion of a nation's students who speak a language other than the official language or the proportion of students living in poverty, and national average achievement scores. Specifically, we might expect countries that report high proportions of students speaking a language other than the official language and/or in poverty to demonstrate lower achievement scores.

In addition, it is a widely held opinion that the more money a country spends on its education system, the better the students should do. There is much conflicting research on this issue, however. Several studies have shown that when student and family background characteristics are controlled, school expenditures have relatively little effect on student achievement (Coleman et al., 1966, and Hanushek, 1994). While the debate over the issue of the relationship between educational resources and educational outcomes is still raging, some evidence suggests a link between per-pupil expenditures and student outcomes (Hedges, Laine, and Greenwald, 1994). This report then, looks at relationships between countries' financial support for education (e.g., expenditures as a percentage of GDP and per-pupil expenditures) and student outcomes, such as achievement and labor market outcomes.

In this discussion, we examine any connections between the various educational inputs and outputs by correlating countries' input measures described in chapters 2 and 3 of the report with output measures described in chapters 4 and 5.

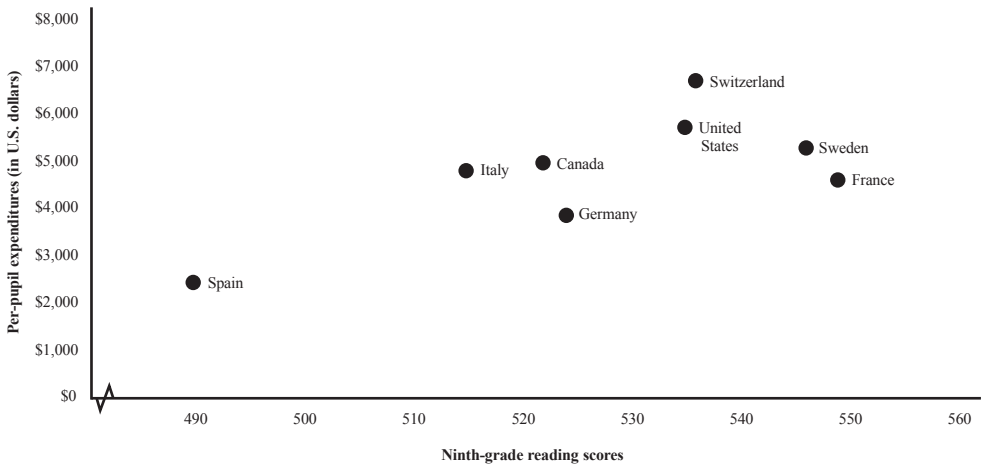
Findings

Our analysis examined the relationship between such educational inputs as student characteristics, teacher characteristics, classroom characteristics, and educational expenditures and educational outputs, including student achievement, school completion rates, tertiary enrollment rates, and labor force participation. Overall, almost none of the measured classroom, teacher, student, or financial inputs correlated with any of the achievement measures—test scores in mathematics, science, or reading—with the exception of per-pupil expenditures and ninth-grade reading scores.

Figure 6.1 shows the relationship between ninth-grade reading scores and per-pupil expenditures. As seen in the figure, most countries are clustered toward the middle to high end of both measures. Because this report focuses on industrialized nations, the graph only depicts countries that have relatively high per-pupil expenditures. No strong pattern emerges among these countries shown in the upper-right-hand corner of the graph. Spain, however, is an outlier, appearing by itself in the lower-left-hand corner. If Spain is removed, there is no significant correlation between ninth-grade reading scores and per-pupil expenditures. No other input measure correlated with this or any of the other achievement measures.

Next, we turn to secondary school completion and tertiary enrollment rates. Although no input measure correlated significantly with secondary school completion rates, one input did show a significant correlation with tertiary enrollment. Figure 6.2 shows that developed countries with high percentages of children in poverty, after accounting for government transfer programs, also had high percentages of 18- to 21-year-olds enrolled in tertiary education. The United States exemplifies this tendency by having high college enrollment rates and high poverty rates for

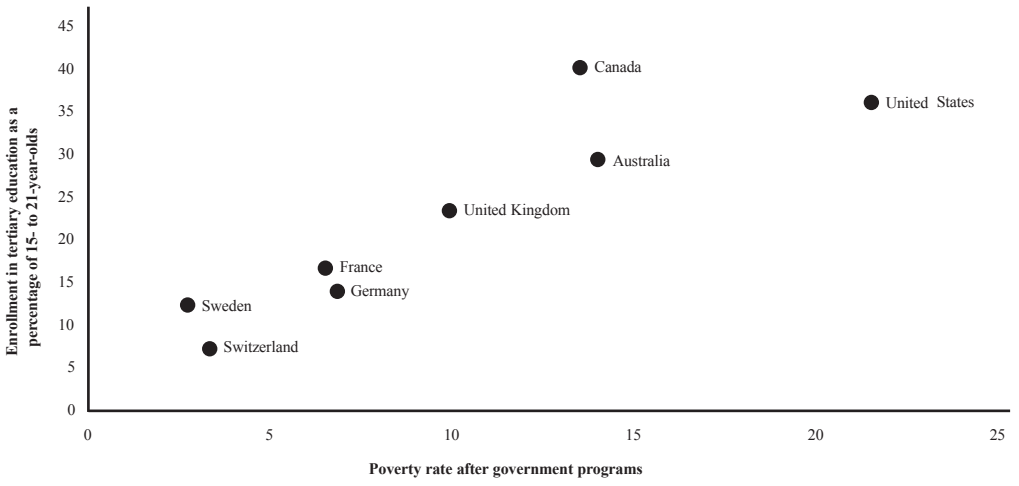
figure **6.1** | **Per-pupil expenditures and ninth-grade reading scores**



NOTE Data are unavailable for Australia, Japan, Korea, and the United Kingdom.

SOURCE Organization for Economic Cooperation and Development, unpublished data, 1997; and U.S. Department of Education, National Center for Education Statistics, *Reading Literacy in the United States: Findings from the IEA Literacy Study*, 1996.

figure **6.2** | **The percent of children in poverty and enrollment in tertiary education, 1995**



NOTE Data are unavailable for Italy, Japan, Korea, and Spain.

SOURCE Luxembourg Income Study estimates, and Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

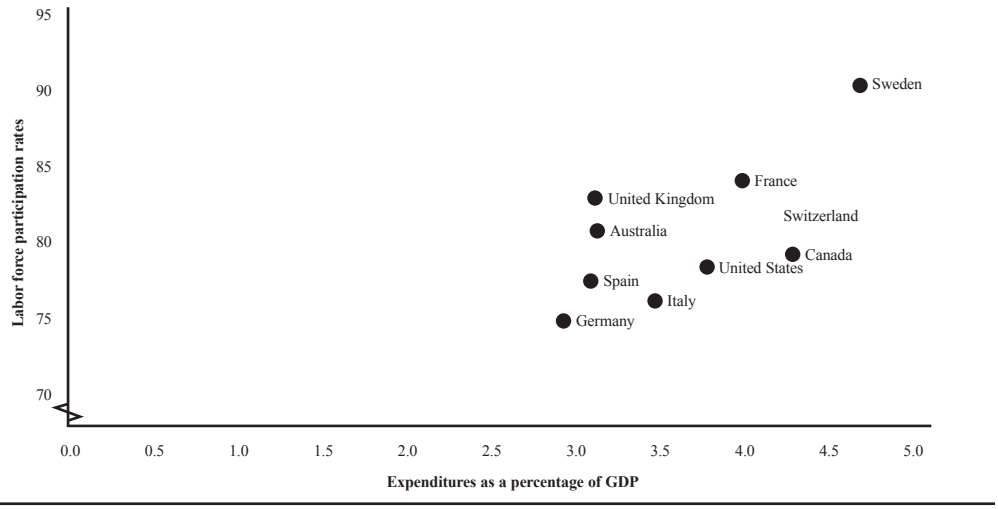
children. Compared to some other developed countries, the percentage of U.S. children in poverty does not decrease as much after accounting for government transfer programs. The positive correlation of poverty and college enrollment may result from such factors as the interaction of government funding decisions, availability and perceived value of higher education, and the nature (e.g. public versus private) of social service delivery programs.

Finally, input measures were correlated with the various labor market outcomes. One interesting relationship appeared between financial expenditures and a labor market outcome. Figure 6.3 shows a positive relationship between expenditures as a percentage of GDP and labor force participation rates. In other words, the greater proportion of money a government spends on education relative to its wealth, the more students with an upper secondary education enter the labor force. For example, Sweden reported both the highest level of expenditures as a percentage of GDP (4.7) and the highest labor force participation rate (90 percent). Similarly, Germany had both the lowest level of expenditures as a percentage of GDP (3.0) and the lowest labor force participation rate (76 percent). Both the United States and the United Kingdom fell in the middle of both categories.

No other input measure was associated with any of the other output measures. Furthermore, the associations mentioned above are either weak or counter intuitive, making it difficult to pinpoint which educational inputs have the greatest impact on educational or economic outputs. Recall that additional measures were examined in chapter 3 to determine whether certain home or school characteristics related to academic achievement. These relationships, too, were either moderate or non-existent. The amount of time students reported spending on homework was not associated with mathematics or science achievement. Time spent in the classroom studying mathematics and science was also not associated with mathematics or science proficiency scores. One significant relationship appeared between working in small groups in mathematics classes and mathematics achievement. However, this correlation was in

the opposite direction from what one might assume. The more frequently a country reported using small-group instruction to teach mathematics lessons, the lower its eighth-grade mathematics proficiency scores. These analyses combined with the ones demonstrated above lead us to conclude that very little of the variation in educational outputs can be explained through the quantifiable inputs most frequently measured.

figure **6.3** | **Public expenditures as a percentage of GDP and labor force participation rates for 25- to 64-year-olds who have completed a secondary education, 1995**



NOTE | Data are unavailable for Japan and Korea.

SOURCE | Organization for Economic Cooperation and Development, *Education at a Glance: OECD Indicators*, 1996.

Synthesis

It would appear somewhat surprising that overall, almost none of the educational inputs measured are related to cross-national differences in student achievement, completion rates, adult literacy, or unemployment rates. When we compare many countries' resources with their educational outcomes, we see few strong relationships. Average time spent in school has little relationship with student performance; the amount of time teachers spend in school prior to becoming teachers has no significant relationship with student outcomes; student/teacher ratios are unrelated to achievement or persistence in schools; and, with one exception, no financial indicator shows any strong relationship with student achievement or labor market outcomes. Yet, there is a wide variation in outputs among the different countries studied. If these measures are not related to student outcomes, what is?

Several explanations are possible. One explanation is that there really are no relationships at this macro-level, as indicated by the research. Another explanation is that we are looking at the wrong measures. Another hypothesis is that some of these factors are significant, but interact in such a way that the significance cannot be measured using bivariate analyses. However, the limited number of countries precludes extensive multivariate analyses.

Much of the research examined in the first part of chapters 2 and 3 indicated that there were no strong relationships between many of the inputs discussed in these chapters and student outcomes. For example, the literature reported mixed conclusions regarding the link between time spent on instruction and student achievement, as well as between student/teacher ratios and achievement. In the area of finance, some studies found little association between school expenditures and student achievement. Other areas where the literature did show a relationship between the measure and a student outcome may have gotten lost in the aggregate. In other words, while there may be a relationship between a student characteristic and a student outcome, if only a small proportion of students have that characteristic, the relationship will be washed out when looking at an entire population. For example, while LEP students and students in poverty were shown to have lower achievement and completion rates, countries with high percentages of students speaking a different language in home than in school and with high percentages of students in poverty were not found to have consistently poor achievement. This mixed result could be due to the fact that, in the United States, for example, LEP or poor students tend to be clustered in certain areas. In addition, in the United States, education is locally controlled. When we look at the national averages, we lose the distinctions between the states and local areas. If we were able to look at the data in more detail, we might find that areas with high numbers of LEP students or high poverty rates may not achieve at the same level as areas with low numbers of LEP students or low poverty rates. In addition, this report is analyzing only wealthy nations. If we truly had a range of countries in terms of resources, expenditures, and outcomes, we might see fewer results.

Another explanation is that we may not be focusing on the best measures. The inputs discussed in this report are primarily quantifiable inputs, and not indicators of quality. For example, no mention has been made of curriculum content, learning processes, or quality of teacher training. In addition, ways in which the students learn (i.e., how teachers present subject material), the role of the teacher, the relevance of the homework assignments, or the kinds of activities in which students are engaged after class all relate to student learning, and thus to outcome measures. Studying these components of the education system is not as easy as collecting administrative data. Understanding these types of inputs requires a more qualitative analysis of curricula, site visits to classrooms, or interviews with teachers and students.

In an attempt to examine these more qualitative aspects of education, we look again to the TIMSS data. In addition to the assessments and questionnaires, three TIMSS countries, the United States, Germany, and Japan, also participated in a videotape analysis of mathematics instruction. A percentage of the eighth-grade mathematics classrooms that participated in the main TIMSS study were randomly chosen to be filmed. Videotapes were made of the classroom instruction and then analyzed by the researchers. The results indicated some interesting findings that were not quantitatively analyzed in our earlier measures. Three of these findings (teaching methods, curriculum content, and the role of homework) provide interesting anecdotes that may go a long way toward explaining some of the differences in these three countries.

Time spent in the classroom is one factor that could possibly be related to student achievement (figure 6.4). Eighth-grade students in the United States receive about 143 hours of mathematics instruction per year, compared to 114 hours in Germany and 117 hours in Japan. Similarly, U.S. students receive about 140 hours of science instruction, similar to that of German students, about 136 hours. Both countries have more instruction than Japanese students, who receive about 90 hours per year (U.S. Department of Education, NCES, 1996b).

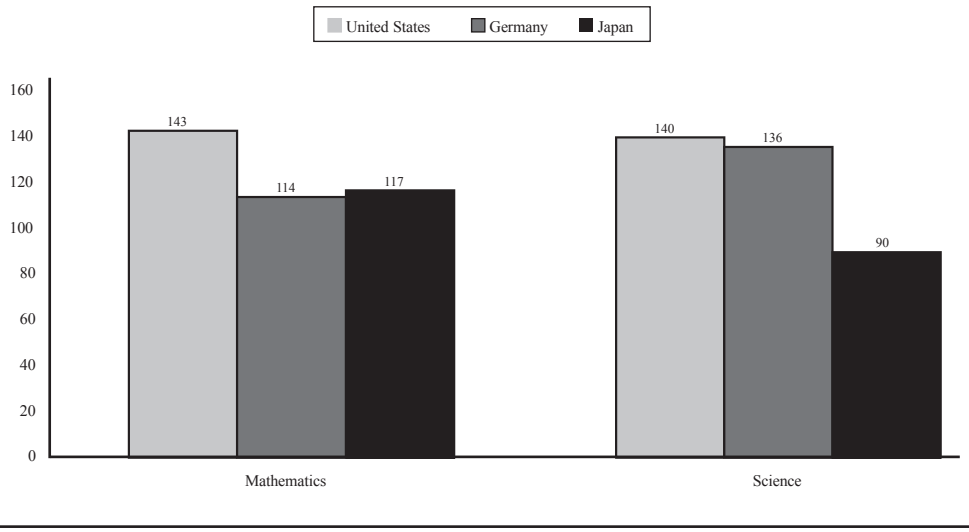
Once again, however, the question becomes "What do teachers do with this time?" The videotape portion of the study examined two issues related to this question:

1) the average percentage of topics in eighth-grade mathematics lessons that are stated or developed, and

2) the quality of the mathematical content of eighth-grade lessons.

Both of these issues relate not to the quantity of time spent in the classroom, but to the quality of that time. The first of these, the average percentage of topics in eighth-grade mathematics lessons that are stated or developed, describes both the way lessons are organized and the role of the teacher in the classroom (figure 6.5). For example, in a classroom where a lesson such as a mathematical proof is stated, the teacher is the active leader and the students are passive listeners in the instructional process. The teacher's role is that of an authority, with the students quietly practicing a new concept to become familiar with it. In a lesson in which the students derive a mathematical proof, the classroom will be noisier with students working either on their own or with the teacher to discover the proof for themselves. The teacher's role becomes that of facilitator, while the students' roles are more active and involved.

figure **6.4** | **Hours of mathematics and science instructional time per year for eighth-graders, 1995**



SOURCE | National Center for Education Statistics, *Pursuing Excellence,* 1996.

The videotapes demonstrated that most of the U.S. classrooms resembled the first lesson described where students play a passive role, while most of the Japanese classrooms resembled the second lesson where students play a more active role in the learning process. German classrooms fell somewhere in between U.S. and Japanese ones in terms of developing concepts. In Germany, students work with teachers to derive a proof, for example, as compared to the

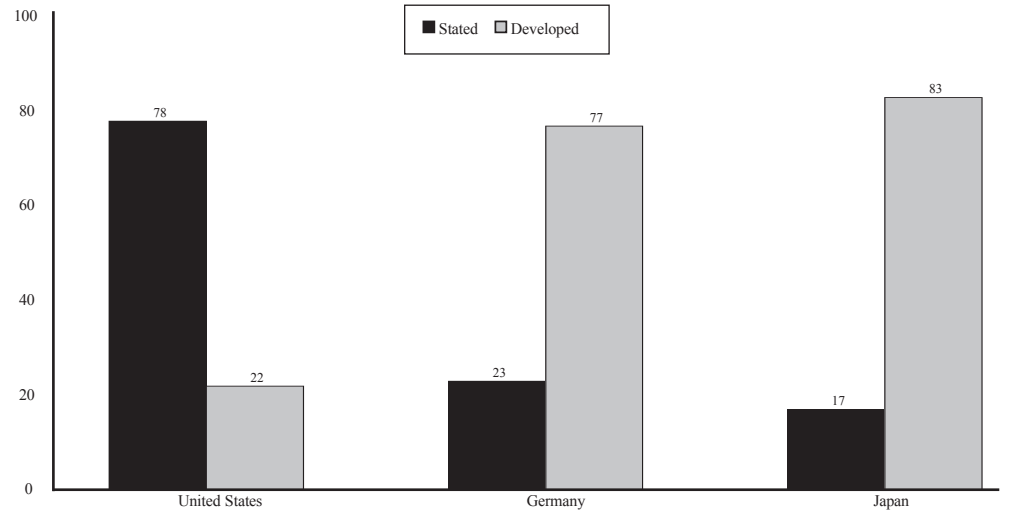
way Japanese teachers allow the students to struggle to derive the proof on their own without assistance.

The differences can be seen in the previous graphic and are explained clearly in this passage taken from the U.S. Department of Education's publication Pursuing Excellence:

> "U.S. teachers rarely developed concepts, in contrast to German and Japanese teachers, who usually did. In Germany, the teacher usually did the mental work in developing the concept, while the students listened or answered short questions designed to add to the flow of the teacher's explanation. Japanese teachers, however, designed the lesson in such a way that the students themselves derived the concept from their own struggle with the problem" (p. 43).

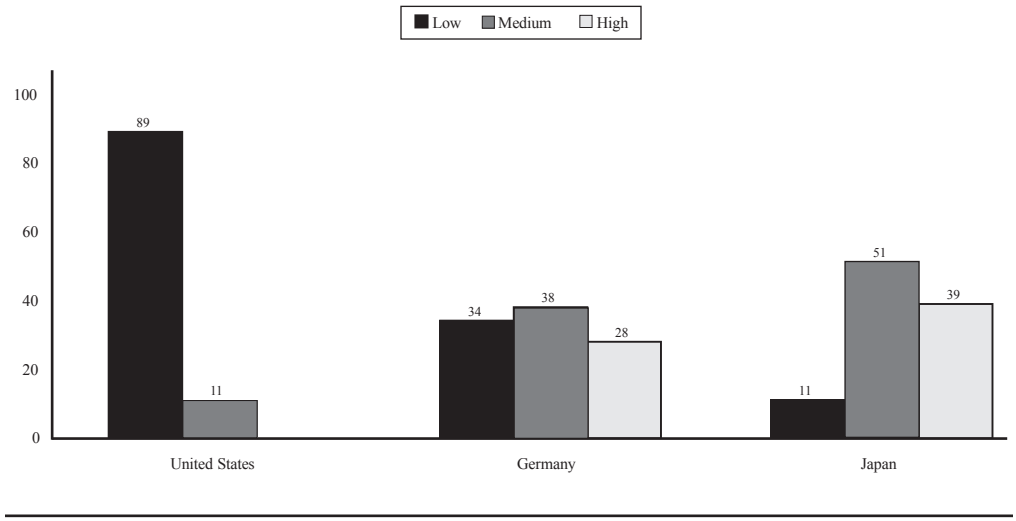
The second issue of what teachers do with their time with students concerns the quality of mathematical instruction (see figure 6.6). The TIMSS report showed that the U.S. eighth-grade mathematics curriculum focused more on arithmetic, while the German and Japanese curricula focused more on geometry and algebra; thus U.S. students were learning in eighth grade what German and Japanese students had learned in seventh grade (U.S. Department of Education, 1999). The videotape researchers used mathematics experts to evaluate the quality of the mathematics being taught in each videotaped lesson. The experts examined transcripts of the lessons and rated the quality of the mathematical content as low, medium, or high by judging factors such as the type of reasoning required of students, the increase in cognitive complexity between the beginning and end of the lesson, and the way in which the problems and examples contributed to the lesson's central concept. The results showed that none of the U.S. lessons contained high-quality mathematics, compared to 28 percent of the German and 39 percent of the Japanese lessons. In contrast, 89 percent of U.S. lessons were rated as having the lowest quality of mathematical content.

figure **6.5** | **Average percentage of topics in eighth-grade mathematics lessons that are stated or developed, 1995**



SOURCE | National Center for Education Statistics, *The TIMSS Videotape Classroom Study*, 1999.

figure **6.6** | **Percent of eighth-grade mathematics lessons rated as low, medium, or high quality, 1995**



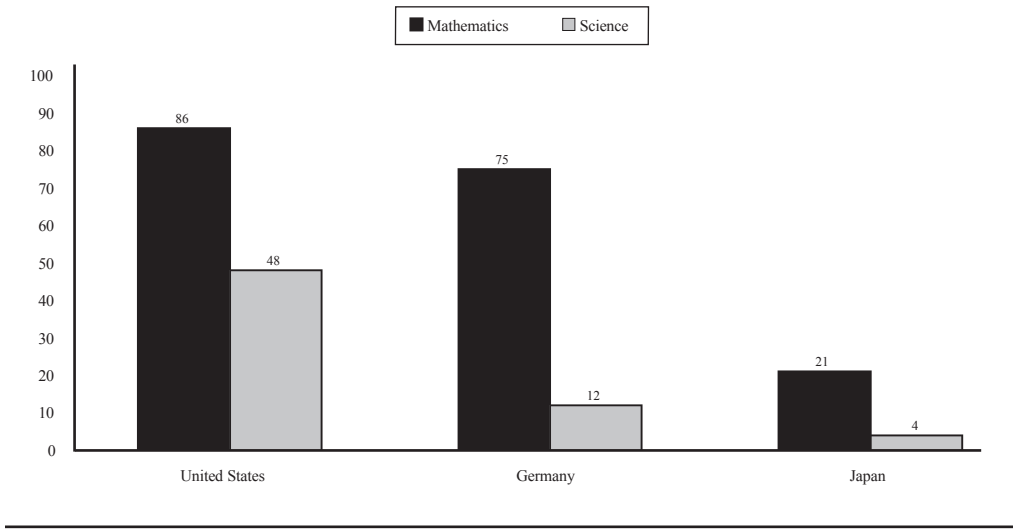
SOURCE | National Center for Education Statistics, *The TIMSS Videotape Classroom Study,* 1999.

The TIMSS report, Pursuing Excellence, concludes this section by saying:

> "These findings that our nation's eighth-grade mathematics classes are based on less challenging material, and lack mathematically rich content suggest that our students have less opportunity to learn challenging mathematics than their counterparts in Germany and Japan" (p. 46).

Finally, the role of homework, including teacher interaction with students on homework assignments, also demonstrates differences between the countries in terms of the classroom experiences of their students (figure 6.7). In terms of the amount of homework students report doing each day, while students from all three countries report spending over 2 hours a day on homework, the number of teachers assigning homework three to five times per week varies widely among the countries. Eighty-six percent of U.S. mathematics teachers assign homework three to five times a week, compared to 75 percent of German teachers and 21 percent of Japanese teachers. The differences are more striking in science: 48 percent of U.S. science teachers assign homework three to five times a week, compared to 12 percent of German teachers and 4 percent of Japanese teachers. What teachers do with the homework also varies across countries. Teachers in the United States spend more time grading homework and more classroom time reviewing it than teachers in either Germany or Japan. Moreover, homework usually constitutes a significant portion of the final grade in the United States, while it is rarely included at all in either Germany or Japan. These practices force us to consider that it may not be the amount of homework assigned that is important, but the type of homework and how it is used.

figure **6.7** | **Percent of mathematics and science teachers who assign homework 3 to 5 times per week, 1995**



SOURCE | U.S. Department of Education, National Center for Education Statistics, *Pursuing Excellence,* 1996.

Japanese teachers spend less time reviewing homework, as this is often done in the jukus, private schools that operate after school hours and on weekends to supplement regular school instruction and provide tutoring and enrichment activities. These jukus offer instruction in the school subjects to enable elementary and secondary students to keep pace with the demanding school curriculum, provide remedial instruction for those who have fallen behind, and offer special assistance in preparing for entrance examinations for senior high schools and universities (U.S. Department of Education, 1987). Germany, however, does not have these supplemental schools, and they are used only rarely in the United States. Yet Germany and the United States still differ greatly on the number of times a week teachers assign homework and on the importance placed on this homework. So, there are no clear-cut relationships between the amount or importance of homework and student achievement.

Conclusion

Few of the quantifiable inputs described in chapters 2 and 3 explained any of the student outcomes discussed in chapters 4 and 5. This is not to say that measures such as student/teacher ratios, intended instructional time, and financial resources are unimportant, only that they fail to explain large variations in achievement scores, completion rates, and labor market outcomes at the country level within a macro framework. Further multivariate research at the regional and school levels both within and among countries will be important in determining some of the effects of background characteristics on student outcomes. Likewise, a more specific analysis of expenditures—such as the allocation of resources—may illuminate where finances have the largest impact on student outcomes. For example, U.S. eighth-graders score relatively higher on the science assessment than on the mathematics assessment. Could the United States be allocating a relatively larger proportion of finances to science education

than to mathematics education compared to the other countries? Answering these types of questions may help to explain the lack of findings at the aggregate level.

On the other hand, financial inputs and background characteristics could truly have less of an impact on student outcomes than curricular inputs and teaching methods. Other, more qualitative, measures may provide further insight into these differences among countries, but care should be taken in drawing inferences about cause and effect. For example, different teaching styles may work better in some countries than others. The Japanese culture is very different from the U.S. culture, thus adopting Japanese teaching strategies across the board in the United States would not necessarily raise student achievement scores.

Elementary and secondary education is a large and complex system. International comparisons allow U.S. policy makers to evaluate strategies that appear to be successful in other countries. However, further research within the United States is also needed to determine what strategies will be successful in our unique social environment.

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