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The "Top Twelve" Selected Readings for the

Rethinking The Learning Community Workshop

March 25, 1993

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Oakes, J., Classroom Opportunities: Curriculum Goals and Instruction in Multiplying Inequalities: The Effects of Race, Social Class, and Tracking on Opportunities to Learn Mathematics and Science. Reprinted with permission by the Rand Co.

TABLE OF CONTENTS

THE GLOBAL ECONOMY AND EDUCATION

1. **Robert B. Reich**
   The Work of Nations
   Summary by Beau Fly Jones

2. **Sue E. Berryman and Thomas R. Bailey**
   The Double Helix of Education and the Economy
   Executive Summary

3. **Lauren B. Resnick**
   The 1987 Presidential Address: Learning in School and Out
   Educational Researcher, December 1987

4. **Willard M. Kniep**
   Essentials for a Global Education
   The ATA Magazine, May/June, 1989

REINVENTING THE FUTURE TO PROMOTE LEARNING

5. **Phillip C. Schlechty**
   New Purposes for a New Era,
   in Schools for the Twenty-First Century

6. **Peter M. Senge**
   The Fifth Discipline
   Summary by Soundview Executive Book Summaries

7. **Marvin Weisbord**
   Inventing the Future: Search Strategies for Whole Systems Improvement
   in Productive Workplaces

"BIG IDEAS" IN EDUCATION FROM RESEARCH AND PRACTICE

8. **Howard Gardner**
   The Unschooled Mind
   Summary by John Abbott

9. **Gaea Leinhardt**
   What Research on Learning Tells Us About Teaching
   Educational Leadership, April 1992

10. **Allan Collins, John Seely Brown, and Ann Holum**
Cognitive Apprenticeship: Making Thinking Visible
American Educator, Winter 1991

11. **James P. Comer**
Educating Poor Minority Children
Scientific American, November 1988, Vol. 259, No. 5

12. Jeanie Oakes
Classroom Opportunities: Curriculum Goals and Instruction
in Multiplying Inequalities: The Effects of Race, Social Class, and Tracking on Opportunities ;to Learn Mathematics and Science

THE WORK OF NATIONS

by Robert B. Reich, 1991

Summary by Beau Fly Jones
International Renewal Institute
North Central Regional Educational Laboratory

The book is divided into the following parts:

- --Introduction: The National Idea
- --The Economic Nation
- --The Global Web
- --The Rise of the Symbolic Analyst
- --The Meaning of Nation

Introduction: The National Idea

A basic thesis of the book is that "there will no longer be national economies ....Each nation's primary political task will be to cope with centrifugal (sic) forces of the global economy which tear at the ties binding citizens together....As borders become ever more meaningless in economic terms, those citizens best positioned to thrive in the world market are tempted to slip the bonds of national allegiance, and by so doing disengage themselves from their less favored fellows. This book describes this economic transformation, and the stark political challenge it presents."

This portrait of an emerging international identity is in contrast to the "vestigial thought" upon which most people currently rely. That is, most of us see ourselves in a "national economic boat" that is piloted by the President and other national leaders along with key corporations, leading scientists, and entrepreneurs. "The public interest is defined as national economic growth: the common good, as a buoyant national economy." But this picture is wrong.

The reality is that the 500 largest corporations failed to add any American jobs between 1975 and 1990. Organized labor has shrunk drastically. Foreign owned companies have flourished. "Money, technology, information, and goods are flowing across national borders with unprecedented rapidity and ease." The wealthy, mostly those who graduated from college, have become more wealthy while the poor, who only graduated from high school and those who dropped out, have become poorer. This is also true of the places where the wealthy and poor live, a thesis developed in Part 3 of the book.

The real economic challenge facing us and other countries is to increase the potential value of what its citizens can add to the global economy, by enhancing their skills and capacities as they relate to the world market. Therefore, there is no real reason for the US and other nations "to protect, subsidize, or otherwise support its corporations above all others." This premise has profound implications for all foreign relations but especially our relationship with Japan.

The Economic Nation

In Chapter 1, Origins of Economic Nationalism, Reich begins by tracing the origins of economic nationalism. Specifically, he argues that "The shift from mercantilism to popular economic nationalism parallels a political shift from absolutism to democracy" which began in the eighteenth century and continued until the twentieth. Democratic patriotism was a more powerful force than loyalty to a monarch. That is, people were far more willing to sacrifice their life and property for one's nation than to a sovereign, though monarchs did become the symbol of the nation. "The idea that the citizens of a nation shared responsibility for their economic well-being was a natural outgrowth of this budding patriotism."

Two arguments were especially important in the growth of a shared responsibility for the nation's economy.

First, Adam Smith's arguments around the wealth of nations made people aware of two inherent determinants of national wealth: the percent of persons gainfully employed and the capacity of the labor force (its knowledge and skills) -- forces still relevant today.

Second, Alexander Hamilton argued that a nations should support the development of industry and that this would not happen automatically. Governments must protect and subsidize industries, at least temporarily. Not surprisingly, industry came to depend on tariffs, but the populace did not understand the real costs, namely, the capability of industry to fix prices. However, the tariff eventually became hotly debated. Most serious was the assumption that sacrifices were justified as enlightened self-interest. This argument differed from the rational for sacrifice in Europe: that sacrifices were legitimate for patriotism and honor. This distinction is important, because of what happens when such claims for sacrifice based on self-interest are no longer convincing.

In Chapter 2, Economic Nationalism and High-Volume Production, Reich argues this: During the last decades of the 19th century, there was a revolution in the methods of manufacturing and moving goods. Specifically, what had been a loose network of local economies became national ones. This created international competition in which nations competed against nations. Equally important, between 1870 and 1900 inventions such as steam engines and interchangeable parts, emerged allowing nations to focus on high volume as the key to competition. Productivity rose dramatically, eventually leading to the problem of over-supply. This cause prices to decline. So the wealthy nations began to compete for the poorer nations and territories for new markets in an age of rising imperialism. "The size and influence of a national economy came to signify the nation's strength and determination." Hobson predicted that the logical endpoint of this type of competition is war, thus anticipating in 1902 the throws of World War I.

A second consequence of high-volume manufacturing was a movement of people from villages, farms with extended families to cities. There was also a massive movement of people to the world's major industrial regions during this period.

In Chapter 3, The Corporation and the National Interest, Reich maintains that neither tariffs nor imperialism solved the problem of over-production. A solution emerged at the end of the 19th century which had a strong impact on current thinking. The solution was "to reduce domestic competition by consolidating production within large nationally based corporations. Here was the final plank of economic nationalism: The well-being of citizens was linked to the successes of the national economy, which depended in turn on the success of giant corporations. However, this process developed in Europe and Japan more quickly than in America because there has been a national distrust of monopolies since colonial times, and debates on the role of large corporations dominated the first half of the 20th century."

The basic problem was how to control these companies. They could not be disassembled without great sacrifice. Eventually, a solution emerged in the form of regulation. World War I provided Americans with their first experience in corporate planning, according to Reich, but there was still the issue of corporate accountability to national goals. The New Deal bolstered the bargaining positions of various groups affected by corporate decisions, with the growth of labor unions and fair trade acts giving small retailers leverage to bargain with giant chain stores. Gradually, CEOs and the public would come to define the leaders of large corporations as "corporate statesmen" who were responsible for balancing the diverse vested interests among stockholders, employees, and the public.

In Chapter 4, The National Champion, Reich returns to the recent present. "By the 1950s the well-being of individual citizens, the prosperity of the nation, and the success of the nation's core corporations seemed inextricably connected." It was a period of great prosperity during which the American business community launched a major campaign to promote the profit system. America enjoyed a sustained period of mass production and mass consumption at home with slogans such as economic survival depends on consumption. The corporate

headquarters of the giants became "shrines of American capitalism."

During this period, millions of jobs were created, one of American capitalism's greatest triumphs. "America's core corporations had blurred the distinction between those who used tools and those who sold services and ideas by creating a large middle group of skilled and semiskilled workers, foremen, supervisors, middle managers, and technicians. All are employees, not owners....Corporate bureaucracy had created a new, growing class of Americans, whose incomes were based not on ownership of assets, but on bureaucratic rank." This is not to say there were no inequities. However, the poor remained almost invisible during this period.

The rest of the chapter is Reich's description of the structure of the corporate giants that were organized like military organizations and, like them, used absolute control to implement plans. At the top were the industrial statesmen whose extensive personal influence was compounded by their common values and interests, arising from common experiences and proximity in where they chose to live. Beneath them were top executives and strategic planners; beneath them the middle managers – the "organization men." Beneath them were the core of production workers on the assembly line.

Unions were organized by industry and had parallel structures from top officials to shop stewards. Union demands for wages and benefits were often accommodated by higher prices passed onto the customer, and for more than a quarter of a century, wages grew. Ultimately, the unions became institutionalized.

Chapter 5, The National Bargain, begins with a discussion of two domains of public responsibility: the relationship of American education to the economy and national defense. Given the system of high-volume and standardized production, the responsibility was to create an educational system to mirror mass production. Thus we had preplanned sequences of progress from grade to grade with tracking for the smartest who could absorb the facts on high tracks, with the slower ones doomed to lower tracks. Teachers had little discretion over what they taught. In terms of national defense, we waged war not only against capitalism but also against the Soviet economy. The Cold War served as a ready justification for massive public-sector spending in education and defense with money concentrated in a few core corporations.

During this period, America led the way toward global capitalism based our American capitalism. "The years from 1945 to 1970 witnessed the most dramatic and widely shared economic growth in the history of mankind." Nor was it coincidence that the Central Intelligence Agency also experienced growth during this period to protect us from communist plots where America's core corporations "either possessed or wanted to possess substantial holdings of natural resources." The bargain was a tacit assumption reached by business, labor, and the public to exercise restraint, sacrificing immediate gains for the sake of larger gains for all parties concerned.

The Presumed Problem, Chapter 6, is this: "That anyone could undertake high-volume, standardized production using state-of-the-art equipment, and could send resulting products cheaply to almost any location on the globe, had one ineluctable consequence: By the late 1960's, America's corporations could no longer set prices. They were now subject to fierce foreign competition...."

One strategy was to try to keep cheap foreign products out of the market. This protectionist strategy provided only short-term relief in part because each industry was dependent upon the other for materials and services. Protectionist walls also ceded the rest of the world's markets to foreign markets who could sell everywhere but America. A second strategy was for American corporations to demand wage cuts from employees so they could compete with the cheap labor available to foreign companies. But this strategy failed to restore the profitability of most companies that tried it. A third strategy for American corporations, forming financial holding companies, was also futile.

The presumed problem would be blamed on various things including the nation's growing indebtedness to other countries and the tendency for foreigners to purchase America assets. While not wholly inaccurate, this picture is "seriously misleading." It presumed the existence of American corporations and an American economy. The reality is that these entities no longer exist as separate from a global economy. The standard of living of Americans and other nations depends on worldwide demand for their skills and insights.

The Global Web

In Chapter 7, From High Volume to High Value, Reich maintains that the modern corporation at the close of the 20th century has few similarities with the national corporate giants at midcentury. America's corporations no longer focus on high volume, and they no longer serve as gateways to the American middle class. Indeed, the core corporation is no longer a singular American entity. Essentially, they are turning increasingly toward serving the needs of particular customers. The firms that are surviving are shifting from high volume to high value. Reich then shows how this is true in steelmaking and plastics. For example, high earnings in the latter industry no longer come from batches of basic polymers but instead from special polymers created from unique combinations of molecules. Traditional services such as technology and transportation also experience the same trends. The bottom line is that customers are now willing to pay a premium for specialized goods and services because they cannot easily be duplicated.

Reich devotes considerable attention to the following thesis: "The new barrier to entry is not volume or price; it is skill in finding the right fit between particular technologies and particular markets." In order for core companies to provide such products and services, they must increasingly invest in developing specialized knowledge and the ability to apply it.

Three skills in particular are important: (1) problem solving, (2) skills required to identify what customers' needs are and how those needs can best be met by the company's products, and (3) skills needed to link problem solving to problem identifiers; i.e., "strategic brokers who know enough about specific technologies and markets to see potential for new products, raise necessary funds, launch the product," and assemble the right problem solvers and problem identifiers to carry it off.

In the high-value enterprise, profits arise from continuous discovery of new linkages between solutions and needs. Moreover, the distinction between goods and services is meaningless because so much of the value provided by successful companies is service.

Chapter 8, The New Web of Enterprise, portrays how big business is now organized not to control resources, armies of production workers, and bloated bureaucracies, but rather in terms of enterprise webs. Consider, if problem identifiers and solvers had to convey everything they were learning upward to top management, and returning information had to travel downward, the results would be too late and also distorted. Thus a major task for strategic brokers is "to create settings in which problem solvers and identifiers can work together without undue interference, giving them whatever resources and freedom they need to make new discoveries but also providing them with enough guidance so that they do not lose sight of the need for profits."

"Problems and solutions no longer emerge from formal meetings but rather from frequent and informal communication among team members." Thus, instead of the traditional pyramid metaphor to explain corporate structures, Reich builds the case for enterprise webs that look more like a spider's web with a strategic broker at the center of each node. This structure permits diverse and simultaneous connections to be spun all the time with only a small number of people at each point of connection. Each participant learns about the others' skills and knowledge over time as they look out for ideas that propel the group forward. Each point represents a unique combination of skills.

Speed and agility are crucial. In fact, relatively few people work for the high-value enterprise in the sense of having steady jobs and fixed salaries. Rather they share in the profits rather than take fixed salaries. "Experimentation is the lifeblood of the high-value enterprise because customization requires continuous trial and error," thereby sharing risks as well as returns and strengthening group vision.

Enterprise webs come in many shapes including: (1) independent profit centers, (2) spin-off partnerships (as independent businesses), (3) spin-in partnerships whereby strategic brokers in headquarters form partnerships with independents, (4) licensing, and (5) pure brokering for the most decentralized webs.

In Chapter 9, The Diffusion of Ownership and Control, Reich argues that the formal organizational chart has little relevance to the true sources of power in the high-value enterprise. This is because power depends more on the capacity to add value to the organization than formal rank or authority. Problem solvers, problem identifiers, and brokers achieve their power through leadership. Moreover, key decisions about partners and products increasingly occur at lower levels. Reich then illustrates how enterprise webs work using a hypothetical example (customized beanbags). Another point relates to the increasing value of trademarks and brand names. Additionally, in the high-value enterprise, only one asset increases its value with time and that is the problem solving, problem identifying and brokering skills of its key people. Indeed, these persons have an ever increasing advantage over others because they are constantly using their skills which put them in touch with information and resources that others lack.

Chapter 10, The Global Web, details how high-value enterprise webs are reaching out over the world, ever merging national distinctions. How do you identify a national product when parts of it were designed in one place, made in another, and assembled in yet another place? Thus most products are international composites, though companies will cloak themselves in national or international images when it is profitable to do so.

The End of the National Champion, Chapter 11, details this process further. All told, more than 20 percent of the output of American owned firms was produced by foreign workers outside the U.S. including Japan, Eastern Europe, and Russia. However, the chief executives of American-owned companies continue to complain that foreign competition is unfair. Reich warns us that this is a necessary pose to confirm their patriotism and to assure the public that the national helm is still national. The reality is that many are disengaging from America in terms of hiring foreign workers. There is also the new trend to locate foreign-owned companies in the U.S. This is interesting because they are not only exporting from America but also conducting more and more high-value research here, including financing American universities and research laboratories. All this at the same time that they, like us, depend increasingly on developing nations for high-volume, standardized production.

The implications of this trend are: (1) national savings increasingly flow to whoever can do things best or cheapest, wherever they are located; and (2) much of the imbalance of the last decade was due not to the activities of foreign-owned firms but to American-owned firms making things abroad.

The Coming Irrelevance of Corporate Nationality, Chapter 12, analyzes how Americans think about these trends. Basically he argues that the assumption that a nation's national wealth depends on the assets that a nation's citizens own and control is "outmoded thinking." As corporations of all nations are transformed into global webs, the critical question is "which nation's citizens learn how to do what, so they are capable of adding more value to the world economy, and therefore increasing their own potential worth."

This is because Americans increasingly own stock in companies whose dominant stockholders are foreign. Further, the total return to American investors from their equity investments no longer depend on the success of these firms. Rather it depends on (1) the total amount that Americans invest, regardless of the firms' locations; and (2) the care and wisdom with which such worldwide portfolios of investments have been compiled.

Why do foreign companies come here? For the same reasons that Americans invest abroad: "because they think they can utilize other nation's assets and its workers better than that nation's investors...." Are foreigners buying up American technology? The answer seems to be "Yes, but...." Foreign-owned firms do not destroy the cumulative learning that resides in people's heads. Moreover, because of their public investment in universities and research, we gain, according to Reich.

Reich explains why he is so concerned with outmoded thinking that opposes foreign investments here in Chapter 13, The Perils of Vestigial Thought. He argues that a foreign-owned company that "contracts with Americans to solve or identify complex problems helps Americans far more than does an American-owned firm that contracts with foreigners to do the same.... Money, plants, and equipment are footloose, along with corporate logo. However, brains are less mobile internationally." He asks us to invite foreign countries to train us, provided that they agree to do research and development here.

The Rise of the Symbolic Analyst

In Chapter 14, Reich details the characteristics of The Three Jobs of the Future. First, routine production services involve repetitive tasks including supervisory jobs for workers that perform these services. Examples include providing circuit work for computer boards, many routinized information-processing jobs such as data entry and textile workers. Second, in-person services are those that must be delivered in person. These jobs also involve simple and repetitive tasks such as sales persons, waiting on tables. Third, symbolic-analyst services include all the problem solving, problem identifying, and strategic brokering jobs, services that can be traded worldwide. Examples include research scientists, software engineers, bankers, real estate developers, and so on.

In Chapter 15, A Digression on Symbolic Analysis and Market Incentive, Reich examines how to harness these symbolic analysts for the public good such as the control of air pollution. This is important because there are great needs in the public domain that can only be tackled by persons who deal in complexities, technologies, and legalities. Basically, he argues that market conditions must be supportive in order for this to happen. This means, among other things, recognizing that markets are not "free" and creating markets through government control. It may also mean that we stop paying exorbitant fees to lawyers and others to do things that do not serve the public good.

Reich takes a good look at the Divergence of American Incomes, and more importantly, why it is occurring in Chapter 16. He describes the trend as follows. When we were a national economy based on high volume, we had a very large middle class with a small class of the wealthy at the top and a small class of very poor at the bottom. Beginning with the mid-1970s, this picture began to change so that there is a small class of wealthy persons becoming increasingly wealthier and then there is the rest of society becoming increasingly poorer. This gap will increase, Reich predicts.

Why is this happening? Many people lay blame to our tax system which gives unfair advantage to the wealthy; social policies allowing the rich to become richer; the growth of single-parent, lower income families; and a growth in young, unskilled, and inexperienced baby boomers. But these explanations are superficial, he argues. He provides two clues: (1) the failure of many jobs to provide a living wage, yielding "a much higher rate of working poor than at any other time in the postwar era;" and (2) the increasing divergence in incomes between persons with and without college education.

To understand how these two factors work, it is necessary to look deeper. Chapter 17 discusses Why the Rich Are Getting Richer and Poor, Poorer. The search for ever lower wages continually drives down the income of the least skilled while modern machinery displaces more and more of these workers the world over. At the same time, union membership has withered since routine production jobs have decreased the most in unionized industries such as autos and rubber. Also vanishing are lower- and middle-management jobs related to routine production.

In-person service work is also shrinking, albeit more slowly. In contrast, jobs needing symbolic analysis are rising rapidly, owing largely to dramatic improvements in worldwide communication and transportation technologies.

It is likely that Americans will continue to excel at symbolic analysis, according to Reich in Chapters 18 and 19, The Education of the Symbolic Analyst I and II. First, America is still best at educating its brightest. Indeed, our research colleges and universities are the best in the world, whereas in Japan, "the reason for educational success has been to ensure that even its slowest learners will have high levels of proficiency."

The formal education of a symbolic analyst involves honing four basic skills: abstraction, system thinking, experimentation, and collaboration -- each of which he describes at length. Perhaps even more important, the education of symbolic analysts is extended throughout the life of the person in the workplace and at home. Specifically, Reich defines zones where symbolic analysts live such as Silicon Valley and Wall Street. These zones function as a large informal organization that supports the education and advancement of its members. Moreover, these zones are usually near or adjacent to public amenities such as airports, convention centers, and research parks.

The Meaning of Nation

In Chapter 20, The Problem Restated, Reich argues that the success of "a nation must be judged ultimately on how well its citizens are able to live and whether these standards of living can be sustained and improved upon in the future....Increasingly, ones's capacity to command both tangible and intangible wealth is determined by the value that the global economy places on one's skills and insights." The challenge is to improve the living standards of the majority of Americans who are decreasing their standard of living in the global economy.

One response is a truly progressive income tax coupled with the closure of gaping tax loopholes. A second response is to ensure that any reasonably talented American child can become a symbolic analyst. Third, it is vital to ensure that symbolic analysts receive sufficient on-the-job training. We could also increase the number of Americans who can apply symbolic analysis to production and in-person service work. Finally, the problems of the long-term poor should be addressed with job training, free day care, remedial opportunities, and intensive preschool programs. "More money" is not the solution here; rather we should improve our methods of education, job training, providing health care, and so on. "Yet without the support of the fortunate fifth (of the population), it will be almost impossible to muster the resources, and political will necessary for change."

In Chapter 21, The Decline of Public Investment, Reich looks at trends in education. For example, he notes that talented people are no longer drawn to serve as teachers. We say we cannot afford to invest more in education and training. That is the official reason. The reality is that "in 1989, Americans had about $3,500 billion to spend after paying taxes. The lower four fifths of the population received a little under half of this sum...which did not permit them any more consumption than a decade earlier....The top fifth, mostly comprising symbolic analysts, received the rest...."

Reich attacks a number of "sacred cows" during the Reagan and Bush years in Chapter 22, The Uses of Vestigial Thought. Some of these include lowering taxes for the wealthy, cutting public spending, reducing the budget, and seeing spending in terms of public vs private sector. "In this traditional view...the public sector spends the money, while the private sector earns and invests it...." However, these premises are based on the mistaken assumption that "national capital is critical to the future wealth of a nation."

The reality is that "the savings of many nations were combining into a vast pool which sloshed across national borders in search of the highest returns....The savings of wealthier Americans no longer...'trickled down' to American corporations and thence to the rest of the American population;" i.e., these savings are "trickled out" to the best returns wherever that is on the globe.

The "new logic" of economic nationalism is this: "The skills of a nation's work force and the quality of its infrastructure are what makes it unique and uniquely attractive, in the world economy. Investments in these relatively immobile factors of worldwide production are what chiefly distinguish one nation from another...."At the same time if we do not develop adequate skills and infrastructure, the reverse is likely to happen -- " a vicious circle in which global investments can be lured only by relatively low wages and low taxes." These conditions make it difficult to invest in education and infrastructure in the future. Which is it to be, Reich asks?

"The proper view of a national economy as a region of the global economy," contrary to public and government assumptions, "is that there is nothing terribly wrong with being indebted to foreigners -- so long as the borrowings are invested in factories, schools, roads, and other means of enhancing future productions," provided that the money is not wasted on consumption. Further, it is vital "to invest in factors of production which are unique to the nation" especially its citizens, transportation, and communications which are critical to our future.

Bush's administration made two mistakes: (1) equating national economic strength with the discretionary income of wealthy Americans, and (2) reducing the budget deficit rather than spending on schools and factories. There are two possible explanations for this faulty thinking. The first, the more charitable view, is that wealthy Americans, and other symbolic analysts, simply do not understand global economics.

The less charitable view is the subject of Chapter 23, The New Community. Reich argues that there is some degree of rational calculation underlying the tenacity of these traditional policies and develops a major hypothesis of the latter part of the book. The symbolic analyst is quite willing to spend personal income on the public good, narrowly defined as good for the community of symbolic analysts. "In this way, symbolic analysts are quietly seceding from the large and diverse publics of America into homogeneous enclaves, within which their earnings need not be redistributed to people less fortunate than themselves."

He then develops this thesis by describing differences in the lifestyles and communities where symbolic analysts live -- the fact that private security guards now outnumber public police forces, the splintering off of urban centers into two cities (one for the symbolic analysts and one for the rest), the segregation in the exurbs in zones of universities and research parks. A related thesis is that the symbolic analysts no longer feel a sense of national identity or patriotism because their wealth is now independent of national boundaries. As long as they can have their laptop computers, a modem, access to an airport, they can work anywhere and make money anywhere.

"As Americans continue to segregate according to what they earn, the shift in financing public services from the federal government to the states, and from the states to cities and towns, has functioned as another means of relieving America's wealthier citizens from the burdens of America's less fortunate.... So that increasingly where you live determines the quality of public service you receive. Moreover, "nowhere has the resulting inequality in government services been more apparent than in the public schools."

However, Reich does not attribute this succession and segregation to racial motives since lower income whites are also excluded. Thus, the segregation is economic. Indeed, "there is only one thing Americans increasingly have in common with their neighbors, and this commonality lies at the heart of the new American 'community.' It is their income level." Objections to this view may refer to the extensive giving to charities among wealthy symbolic analysts and corporations. Yet Reich shows that most of their contributions go to being cured, educated, inspired, or entertained and not to schools and services for the poor.

This thesis is developed further in Chapter 24, The Politics of Secession, but here the focus is on understanding how and why public policies support this economic segregation and increasing inequities. After some lengthy discussion of the decline of protectionism, Reich turns to our immigration policies as the key. In essence, it is in the self-interest of the symbolic analysts to keep our doors open to immigrants who will work for low wages, as an alternative to spending for education and training.

But why is it that the four fifths of the population has not actively protested the policies of the one fifth such as proposing progressive taxes, supporting education and training, or lobbying for protection for labor against low-wage foreign competitors? Some reasons: lack of understanding, dominance of vestigial thought, the assumption of just desserts (the wealthy believe they have earned their rewards), the belief in upward mobility as part of the American creed, and finally, the belief that political action would have no effect.

Regarding the latter, he argues that many Americans are engaged in a political vicious circle whereby "cynicism about American politics is rewarded by government decisions which confirm their worst suspicions, thus engendering still more cynicism and passivity." The Democratic party plays an important role here. Specifically, the ever-present need for more campaign funds constrains bold thinking about the future and closes off options that the wealthy might oppose such as progressive taxes. Ironically, this thinking could easily be overwhelmed by the voices and small contributions of the lower four fifths but, unlike most other Western democracies, there is no political representation for workers. So the reality is that the lower four-fifths is dependent on the activities and policies of the one fifth. And cities as well as states support the activities of the one fifth in the mistaken notion that they will bring jobs and wealth to their locations.

In the final Chapter 25, Who is "Us"? Reich poses our options for the future. To pose this question, he returns to an earlier comment. He notes (1) that other countries in Europe and Japan "view themselves as cultures whose strength and survival depend on sacrifice of the more fortunate as a matter of national duty and pride," and (2) that these very same nations experienced the most spectacular growth of all industrialized nations. "Could such sentiments be nurtured in America? Should they be?" The options.

> First, there is "zero-sum" nationalism: either we win or they win. But this option can corrode public values abroad and at home including dangerously narrow policies on international environmental issues. And ultimately this option endangers global economic perspectives.
>
> A second choice is cosmopolitanism. The good side could be that symbolic analysts will share their wealth with the less fortunate. But the darker side, and more likely event, is impassive cosmopolitanism, the sense that the worlds problems are intractable and overpowering, leading to hopelessness -- the greatest enemy of progress.
>
> The third choice is essentially a "win-win" policy of positive economic nationalism. In this choice, "each nation's citizens take primary responsibility for enhancing the capacities of their countrymen,"...but they will also "work with other nations to ensure these improvements do not come at others' expense." So we enhance global welfare at the same time that we enhance national welfare. This approach would (1) encourage public spending in each nation to enhance the skills and capacities of its citizens; (2) support public subsidies to companies engaged in high-value work, resulting in a kind of GATT (General Agreement on Tariffs and Trade) for direct investment; and (3) ease the transition of workforces out of older industries.

It is reasonably clear that we are currently headed toward the second choice, a laissez-faire cosmopolitanism that will ultimately increase the inequalities among the four fifths and the one fifth. However, "we are presented with a rare historical moment in which the threat of worldwide conflict seems remote....There is thus the opportunity for us, as for every society, to redefine who we are, why we have joined together, and what we owe each other and the other inhabitants of the world. The choice is ours to make."

The Double Helix of Education & the Economy

Sue E. Berryman
Thomas R. Bailey

EDUCATION AND THE AMERICAN ECONOMY: A DYNAMIC RELATIONSHIP

How the United States organizes its education – what we teach, to whom, when, and especially how – approximately matches how the country has organized economic activity for decades. The workplace, however, is gradually changing, and our traditional way of organizing education no longer meets the needs of our students. At the same time, a powerful research base, cognitive science, has revealed that traditional schooling, especially its pedagogy, is poorly organized for learning, *whatever* the economic environment students find themselves in. That same research base has also shown that the skill requirements of restructured workplaces and optimal ways of organizing learning fit one another. *The Double Helix of Education and the Economy* illuminates the complementarity between the changed workplace and what is now known about effective learning – two separate strands.

THE FIRST STRAND: A CHANGING WORKPLACE

The workplace is changing, and these changes are gradually rendering education as traditionally delivered more and more unconnected to what its graduates need to know and how they need to perform at work.

U.S. business rose to power on the basis of a mass production system designed to drive down the unit costs of long runs of standardized products. The emphasis was on narrowly defined jobs that could be filled by interchangeable, low-skilled workers, large inventories to make up for errors or poor quality, sophisticated quality control systems to catch defects at the end of production, and technologies designed to control or limit worker discretion. To make this system work, firms needed many layers of managers, supervisors, and technical personnel to control workers, handle non-routine events, and mop up mistakes at the end.

But external forces – intensified international competition, a proliferation of products, accelerating product cycles, a fast pace of change in production technologies, and a growing consumer interest in quality – are undermining industry's reliance on this traditional production system. Today, in an economic environment characterized by change, variety, and uncertainty, the keys to effective competition are flexibility, fast response to market shifts, and continuous innovation.

The old way of organizing production is so clogged with layers of management and supervision that companies can only respond to competitive threats clumsily and slowly. To reduce the time it takes to develop, produce,

and distribute products, firms are (1) reducing the managerial/supervisory and technical support staff, (2) delegating these functions downward to previously regimented workers and broadening their job responsibilities, and (3) reducing the number of separate job categories. Flexible production multiplies the number of decisions, and the need to respond quickly means that decisions can no longer be bucked up supervisory lines but must be made on the shop floor.

These changes are transforming the workplace

- **reducing the number of lower-skill jobs**
- **requiring higher-level skills**
- **changing what all workers need to know and how they need to use what they know**
- **limiting the long-term value of any current stock of knowledge or skill**

For example, in banking, increasing computerization has eliminated much of the repetitive, routine, manual processing of work that has long been the basis of many jobs. At the same time, the proliferation of services has brought about a shift toward better-educated workers who can understand the bank's services and its customers' needs.

In the textile market, customers are demanding faster delivery and more frequent style changes. To meet the competition, companies have had to integrate machine maintenance, inventory control, and record-keeping into the jobs of operators. Loom operators must now make judgments about the causes of machine problems, and machine maintenance workers now need a mathematics background. The result: Firms are forced to find higher-skilled, better-educated workers.

In the apparel industry, new production techniques are changing what workers do. In 1985, only one percent of production workers were involved in processes designed to reduce in-process inventory and speed throughput times. In the 1990s, 20 percent are involved in such processes. These processes put a premium on teamwork and an ability to cope, on the spot, with a growing number of unpredictable problems.

Evidence of these changing skill requirements can be seen in the following changes in relative wages and shifting occupational patterns.

- In 1979, full-time 25- to 34-year-old male workers with college degrees earned 13 percent more than similar high school graduates. By 1987, male college graduates in this age group were earning 38 percent more than high school graduates. For women in the same age group, the premium earned by college graduates rose from 23 percent in 1979 to 45 percent in 1987.
- The employment of full-time 25- to 34-year-old college graduates rose by 10 percent between 1979 and 1987, while their earnings rose by 33 percent.
- In contrast, the employment of high school graduates (in manufacturing) in the same age group rose by only 6 percent, while their earnings *fell* by 11 percent.
- Since the mid-1970s, higher-level occupations (executive, administrative, managerial, sales, and marketing) have grown almost two-and-one-half times the rate of lower-skilled occupations. More than one-half of all net employment growth between 1975 and 1990 took place within the higher-skilled occupations, even though higher-level occupations accounted for only 40 percent of total employment even in 1990.
- Jobs that are *currently* filled by workers with higher educational levels are expected to grow faster than those filled by workers with lower levels of educational attainment. Thirty percent of all *new* jobs expected to be created between 1990 and the year 2005 will go to college graduates. Today, 22 percent of current jobs are filled by college graduates.

In sum, industries find fewer opportunities for routinization and experience a greater need for the integration of traditionally separate functions (design, engineering, marketing), flatter organizational hierarchies, decentralization of responsibility, and greater employee involvement at all levels. These changes in the economy carry significant implications for our educational system since they fundamentally alter what workers at all skill levels need to know, how they need to use what they know, and when they need to learn it.

THE SECOND STRAND: A NEW UNDERSTANDING OF EFFECTIVE EDUCATION

Our schools routinely and profoundly violate what we know about how people learn most effectively and the conditions under which they apply their knowledge appropriately to new situations. These practices permeate all levels and sectors of American education and training, from K-12 to corporate training.

What makes many learning situations so ineffective is that they reflect mistaken assumptions about how people learn. Most education and training is structured around the assumptions that

- **learners are passive receivers of wisdom**
- **what is learned should be broken down into separate pieces**
- **getting the right answer is the purpose of learning**
- **skills and knowledge should be acquired independently of their context**

These assumptions lead to an organization of learning that is characterized by (1) a lecture mode of teaching, instead of active engagement with learning, (2) control over learning in the hands of the teacher, (3) a curriculum of disconnected items, tasks, and subtasks taught independently of the contexts in which the knowledge or skills will be used, and (4) a focus on "correct" responses rather than on the processes by which responses are generated.

This kind of education and training creates learners

- **who are overly dependent on their teachers, lack confidence in their ability to function independently, and lack the skills possessed by people who know how to learn**
- **who can come up with (or play back) correct answers but don't know how to approach problems, don't understand the principles involved in their answers, and revert to their own naïve conceptions as soon as they are out of the classroom**
- **who are passive, bored, inattentive, and uninvolved in their learning**

This kind of education and training misses the point that human beings are inquisitive, sense-making animals who learn best when they are fully and actively engaged in solving problems that mean something to them. Because it violates the way that people learn most effectively, our current approach to education and training simply does not work. Extensive research demonstrates that students are very poor at transferring and

applying what they learn from school to everyday situations – which should not surprise us. Knowledge and skills poorly learned or understood will not transfer effectively to new situations.

Fortunately, a century of thought, research, and actual trials blaze a path toward more effective learning. Based on how people learn most naturally and effectively, these ideas promise to (1) make markedly more efficient use of students' learning time and (2) involve the less-motivated more deeply and productively in learning.

The spectacular learning of very young children offers a clue to a more effective approach to learning. Children learn in context – in the midst of ongoing activities that give them immediate feedback on the success of their efforts. And their learning is guided by parents and peers, who serve as models and help them see the meaningful connections between different experiences.

Traditional apprenticeship learning offers further clues. Traditional apprenticeship is a way of life; there is almost no separation between the activities of daily living and the learning of work skills. The apprentice masters tasks in order to get the work done. Standards of performance are embedded in the work environment. Judgments about the learner's competence emerge naturally and continuously in the course of work. Whatever instruction the apprentice receives comes not from a teacher teaching, but from a worker doing work which the apprentice observes. In short, apprentices are inducted into a *community of expert practice* in which the master's (teacher's) performance constitutes the standard for the apprentice.

Drawing on what they have learned from observing young children and from studying traditional apprenticeships, cognitive scientists have developed principles of effective learning. These principles are modified for modern activities where the components and processes are not always visually observable (e.g., mathematics and computer-based inventory management). One application of these modified principles, called cognitive apprenticeship, is particularly promising. It results in very different classrooms and dramatically changes the roles of teachers and students. The learning environment takes on the technological, social, and motivational characteristics of real-world situations. With the context for learning changed, students actively engage in solving real-world problems, use their own ideas and experiences, and test them against their peers and teachers. Teachers serve as role models, guides, and coaches.

THE TWO STRANDS COME TOGETHER

Strengthening the educational system so that it conforms to the ways that people learn best will also directly enhance its ability to prepare students for the transformed workplace.

The two strands – the broad skill requirements of the reorganized workplace and our knowledge of how people learn most effectively – are intertwined. They are the double helix. They both imply similar strategies for educational reform. The research and analysis of the past five years show that the changes that should be made for purposes of learning turn out to be consistent with and supportive of how individuals are expected to function in the restructured workplace.

In traditional workplaces, tasks are narrowly defined, and workers are not expected to be versatile. Educational practices that keep control over learning in the hands of teachers, who "pour knowledge" into their passive students, closely matches the hierarchical organization of the traditional workplace. Higher-level employees are expected to receive and pass on orders; lower-level workers to follow orders. Neither group is expected to bring their own ideas to work. This approach, which causes behavior problems in the classroom, produces turnover and absenteeism on the job.

Just as traditional learning emphasizes strengthening the bond between stimuli and correct responses, workers in the traditional workplace are expected to handle well-defined, nonambiguous situations. Workers are trained to have a limited number of responses to a limited number of possible circumstances; specialized support personnel and supervisors are expected to handle unusual events. In the context of the traditional workplace, increasing skill means simply increasing the number of stimuli for which an individual knows the correct response.

Schools emphasize getting the right answer, with correspondingly less attention to learning from mistakes and developing alternative ways to solve problems. Similarly, the traditional workplace focuses on completing the task rather than understanding it and improving its subsequent performance. The traditional view of quality control matches the educational neglect of learning from mistakes. Since errors are repaired at the end of the production line, quality control does not get built into the way the work is done. As a result, workers do not learn from their mistakes, and the products and processes do not get improved.

Finally, traditional pedagogy assumes that knowledge should be learned independently of the context in which it will be used. Similarly, in the traditional workplace, workers are not expected to understand much about the broader context in which they work. Context is not important when tasks are well-defined and routinized.

Today, however, firms find it increasingly costly to hang on to production approaches that depend on low-cost, low-skilled workers who are waiting to be told what to do. Today's workers need a broad understanding of the systems in which they operate. Even more importantly, they need a conceptual understanding of what they are doing. Only that kind of understanding will allow them to carry out tasks or solve problems that they have not previously encountered.

Cognitive apprenticeship works with rather than against the natural learning system of human beings. It therefore offers a learning strategy that is consistent with how people need to function in restructured workplaces. Cognitive apprenticeships are designed so that students see the usefulness of what they are learning, actively solve real problems, test solutions, learn from their errors, and work together. Students learn the subject matter better and develop a broader understanding of how that subject matter connects to other things in the student's world. More importantly, they learn how to explore new fields, how to get more knowledge in a field they already know, and how to organize and reinterpret knowledge they already have – in short, they are equipped to continue learning.

WHAT DOES THE CONVERGENCE OF THESE TWO STRANDS MEAN FOR POLICY MAKERS?

As these marketplace and learning realities converge, we are challenged to rethink what we teach, to whom, how, and when. Our analysis of the research on schools and the economy leads us to three fundamental recommendations.

1. *Change the mission of K-12 schools to take educational responsibility for the economic futures of all students.*

For many years, the teaching methods, curriculum, and structure of K-12 schools were geared towards college preparation. Non-college-bound students were simply carried along, often in poor quality vocational programs or, worse, in the wasteland of general tracks. The costs of this way of organizing schools were less obvious when lower-skill jobs were more prevalent and when some share of these jobs paid middle-level wages.

Today's economy, however, is increasingly dominated by middle-skill and higher-skill jobs. Equally important, only these jobs pay wages that allow family formation and maintenance. Slowly but steadily, the economy is eliminating or restructuring lower-skill work. The educational implications of these economic realities are stark, fundamental, and unavoidable. *All* students, not just some, now need the knowledge and skills required for middle- and higher-skill jobs. Since most of these jobs will require post-K-12 training, K-12 should equip *all* students with the knowledge and skills needed to complete additional training and education.

2. *Dissolve the dualism that perpetuates the deep division between academic and vocational education.*

The mismatch between the current focus of K-12 schools and the needs of our students is deeply rooted in a dualism that distinguishes between

- **head and hand**
- **academic and vocational education**
- **knowing and doing**
- **abstract and applied**
- **education and training**
- **school-based and work-based learning**

This dualism manifests itself in both the curricular structure of schools and the way curricula are taught: academics taught out of context and academically debased vocational education. The dualism locks an increasing group of individuals out of the economic mainstream, either precluding their entry into it or making them marginal to the labor market.

At the heart of cognitive research is the observation that intelligence and expertise are built out of interaction with the environment, not in isolation from it. This research thus challenges these traditional distinctions and shows that effective learning engages both head and hand and requires both knowing and doing.

3. Organize learning around the principles of cognitive apprenticeship.

What cognitive science tells us about learning amounts to a slash across the canvas and requires a radical departure in how we organize learning. Cognitive apprenticeship works with, rather than against, the natural learning impulses of human beings – the desire to make sense out of our experiences, to solve problems, to interact with, explore, and gain mastery over our environment. It is thus an effective learning strategy for all students. For those more committed to school and learning, cognitive apprenticeships promise deeper and more disciplined learning that is better remembered and more appropriately used. For the less academically inclined, cognitive apprenticeships promise a motivating engagement with the learning process.

Cognitive apprenticeships stress subject-specific content *and* the learning strategies and skills required to operate effectively in, on, and with the content. Thus they emphasize the learning skills that employers in restructured workplaces need in all employees.

Cognitive apprenticeships integrate the dual principles of mind and matter, the theoretical and the applied, therefore systematically preserving and integrating the best of what today we call academic and vocational education into an approach that can be used to teach any subject, whether mathematics or interior design. In cognitive apprenticeships, the primary difference between academic and vocational education is the specific content that is taught.

Cognitive apprenticeship retains the option of postsecondary education for all students. It is education designed to create a well-prepared mind at ease with the demands of real-world tasks and equipped to continue learning. Thus, it eliminates the historic K-12 conflict between workplace preparation and preparation for postsecondary education.

Cognitive apprenticeship is generalizable to many learning situations. Its principles are appropriate for learners of different ages with different learning objectives – initial preparation, "second chance" learning, or retraining as experienced workers.

What Do Our Recommendations Imply For The Current Reform Debate?

- The current reform discussion focuses on content. But the analysis in this book underscores equally critical problems with pedagogy. No matter which content areas are deemed to be basic, *how* content is taught makes all the difference in whether content is *learned, retained, and appropriately used*. If we want spectacular improvements in learning, we must expand the reform discussion to include pedagogic issues.

- Because there is evidence that teachers and schools "teach to the test," current reform efforts want to replace input and process measures with student outcome standards. The theory is that if we get our performance measures right, we will get the skill and knowledge outcomes right. However, improved student outcome measures, although needed, will not automatically lead to improved teaching.

  Current discussions of national tests entertain substantial changes in content, in the operations that students are expected to perform on content, and in the use of portfolios or projects for assessments. But the knowledge and skills needed by teachers to meet these changed standards are not widely available in our school systems. In some cases, experts are not even clear about the pedagogic and curricular approaches needed to generate the desired student competencies.

These new standards need to be complemented with standards of best content and best pedagogic practice, and the standards must be professional and substantive, not bureaucratic or regulatory.

- Implementing professionally based standards will require a systematic diffusion strategy – an aspect of school reform that is often ignored. How can local educators connect with externally established standards of best practice? An intriguing answer to that question can be found in the new corporate practice of "benchmarking." Benchmarking is inherently a comparative process, requiring the borrower, first, to ask itself such critical questions as: Which functions, if improved, would make the greatest contribution toward attaining the organization's goals? What are the key metrics that would reveal successful performance?

  Second, they compare their own practices and processes against those of organizations identified as having "best-in-class" practices in various domains. Unlike education, where we think in terms of importing whole models, the benchmarking strategy requires that models be conceptualized in terms of their discrete pieces. Since no one organization is good at everything, the benchmarking company (or school) borrows discrete pieces of whole models. And although educators normally look only at other schools, benchmarking encourages looking both within and beyond the industry for best-in-class practices. Thus, the Xerox Corporation sent benchmarking teams to L.L. Bean to learn about efficient distribution of goods, to Federal Express for billing efficiency, and to Cummins Engine for production scheduling.

- We need more and better resources for teacher retraining. Educational reform discussions involve changed curricula, new pedagogies, more powerful uses of multimedia, computer-based technologies, new ways of assessing student progress, and market-based rewards and punishments for success and failure. But insufficient attention is given to the question of how teachers are supposed to learn and be able to use the concepts and methods of all these new curricula and pedagogies. *America 2000*, for example, barely mentions the teacher retraining that would be required to achieve the curricular and other changes sought by that report. The retraining that educational reform implies will take more than the one or two days that teachers get during the school year. The proper amount of retraining will require not just better uses of old money but new money as well.

- K-12 standards for student performance should be set to reflect the nature and level of the skills and knowledge needed for higher level jobs. Several national panels and councils are engaged in setting outcome standards for the K-12 system and for individual students.

Yet generally, with the exception of the Secretary of Labor's efforts (SCANS), they are not talking about the connection to workplace requirements. Many of the ideas on the reform table have a relationship to workplace performance standards, but the reform panels make no argument to that effect; the nature of the relationship is not explored; and the competency levels needed are not specified.

- Because the U.S. lacks a national system to move young people from school into the workplace, there has been an explosion of interest in apprenticeship. Initial efforts to create such a system have, for several reasons, conceived of it as work-based. The German, Austrian, and Swiss work-based apprenticeship systems are better known in the U.S. than the school-based systems of Sweden, Denmark, or France. Further, it is generally acknowledged that many school-based programs in the U.S. are divorced from the needs of the workplace. A work-based system, therefore, has seemed a good solution, simultaneously eliminating the problem of coordinating work-oriented schooling with the work place and reducing any school-to-work transition problems for youth.

  However, we strongly recommend that the question of where youth should be prepared for the workplace – in school, at work, or with a mixture of the two – be thought through carefully. The latest research reveals that the key issues for learning in the workplace are the same as for school-based learning: How are the work or learning activities set up? What kind of learning do they encourage? A company that organizes work, or a school that organizes learning, as a set of segmented tasks isolated from their context will limit what its workers or students learn. Whether in the workplace or the school room, what is emphasized or encouraged in the setting helps learners develop either a conceptual understanding or a highly routinized, inflexible set of responses. We argue, therefore, that the key issue is not where the learning is done, but how.

The learning situation needs to

- **be organized to deliver learning efficiently**
- **reflect the knowledge demands of the workplace and the work contexts in which knowledge and skills have to be used**
- **develop knowledge and skills that are broadly applicable**
- **blur the division between academic and vocational**

Using these criteria, which are based on research completed thus far, work-based apprenticeships and school-based cognitive apprenticeships have both pluses and minuses. Work-based apprenticeships are by no means clear winners.

One fundamental impetus for the idea of work-based apprenticeships is the realization that schools have done a poor job of preparing the non-college-bound. If the workplace turns out to be the best place for this group to learn, well and good. But we must be careful not to resort to work-based programs simply as a way to finesse problems with the schools. We are already paying for second-chance programs and remedial college programs to do what the K-12 system should have accomplished in the first place.

Concluding Thoughts

Any powerful educational reform should start from and build on

1. **what people need to know and know how to do in non-school settings**
2. **how they learn most naturally and effectively**

This aim of school reform is frequently lost, even key players sometimes forgetting the central objective. *The core issue is learning: what do people need to learn and how do they best learn it.* All reforms – the "new basics," choice, teacher retraining, assessment redesign, or whatever – matter only as they produce significant improvements in learning.

We believe that our economic and educational institutions face virtually the same challenge. That challenge is to organize their activities, whether learning or production, to capture the power of the fact that human beings are naturally sense-making, problem-solving, and environmentally interactive. This means that our educators and employers have to reconceptualize human potential, thought, and action.

The 1987 Presidential Address

Learning In School and Out

LAUREN B. RESNICK

It takes all sorts of in and outdoor schooling
To get adapted to my kind of fooling.
—Robert Frost

Popular wisdom holds that common sense outweighs school learning for getting along in the world—that there exists a practical intelligence, different from school intelligence, that matters more in real life. As is often the case, this wisdom is difficult to assess directly from a base of scholarly research. But recent research on the nature of everyday, practical, real-world intelligence and learning is beginning to provide a basis for understanding what distinguishes practical from formal intelligence. Drawing on this work, I want to explore in this essay four broad contrasts which suggest that school is a special place and time for people—discontinuous in some important ways with daily life and work. Then, in light of these contrasts, I will consider where and how the economic, civic, and cultural aims of education can best be pursued and whether schooling itself should be reorganized to take account of what we are learning about the nature of competence in various aspects of our lives.

How School Learning Differs from Other Learning

A small body of recent research by cognitive anthropologists, sociologists, and psychologists has examined cognitive performances in a number of practical settings. Cumulatively, this research highlights four broad characteristics of mental activity outside school that stand in contrast to typical school work. The studies I discuss here have examined very specific work situations, but the findings suggest wider applicability.

Individual cognition in school versus shared cognition outside. The dominant form of school learning and performance is individual. Although group activities of various kinds occur in school, students ultimately are judged on what they can do by themselves. Furthermore, a major part of the core activity of schooling is designed as individual work—homework, in-class exercises, and the like. For the most part, a student succeeds or fails at a task independently of what other students do (except for the effects of grading on a curve!). In contrast, much activity outside school is socially shared. Work, personal life, and recreation take place within social systems, and each person's ability to function successfully depends on what others do and how several individuals' mental and physical performances mesh.

An elegant example of this social distribution of knowledge and skill has been provided by Edwin Hutchins (personal communication, April 1987), an anthropologist who has studied navigation practice in the highly technological work environment of U.S. Navy ships. The activity of interest occurs on a ship being piloted into and out of San Diego harbor and involves six people with three different job descriptions. On the deck two people take visual sightings on predetermined landmarks, using special telescopic devices mounted on gyrocompasses that yield exact readings of direction. They call out their readings to two other individuals, who relay them by telephone to a specialist on the bridge. This individual records the bearings in a book and repeats them aloud for confirmation. Next to the recorder, another individual uses specialized tools to plot the ship's position on a navigational chart and to project where the ship will be at the next fix and beyond. These projections of position are used to decide what landmarks should be sighted next by those on deck and when a course correction will be required. The entire cycle is repeated every one to three minutes.

No individual in the system can pilot the ship alone. The knowledge necessary for successful piloting is distributed throughout the whole system. Furthermore, important aspects of that knowledge are built into tools. These aspects of knowledge, although not needed by the people who actually pilot the ship, are needed by cartographers and gyrocompass builders. Thus, there is a further sharing of knowledge—with tools, and with the builders of tools, who are not present during piloting, but who are part of the total knowledge system required for successful piloting.

Pure mentation in school versus tool manipulation outside. The centrality of tools in ship piloting suggests a second major contrast between cognition in school and outside. In school, the greatest premium is placed upon "pure thought" activities--what individuals can do without the external support of books and notes, calculators, or other complex instruments. Although use of these tools may sometimes be permitted during school learning, they are almost always absent during testing and examination. At least implicitly then, school is an institution that values thought that proceeds independently, without aid of physical and cognitive tools. In contrast, most mental activities outside school are engaged intimately with tools, and the resultant cognitive activity is shaped by and dependent upon the kinds of tools available.

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23

The ways in which tools shape, enable, and share cognition are especially clear in the history of navigation. Sailors once navigated by the stars; in addition to recognizing the constellations, they needed to perform complex geometric calculations. Simple magnetic compasses dramatically changed the skill requirements for navigation, although computations to compensate for degrees of variation between magnetic and true north were still needed (Dunlap & Stufeldt, 1969). Later, the invention of a compass with built-in compensations for variation provided a tool that pointed directly to true north, thereby eliminating most of the computational work. But it was still necessary to know the relationships between north and other points of the compass to determine direction of sighting. Today's gyrocompasses remove even that requirement, because they compute and name the direction of sighting. With each of these changes in technology, compasses in effect became "smarter," and the user needed successively less skill. But the total system lost no intelligence or knowledge. Instead some skill and knowledge passed out of the hands of compass users and into the hands of compass designers and their products.

Cognitive tools can be as simple as lists of frequently used calculation results. In the days before computers, when we did statistics by hand, we frequently referred to books of tables containing such esoterica as square and cube roots, arcsine and other transformations. We did not need to know how to compute these, only how to read the tables and use the information in the context of some larger task. In 17th and 18th century England and America, Patricia Cline Cohen (1983) tells us, many people of very limited formal education used *Ready Reckoners*, books containing tables of common price and measurement calculations. Such tables were in demand because of the need to use, and sometimes convert between, various systems of money, weights, and measures. Similar but more task-specific tables are used today by Brazil's black market lottery bookies, many of whom have had little or no schooling. Schliemann and Acioly (in press) describe in detail how these bookies manage to operate a very complex lottery system, taking many different combinations of bets with varying payoff ratios, without needing to calculate—or even know about—permutations, probabilities, or ratios. Instead they use memorized or written tables specifying the number of possible combinations for a given string of digits. Like *Ready Reckoner* users, the Brazilian bookies are able to function in a much more demanding mathematical system than they could if they had to set up and carry out calculations on their own. They share their mental work with cognitive tools that others have prepared.

Tool use is not only a way for people of limited education to participate in cognitively complex activity systems; it is also a way of enhancing the capacity of highly educated people well beyond what they could do independently. The manager who uses simulation tools to develop business forecasts and strategies, for example, shares an intellectual task with a computer and its software. This sharing shapes what the manager needs to know: less today than 30 years ago about performing computations, but more about how to interpret complex multivariate statistics and graphs, and, probably, more about complex economic theory. (See Simon, 1977, for a discussion of how the growth of these management tools is changing cognitive demands in the business workplace.)

Symbol manipulation in school versus contextualized reasoning outside school. Extensive use of tools is only one of the ways that out-of-school thinking engages the physical world more than in-school thinking. Outside school, actions are intimately connected with objects and events; people often use the objects and events directly in their reasoning, without necessarily using symbols to represent them. School learning, by contrast, is mostly symbol-based; indeed, connections to the events and objects symbolized are often lost.

Sylvia Scribner (1984) has studied the use of mathematics knowledge by dairy workers who assemble and price orders and take inventory in the warehouse. She documented multiple ways in which these workers used knowledge of case size and physical space to make their work physically and temporally more efficient. Here a preloader, an individual whose job is assembling milk product orders, describes how he filled an order for half a case:

> I walked over and I visualized. I knew the case [of size 16] I was looking at had ten out of it, and I only wanted eight, so I just added two to it. . . . I don't never count when I'm making the order. I do it visual, a visual thing, you know. (p. 26)

In another example, men taking inventory in the dairy warehouse used the physical environment as part of their arithmetic calculations. Because they knew exactly how many cases filled a certain space, they subtracted from that number the number of cases they estimated were missing from the cube the cases would form if the space were completely filled. Scribner's dairy workers, then, did less work that is recognizably arithmetic than we might have expected. But they got reliable arithmetic results by treating the material they were working with as part of their calculation process, rather than by just operating on symbols.

Another example of how physical objects or materials can render arithmetic performance unrecognizable from a school perspective has come from Olivia de la Rocha's (cited in Lave, Murtaugh, & de la Rocha, 1984) study of people in a Weight Watchers program. Weight Watchers are a particularly good group in which to study arithmetic applied in everyday life, because they must calculate recipes and exact portions of food every day. In one particularly interesting case, a person was observed solving the problem of measuring out three-fourths of two-thirds of a cup of cottage cheese. Instead of multiplying the fractions, he used a measuring cup to find ⅔ of a cup of cottage cheese. Then he patted the cheese into an approximately round pancake, divided it into quarters, and used three of the quarters. In this case, the cottage cheese itself served as part of the computation. The problem was broken into two parts, each of which could be solved by direct action on the cottage cheese. Pure, abstract arithmetic was never done. Very probably, the individual never knew, or cared, or needed to know that he was about to eat half a cup of cottage cheese.

Yet another illustration of the contrast between the out-of-school mode of functioning and the standard school mode comes from an in-school problem solving session that is part of a study in which my colleagues and I are examining socially shared mathematics problem solving among elementary school children. The children—fourth graders—were trying to solve the problems cooperatively. In one

problem, an ice cream cone could be bought for 60 cents, and some coins were in hand—a quarter, a dime, two pennies. The children were asked, "How much more do you need to buy the cone?" If taken as a real-world problem, the question would probably lead to a search through pockets for "round change"—a quarter, or, if necessary, dimes and nickels—to add to the quarter and dime already in hand. But because this problem was presented in school, it also could be interpreted as an invitation to do pure calculation—that is, to find the difference between the price and the total money in hand.

The children in our group interpreted the problem both ways and, in the process, unwittingly gave evidence of the normal lack of fit between the two. One girl, the best student in the group by ordinary school standards, immediately interpreted the problem in school calculation terms, did the subtraction in her head, and announced, "The answer is 23." This went unheeded by other children who interpreted the problem in terms of coins and eventually figured out that, if one ignored the two pennies in hand, an additional quarter was needed to buy the cone. But the girl who had first worked out the subtraction answer did not want to give up her initial solution and, in an attempt to convince the group, proposed, "We could get change from out of the quarter," implying that they would then use only 23 cents of it! This proposal, although it preserved her role as the quick study of the problem solving group, helps to show how—at one level—school arithmetic and real world use of number knowledge do not map well to each other. Yes, one *could* get change for a quarter and then give the clerk 23 cents of it, along with the original 37 cents. But one never *would*. That would not be sensible behavior when buying an ice cream cone. As in the dairy plant and the weight watcher's kitchen, standard arithmetic seems to disappear in the real-world solution. Of course there is still, in this case, some number manipulation required—but not the kind that would place this problem in the subtraction chapter of a mathematics textbook.

Out of school, because they are continuously engaged with objects and situations that make sense to them, people do not fall into the trap of forgetting what their calculation or their reasoning is about. Mental activities make sense in terms of their results in a specific circumstance; actions are grounded in the logic of immediate situations. In school, however, symbolic activities tend to become detached from any meaningful context. School learning then becomes a matter of learning symbol manipulation rules and saying or writing things according to the rules. This focus on symbols that are detached from their referents can create difficulties even for school learning itself. For example, it can lead to systematic and persistent errors of a kind that seem virtually absent in practical arithmetic. Extensive studies of practical thinking in street markets, carpentry shops, construction sites, and the like (Carraher, Carraher, & Schliemann, 1985; see also Resnick, 1986) show people doing virtually error-free arithmetic, often applying principles of number composition and decomposition quite flexibly. Yet in school, children regularly invent "buggy algorithms" (Brown & Burton, 1978; Resnick & Omanson, 1987)—that is, written calculation rules with slight errors in them that produce reliably wrong results. These buggy algorithms tend to honor the rules for manipulating symbols (e.g., there are borrow and carry marks in the right places; all columns are filled with only one digit per column), but they violate basic principles of number. In the course of subtracting, for example, many children will "borrow" 100 from the hundreds column, skip the tens column, and "return" only 10 to the units column, an exchange that destroys the original value of the number and thus insures an incorrect answer. Yet when children are thinking about arithmetic without a need to do standard written calculation, they often demonstrate clearly that they know such an exchange would violate the constraints on exchanges among parts of a number (Resnick, 1986).

It seems that children treat arithmetic class as a setting in which to learn rules, but are somehow discouraged from bringing to school their informally acquired knowledge about numbers. This tendency for school knowledge to be disconnected from real life is not limited to mathematics—although it is particularly easy to draw clear examples from mathematics learning. The process of schooling seems to encourage the idea that the "game of school" is to learn symbolic rules of various kinds, that there is not supposed to be much continuity between what one knows outside school and what one learns in school. There is growing evidence, then, that not only may schooling not contribute in a direct and obvious way to performance outside school, but also that knowledge acquired outside school is not always used to support in-school learning. Schooling is coming to look increasingly isolated from the rest of what we do.

Generalized learning in school versus situation-specific competencies outside. Part of the reason for this isolation may be that schools aim to teach general, widely usable skills and theoretical principles. That is their *raison d'etre*. Indeed, the major justification offered for formal instruction is—usually—its generality and power of transfer. Yet to be truly skillful outside school, people must develop situation-specific forms of competence. As we have seen—even in arithmetic, a curriculum whose usefulness is seldom questioned—the packages of knowledge and skill that schools provide seem unlikely to map directly onto the clusters of knowledge people will use in their work or personal lives. This seems true even for highly technical professional training. For example, one study (Lesgold et al., in press) has demonstrated that expert radiologists interpret X-rays using mental processes different from those taught in medical courses, textbooks, and even hospital teaching rounds. Another (Morris & Rouse, 1985) has shown that extensive training in electronics and troubleshooting theories provides very little knowledge and fewer skills directly applicable to *performing* electronic troubleshooting. Growing evidence of this kind points to the possibility that very little can be transported directly from school to out-of-school use. Both the structure of the knowledge used and the social conditions of its use may be more fundamentally mismatched than we previously thought.

On the other hand, situation-specific learning by itself is very limiting. As already noted, extensive studies of individuals with little formal schooling show how people can effectively perform work that includes extensive mathematical calculation. Some of these studies also document the limits of highly situated skills acquired in the workplace. Several demonstrate that when familiar aspects of a task change in certain ways—for example, when construction

foremen are asked to work with scales not used in their culture (Carraher, 1986), or when bookies are asked to accept bets that cannot be calculated from their tables (Schliemann & Acioly, in press)—unschooled individuals have considerable difficulty and may fail entirely. Schooled people do better, although they rarely use the supposedly general algorithms taught in school. Instead, they invent new methods specific to the situation at hand.

What Role for Schooling Then? —And What Kind of Schooling?

I have identified four general classes of discontinuity between learning in school and the nature of cognitive activity outside school. Briefly, schooling focuses on the individual's performance, whereas out-of-school mental work is often socially shared. Schooling aims to foster unaided thought, whereas mental work outside school usually involves cognitive tools. School cultivates symbolic thinking, whereas mental activity outside school engages directly with objects and situations. Finally, schooling aims to teach general skills and knowledge, whereas situation-specific competencies dominate outside. What do these striking discontinuities suggest about the relationships—actual and possible—between schooling and competence in work and daily life? I consider this question from three points of view: the role of schooling in directly preparing people for economic participation, its role in preparing people to learn effectively over the long course of their work lives, and its role in preparing people for civic and cultural participation.

Outside the education profession, schooling and school learning enjoy a very ambiguous status. We in the field take for granted that formal education is good, that more of it is better, that personal and national well-being depend vitally on it. We are sustained in these beliefs by the evidence of a century in which schooling has been an ever-expanding enterprise, associated in fact and in rhetoric with modernization, economic growth, and national aspirations. These correlations seem to support the view that schooling produces economic benefits. Indeed, at present, claims of education's significant economic value are used to encourage support of education and educational reform. Such claims appear daily in the newspapers and undergird arguments in professional periodicals and newsletters.

This economic valuation of education assumes that schooling actually *produces* economic benefits. But skeptical voices argue that the causal relationship between schooling and economic prosperity may run in the opposite direction. According to some, we have produced an arbitrary relationship between academic success and life success by requiring increasingly advanced school or college credentials for work that does not really demand so much formal study (Berg, 1970). Others argue that the economically advantaged —whether individuals, regions, or countries—demand more and choose to pay for more education; education is, thus, more a consumer good than a vehicle for increasing economic productivity.

The sociocognitive analysis of the contrasts between in-school and out-of-school functioning that I have sketched here suggests a more complex and interactive relationship between schooling and economic efficiency. To see this relationship, we must first consider whether, and then how, education functions to directly prepare people for specific economic roles, their jobs. I propose that, while school is probably an ineffective setting for job training, most current on-the-job training solutions do not work very well either. More effective forms of vocational and professional preparation than now exist are needed—forms more closely linked to job performance than those now customary. At the same time, there is a broadly enabling role that schooling can play with respect to the economy—a role of preparing people to be adaptive to the various settings they may encounter over the course of their working lives. Efforts to play this enabling function are likely to result in new forms of schooling that are also our best hope of preparing the next generation to participate knowledgeably and effectively in the civic functions of a technologically complex democratic society.

Schooling and economic participation: The question of job training. The simplest view of education as a means of improving economic productivity treats schools and classrooms as places in which to prepare students directly for jobs. Such training has been central to vocational education since its inception. Ever since the Smith-Hughes Act of 1917, schools have been expected to provide certain students with experience with the same kinds of machines and the same kinds of tasks that they will encounter in the workplace. Whatever its merits may once have been, this kind of direct job training in school is unsuited to today's conditions. Apart from the classic criticism that such education curtails opportunity by tracking some students out of high-opportunity and intellectually demanding curricula, the job training vocational education agenda fails today because of the sheer impossibility of preparing people for the quickly changing requirements of specific jobs. The direct training approach can only work when there is relatively slow change in the technological and social structure of work and when the equipment of the workplace can be duplicated within the economic and safety tolerances of the education system. Neither of these conditions holds today.

The obvious alternative to school-based job training is training at the worksite. This was customary in traditional apprenticeship, where a beginner in a field worked in the shop or laboratory of an established expert and gradually acquired various elements of skill. Although full-scale apprenticeships are not common today, Jean Lave's (1977) study of tailoring apprenticeships in Liberia, where many of the traditional forms still survive, provides an understanding of how this kind of training works. Lave found that tailoring apprentices spend numerous hours watching masters, journeymen, and older apprentices at work. From the beginning, they observe both the full process of garment production and the resultant product, and they practice a few basic skills—pressing, cutting, using the sewing machine. When they achieve an acceptable level of competence in these basic skills, they attempt the entire process of making a simple garment, such as a hat or drawers. This task, repeated until mastered, is not practiced as an exercise without economic significance; the apprentice's products may be offered for sale, although at a lower price than the master's work. When construction of one garment is mastered, the apprentice begins to work on another, more complex garment and thus proceeds through a "curriculum" that, while graded and sequenced, always exer-

cises component skills in the context in which they will be used. Although there is very little teaching—only occasional instructions or pointing out of errors by the masters—there is much learning through this graded, contextually embedded practice. There is also considerable self-correction, which is possible, according to Lave's analysis, because apprentices, through observation, have established criteria against which they can judge their own products.

In America, the story of the rise of vocational education in the skilled trades is simultaneously the story of the decline of apprenticeship. As the ideology of expanded schooling took hold and the nature of the workplace changed, we gave up opportunities for learning in the workplace in favor of school-based vocational education. School-like forms of instruction now dominate even in many "on-the-job" training programs. In the military, in community colleges, and in proprietary training institutes, the classroom culture often dominates, and difficulties frequently arise in the transition to actual job functioning.

As an example, consider a military training program for aviation equipment maintenance experts (Susanne Lajoie, personal communication, April 1987). Trainees first take theory-oriented courses that provide no hands-on experience with equipment. Afterwards they are placed "on-the-job" to observe experienced airmen diagnosing and repairing equipment faults. They receive no sequenced practice and few opportunities to try their hands at diagnosis or maintenance activities in the manner of the Liberian tailoring apprentices. Those traditional apprenticeship activities seem to be precluded by the high-technology work environment. It may take hours or days to complete an equipment diagnosis, and some problems may not occur at all during the course of training. As a result, trainees cannot be exposed to the full range of conditions they will encounter as working technicians. In addition, the environment is dangerous and expensive if mishandled; it is not reasonable to allow trainees to make and then correct errors. Finally, neither the equipment's functioning nor the mental activity of an expert equipment diagnostician is visible, as the master tailor's physical activity and product are; so observation alone is unlikely to support the desirable and necessary conceptual development that occurs in the tailoring shop. The combination of school-type instruction, unstructured observation, and practice that is common in much technical skill training produces unsatisfactory results (Gott, 1984; Morris & Rouse, 1985). Many trainees never learn adequately, despite having mastered the classroom portion of instruction.

The story is much the same in management training. Corporate America, it is estimated, spends at least $40 billion per year on educating and training its employees, mostly for management functions. The size and dollar value of educational activities within corporations approach that of America's 3500 colleges and universities. But when we examine the situation closely, we discover that in corporate education programs people typically go to classes, take tests, and proceed through a sequence of school-like activities. A recent Carnegie Foundation report (Eurich, 1985) labeled this venture of on-the-job training for managers "corporate classrooms"; such classrooms do not typically use the workplace itself as a learning environment. Although corporate classrooms have not been studied systematically, we can expect that they will share the advantages and disadvantages of school itself, despite more uniformly high motivation and up-to-date equipment.

Professional education, like technical training, has, over approximately a century, retreated from the place of practice (e.g., hospitals, law offices) to institutions specifically devoted to teaching. Universities have come to dominate professional education, partly because of burgeoning knowledge bases and partly to control standards for entry. The transfer has brought its own problems, however. There exists a continuing tension in all professional fields between theoretical and practical or clinical training. This tension is visible today in discussions of teacher education and certification. Some critics of current practices hold that no formal training in the art and science of pedagogy is required, that everything necessary can be learned through on-the-job teaching practice by an individual with deep knowledge of the subject matter to be taught. Even the staunchest defenders of formal teacher training (e.g., Carnegie Forum on Education and the Economy, 1986; The Holmes Group 1986) call for a mixture of the theoretical and the practical (presumably provided by the school and the apprentice-like experience of student teaching respectively), but are not very specific about how the two parts should interact.

This analysis suggests that technical, management, and professional education are all suffering from too much adherence to instructional forms borrowed from the traditional classroom. There is inadequate engagement with the tools and materials of work, and more time is given to theoretical explanation than to building truly expert performance skills. New forms of training for competent functioning in various kinds of work need to be developed. Ways must be found to reintroduce key elements of traditional apprenticeship in forms appropriate to modern conditions of work. Since the technological and social complexity of modern work sites often makes it impossible to observe and practice in the traditional ways, special forms of "bridging apprenticeships" that use simulated work environments and specially designed social interactions may be beneficial. Such possibilities are being explored in some current research and development projects. For example, certain projects (e.g., Lesgold et al. 1986; Woolf, Blegen, Jansen, & Verloop, 1986) are developing forms of tutoring and coaching that reproduce many of the key conditions of apprenticeship in a computer-based simulation environment. The simulated apprenticeship environment acts as a bridge between the theoretical learning of the classroom and the actual practice of the work environment. In professional and management education, the case based teaching methods common in some institutions represent another kind of effort to bridge the gap between classroom and practice. To further develop these and other forms of bridging apprenticeships, programs of research on cognitive aspects of job performance are required.

Skills for learning outside school. Beyond reorganized job-specific training, modern economic conditions also call for education aimed at helping people develop skills for learning even when optimal instruction is not available. Such education is essential to prepare people to function well when "breakdowns" (cf. Winograd & Flores, 1986) in the customary structure of activity occur. Breakdowns—unexpected changes or difficulties that render the normal,

27

routine way of doing things inadequate—can result from equipment failures, changes in staffing patterns in a work site, new weather or economic conditions in a region, and the like. Such occurrences must be treated as normally recurring features of technologically complex work environments. When breakdowns occur, people have to do exactly what machines cannot: step outside the system and reason about it. People using various mechanized and computerized systems need to be equipped to recognize breakdowns, to work around them temporarily, to repair them, and, ultimately, to design better systems. For safety and efficiency in work, these capabilities cannot be limited to those "at the top"—the traditional decision makers, the engineers and system designers. Productive responses should be possible everywhere in the working system.

Cognitive research demonstrates that people work best with and within a complex system if they have a "mental model" (cf. Gentner & Stevens, 1983) of the system—that is, an idea of all its parts, what each does and how they work together, how changes in one part of the system cause changes in other parts. This mental model permits flexibility in responding to unexpected situations. It also provides a kind of insurance against actions that may appear to follow the prescribed routine or solve a local problem but will in fact cause difficulties—perhaps grave ones—somewhere else in the system. One important function of schooling is to develop the knowledge and mental skills students will need to construct appropriate mental models of systems with which they will eventually work.

Transitions into new work environments also require capabilities beyond those that can be acquired in situation-specific training. For example, studies of the nature of writing skill in different educational and work environments show how people who are considered adept writers in one context often are judged to be ineffective writers in a new context (Williams, in press). As a case in point, outstanding law students—those who successfully served on law review journals while in law school—often are judged poor writers when they enter law firms and must prepare briefing memoranda. New work situations and new performance criteria produce breakdown conditions in which established skills cannot be readily applied. Nevertheless, the educational experience of young lawyers aids them in crafting new skills suited to the new context in which they find themselves. Analogous breakdowns in normal skill patterns have been documented in studies of unschooled Brazilian craftspeople and tradespeople; and there, too, schooling seems to play a role in helping people adapt. For example, Schliemann and Acioly's (in press) bookies invented new procedures in the face of unfamiliar problems in rough proportion to how much schooling they had had.

We need to identify and closely examine the aspects of education that are most likely to produce ability to adapt in the face of transitions and breakdowns. Rather than training people for particular jobs—a task better left to revised forms of on-the-job training—school should focus its efforts on preparing people to be good *adaptive learners*, so that they can perform effectively when situations are unpredictable and task demands change. We can expect to succeed in this only through diversified research efforts on learning in out-of-school contexts. Through studies such as those cited here, we have begun to build a picture of how people actually work and function cognitively in their normal out-of-school lives. But these studies have focused mainly on experts—individuals functioning in smoothly operating work situations where they already know the routines and are skilled in using them. What we require now are studies of the development of competence in people who are *becoming* experts in their fields. We also must mount detailed examinations of people coping with situations of breakdown or transition in their work.

Most research on transitions in competence presently focuses on performances in academic domains. We know a good deal about the differences between good and poor students in reading, mathematics, and science, and between those who generally do their school studying effectively and those who do not (cf. Glaser, 1987). This knowledge has begun to provide ideas for promising instructional programs to help weaker students acquire some of the capabilities of the stronger (Resnick, 1987). But we know little about how these findings translate to learning in practical settings or on the job. The evidence developed here on the discontinuity between school and work should make us suspicious of attempts to apply directly what we know about skills for learning in school to the problems of fostering capabilities for learning outside school. As long as school focuses mainly on individual forms of competence, on tool-free performance, and on decontextualized skills, educating people to be good learners in school settings alone may not be sufficient to help them become strong out-of-school learners.

Revising schooling: The civic and cultural functions of education. But perhaps school itself should not retain all the features that distinguish it so sharply from practical life. Indeed, evidence is beginning to accumulate that traditional schooling's focus on individual, isolated activity, on symbols correctly manipulated but divorced from experience, and on decontextualized skills may be partly responsible for the school's difficulty in promoting its own in-school learning goals (cf. Schoenfeld, in press). Modifying schooling to better enable it to promote skills for learning outside school may simultaneously renew its academic value.

In a recent study (Resnick, 1987), I undertook an examination of a number of programs claiming to teach thinking skills, learning skills, or higher order cognitive abilities. I looked for elements common to the successful programs that could point cumulatively toward a theory of how learning and thinking skills are acquired. I found three key features. First, most of the effective programs have features characteristic of out-of-school cognitive performances. They involve socially shared intellectual work, and they are organized around joint accomplishment of tasks, so that elements of the skill take on meaning in the context of the whole. Second, many of the programs have elements of apprenticeship. That is, they make usually hidden processes overt, and they encourage student observation and commentary. They also allow skill to build up bit by bit, yet permit participation even for the relatively unskilled, often as a result of the social sharing of tasks. Finally, the most successful programs are organized around particular bodies of knowledge and interpretation—subject matters, if you will—rather than general abilities. The treatment of the subject matter is tailored to engage students in processes of meaning construction and interpretation (e.g., Palincsar & Brown, 1984) that can block the symbol-detached-from-referent thinking

28

that I have noted is a major problem in school. Just such self-conscious meaning construction and interpretation skills are likely to be needed in conditions of breakdown and transition outside school, when one must use powers of reflection and analysis to craft sensible responses to new situations.

This set of shared features of successful programs for teaching thinking points to a conclusion that is, at first blush, surprising. When we begin to focus attention on thinking and learning abilities as goals of education, the distinctions between learning in school and out seem less sharp. The programs that appear effective in teaching school-learning skills have common features—such as socially shared mental work and more direct engagement with the referents of symbols—that are characteristic of out-of-school cognitive activity. This suggests a general need to redirect the focus of schooling to encompass more of the features of successful out-of-school functioning.

Such a redirection of educational effort should also have the effect of reasserting and revaluing the traditional civic and cultural functions of schooling. An efficient economy is not the only—perhaps not even the major—reason for institutions of education. "The chief reason for going to school," Robert Frost once wrote, "is to get the impression fixed for life that there is a book side to everything" (1972, p. 412). We can be sure that Frost's "book side" does not refer to training manuals. But Frost may have meant what I have in mind when I speak of the civic and cultural functions of schools.

School is not only a place to prepare people for the world of work and everyday practical problems. It is also a place in which a particular kind of work is done—intellectual work that engages reflection and reasoning. At its best such work steps back from the everyday world in order to consider and evaluate it, yet is engaged with that world as the object of reflection and reasoning. If we value reason and reflection in social, political, or personal life, we must maintain a place devoted to learning how to engage in this extremely important process. School, at its best, is such a place. There, reasoning and reflection can be cultivated, and a shared cultural knowledge that permits a population to function as a true society can be developed.

It is difficult to stipulate what combination of ingredients makes a self-governing society effective. Certainly we cannot point to research on the cognitive capabilities needed for democratic participation of the specific kind that supports calls for reorganized technical and professional education. Yet we do, I submit, share a vision of how a properly functioning democracy would look if appropriate education at appropriately high levels were to exist. This vision owes much to those of Jefferson, Dewey, and others who saw education as the cornerstone of democratic society—a society that bases decisions on maximum information and maximum interested discussion. Interested discussion, the opposite of turning decisions over to "the experts," means that the people most affected by any decision have maximum information *and know how to use it*. This is not a rationalist or technocratic society reaching "correct" decisions in cool and distanced ways. In this vision, people fight hard for what they want—which is often in conflict with what others want—but they do so using information and tools of persuasion in the expectation that those involved will listen to and analyze each other's arguments. We imagine, in short, communities of reasoned discourse on public issues.

When we speak of the civic functions of education then, we envision a culture of reason, analysis, and reflection, based on certain shared knowledge. Realizing this vision will require a civic consciousness that goes beyond the individualist one of current classroom learning models and draws on models of shared intellectual functioning such as we see in our best work environments. Building such civic consciousness, by long apprenticeship in the special kind of community that only school has both the distance and the engagement to create, may be the most important challenge facing educational research and reform today. □

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Berg, I. (1970). *Education and jobs: The great training robbery.* New York: Praeger.

Brown, J. S., & Burton, R. R. (1978). Diagnostic models for procedural bugs in basic mathematical skills. *Cognitive Science, 2,* 155-192.

Carnegie Forum on Education and the Economy. (1986). *A nation prepared: Teachers for the 21st century. The report of the Task Force on Teaching as a Profession.* Washington, DC: Author.

Carraher, T. N. (1986). *From drawings to buildings: Mathematical scales at work.* Unpublished manuscript, Universidade Federal de Pernambuco, Department of Psychology, Recife, Brazil.

Carraher, T. N., Carraher, D. W., & Schliemann, A. D. (1985). Mathematics in the streets and in schools. *British Journal of Developmental Psychology, 3,*(1), 21-29.

Cohen, P. (1983). *A calculating people: The spread of numeracy in early America.* Chicago: University of Chicago Press.

Dunlap, G. D., & Stufeldt, H. H. (1969). *Dutton's navigation and piloting* (12th ed.). Annapolis, MD: United States Naval Institute.

Eurich, N. (1985). *Corporate classrooms.* Princeton, NJ: The Carnegie Foundation for the Advancement of Teaching.

Frost, R. (1972). In E. C. Lathem & L. Thompson (Eds.), *Robert Frost poetry and prose.* New York: Henry Holt.

Gentner, D., & Stevens, A. L. (Eds.). (1983). *Mental models.* Hillsdale, NJ: Erlbaum.

Glaser, R. (1987). Thoughts on expertise. In C. Schooler & W. Schaie (Eds.), *Cognitive functioning and social structure over the life course* (pp. 81-94). Norwood, NJ: Ablex.

Gott, S. P. (1984, April). *Training for high technology: What skills are basic for troubleshooting?* Paper presented at the meeting of the American Educational Research Association, New Orleans, LA.

The Holmes Group. (1986). *Tomorrow's teachers: A report of The Holmes Group.* East Lansing, MI: Author.

Lave, J. (1977). Tailor-made experiments and evaluating the intellectual consequences of apprenticeship training. *Quarterly Newsletter of the Institute for Comparative Human Development, 1,* 1-3.

Lave, J., Murtaugh, M., & de la Rocha, O. (1984). The dialectic of arithmetic in grocery shopping. In B. Rogoff & J. Lave (Eds.), *Everyday cognition: Its development in social context* (pp. 67-94). Cambridge, MA: Harvard University Press.

Lesgold, A., Lajoie, S., Eastman, R., Eggan, G., Gitomer, D., Glaser, R., Greenberg, L., Logan, D., Magone, M., Weiner, A., Wolf, R., & Yengo, L. (1986). *Cognitive task analysis to enhance technical skills training and assessment* (Contract No. F41689-83-C-0029). Pittsburgh: University of Pittsburgh, Learning Research and Development Center.

Lesgold, A., Rubinson, H., Feltovich, P., Glaser, R., Klopfer, D., & Wang, Y. (in press). Expertise in a complex skill: Diagnosing x-ray pictures. In M. T. H. Chi, R. Glaser, & M. Farr (Eds.), *The nature of expertise.* Hillsdale, NJ: Erlbaum.

Morris, N. M., & Rouse, W. B. (1985). Review and evaluation of empirical research in troubleshooting. *Human Factors, 27*(5), 503-530.

29

Palincsar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction, 1*, 117-175.
Resnick, L. B. (1986). The development of mathematical intuition. In M. Perlmutter (Ed.), *Perspectives on intellectual development: The Minnesota Symposium on Child Development* (Vol. 19, pp. 159-194). Hillsdale, NJ: Erlbaum.
Resnick, L. B. (1987). *Education and learning to think*. Washington, DC: National Academy Press.
Resnick, L. B., & Omanson, S. F. (1987). Learning to understand arithmetic. In R. Glaser (Ed.), *Advances in instructional psychology* (Vol. 3, pp. 41-95). Hillsdale, NJ: Erlbaum.
Schliemann, A. D., & Acioly, N. M. (in press). Intuitive mathematics and schooling in understanding a lottery game. *Cognition and Instruction*.
Schoenfeld, A. H. (in press). On mathematics as sense-making: An informal attack on the unfortunate divorce of formal and informal mathematics. In J. F. Voss, D. N. Perkins, & J. Segal (Eds.), *Informal reasoning and instruction*. Hillsdale, NJ: Erlbaum.
Scribner, S. (1984). Studying working intelligence. In B. Rogoff & J. Lave (Eds.), *Everyday cognition: Its development in social context* (pp. 9-40). Cambridge, MA: Harvard University Press.
Simon, H. A. (1977). *The new science of management decision*. Englewood Cliffs, NJ: Prentice-Hall.
Williams, J. (in press). Informal reasoning and rhetoric. In J. F. Voss, D. N. Perkins, & J. Segal (Eds.), *Informal reasoning and instruction*. Hillsdale, NJ: Erlbaum.
Winograd, T., & Flores, F. (1986). *Understanding computers and cognition: A new foundation for design*. Norwood, NJ: Ablex.
Woolt, B., Blegen, D., Jansen, J., & Verloop, A. (1986). Teaching a complex industrial process. *Proceedings of National Association of Artificial Intelligence*. Philadelphia, PA.

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(Continued on p. 54)

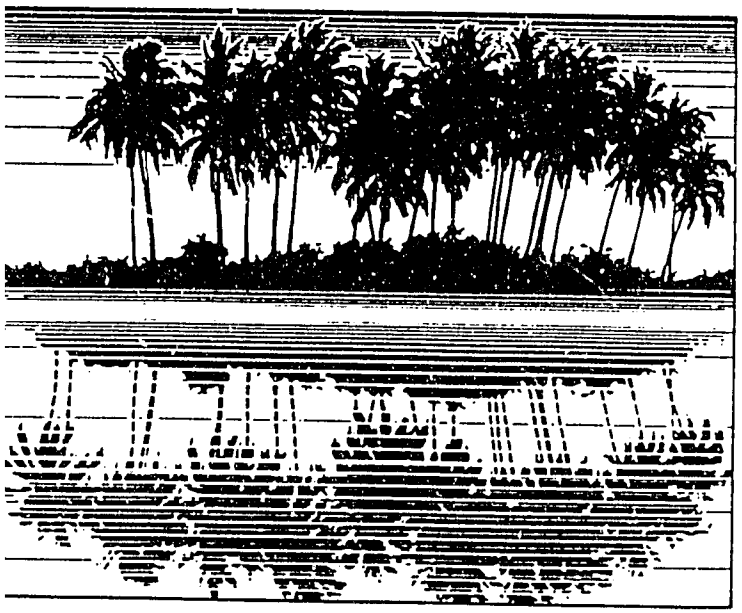
Essentials for a Global

By Willard M. Kniep

Global education has a relatively short history. Born in the sixties, it is based on the beliefs that schools have not been doing enough to prepare young people for life in the future they will inherit and that schools and their programs have not kept up with a world in which increasingly rapid change affects practically every facet of our lives.

The fact that all human beings in today's world are part, as never before, of a complex web of worldwide interconnections is one dramatic example of the impact of change. As citizens, consumers, workers and investors; as members of religious, ethnic and cultural groups, we live in a multi-boundary world. It is not simply a world of nation-states, but one with a diversity of worldwide systems in which all of us affect and are affected by others across the globe.

Along with this connectedness, we have a sense of shared peril through knowing that for the most threatening of today's environmental and social problems either there will be an international solution or there will be no solution at all. Acid rain, pollution of ground and surface waters, desertification and climatic change all will require solutions on a global scale. So too will chronic hunger and starvation in a world of abundance, the world-debt crisis, international terrorism, problems of refugees and the homeless, the nuclear threat and the arms race.

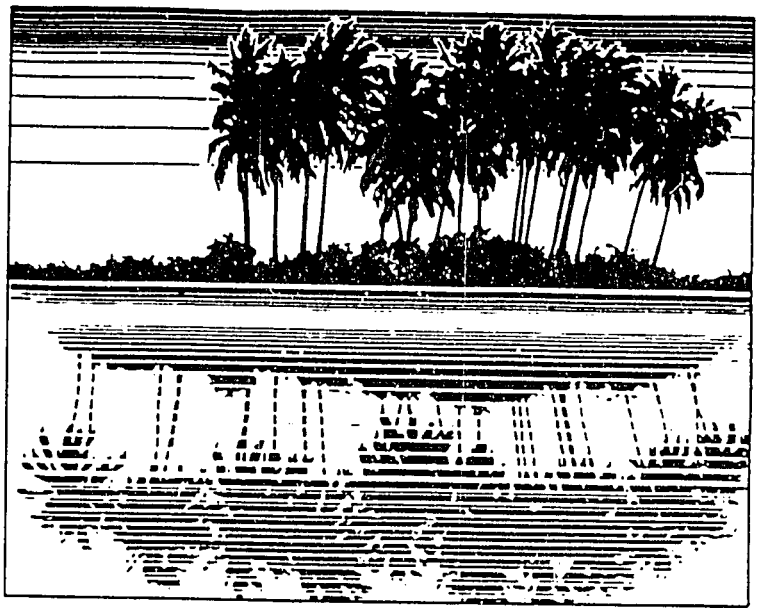


If our schools are to respond to these challenges to world survival, and if we are to help our students truly comprehend their role as national citizens in this global society, we must develop and teach new curricula rooted in and reflecting today's global realities. The central question to be addressed in developing these new curricula then becomes the question of substance: What should schools be teaching to prepare students for national citizenship in the globalized society of the twenty-first century?

In the final analysis, it will be the content we choose that will distinguish global from other kinds of education. Many of the goals of global education—thinking critically, valuing diversity, seeing connections—also can be rightly claimed by other disciplines and movements in education. So too can the processes and methods we promote as part of a global education. What is essential and unique about global education is its substantive focus, drawn from a world increasingly characterized by change, interdependence and pluralism.

So, the question of what to teach must be answered in the context of today's local, national and global realities. To be sure, today's students need to be grounded in their own history and culture. But, since we live in a world where people and nations are increasingly connected with one another, today's young people need a sense of global history, an awareness of common human aspirations in a diverse world, and the will and abilities to tackle the great problems and issues facing not only their own nation but all the inhabitants of the planet.

Education



What, then, are the essential elements of a global education? In our work at the American Forum for Global Education, we have attempted to arrive at an answer to that question based on an analysis of the most pervasive characteristics of our time. From our analysis of the nature of global change, we have developed a framework organized around four elements that we believe are essential to a global education.

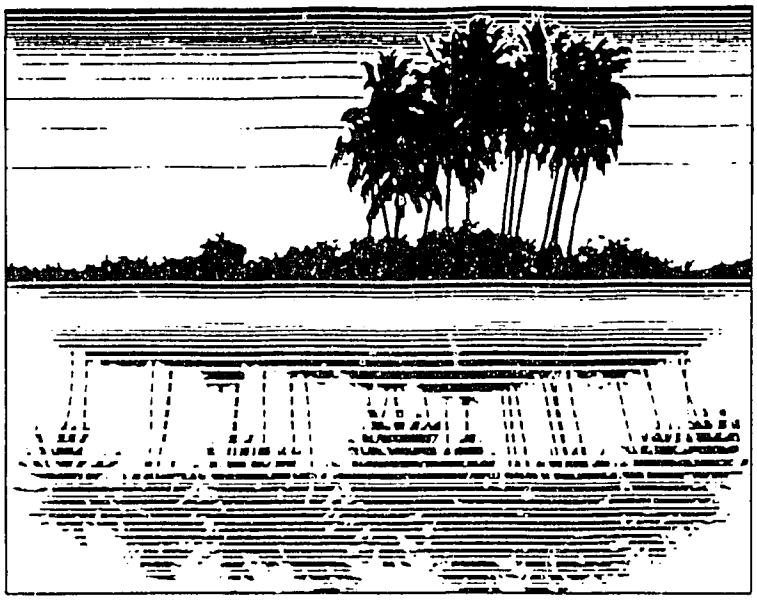
First of all, programs will be incomplete unless they engage students in the study of *global systems*. The most obvious and pervasive change that we have experienced in our lifetime, and which our children will surely experience in theirs, is an increasing sense of interdependence. Interdependence did not just magically appear. It is a function of the worldwide systems in which we live—the mechanisms through which we experience the linkages with people and nations throughout the world. The increasing dominance of systems over all aspects of our lives can be traced to advances in science and technology and to changes in interactions among states that have come with the creation of the United Nations and the breaking up of traditional colonial empires.

Among these global systems, economics provides the most striking and obvious example of individual and national interdependence among peoples and nations of the world. A global education will help students see themselves as actors in the global economy. Because they are all actors in the economic system, many opportunities are available for students to trace linkages from themselves to other actors and to analyze the interdependent nature of economics. In doing so, students will be able to see how they are affected by others and how their own decisions and life-styles affect many others around the globe.

Current world events also demonstrate dramatically the interdependence of political activity around the world. In Canada, as in the U.S. and other democratic countries, individuals play an important role in the global political system to the extent they exercise their rights of participation. Because we live in the industrialized world, the effects of our actions as individual citizens on others are especially clear and strong. Because of our privileged position, and the responsibilities that go with it, we have an extraordinary need to be informed about our world and to see our linkages to others. Our students have the same needs if they are to participate effectively and responsibly as citizens of their country in the global political system.

Our students also have a need to understand the earth as an ecological system. Of all the species that make up life on the planet, human beings have become the most critical actors in this system. A global education will emphasize for our students the interdependent and symbiotic relationships of all living and non-living things. Above all, it will help them to feel part of the living world, to respect it and their unique place in it, and to undertake actions only after considering the consequences for the whole ecological system.

Through the study of technological systems, our students will come to understand how much of the interconnectedness of peoples and nations in the modern world is due to rapid technological advances, particularly in communications and transportation—the two primary means of human contact. Ultimately, the study of technological systems will enable students to understand the transformation of the world toward a global society; to explore the ramifications of that transformation on the world's peoples, cultures and nations; and to develop knowledge and skills for living in and coping with an increasingly complex world.



A focus on systems must be the substantive core of programs in global education if our students are to understand the opportunities, challenges and consequences of interdependence. Tomorrow's citizens will be equipped for participation in their world only if they see their place as actors within these systems and to the degree to which they have acquired the knowledge, skills and motivation for effective and responsible participation within them.

Secondly, programs in global education must engage students in the study of *human values and cultures*. One of the consequences of increased interdependence is increased contact among peoples, cultures and nations. In today's world, activities in almost all arenas—from commerce to sport, finance to entertainment, communications to social movements—are carried out on a global scale. If our students are to be effective and responsible participants in this kind of world, they must understand both the unique perspectives and world views that come with cultural diversity and the universal human traits and values that transcend group identity.

The cultural differences that go with group membership are the most obvious manifestation of the variety of values and perspectives among human beings. These differences, reflected in tastes, preferences, attitudes, life-styles and world views, are the product of a people's unique evolutionary adaptation to their environment and circumstances. Our students need to see that there is a variety of values in the world, some different from their own, rooted in tradition and possessing the legitimacy of experience and history.

But a global education also must help students to see commonality within this cultural diversity and to perceive the qualities of humanness they share with those who are different from themselves. This means knowing that all peoples have developed a material culture and unique forms of aesthetic expression, work and play, language, and systems of expression. It means knowing that all have an evolved social organization; the means for social control, education, and transmission of social values and traditions; and mechanisms for carrying out economic functions. Moreover, it involves an appreciation that with the creation of the United Nations, the world's peoples, in all their religious, philosophical and ideological diversity, have begun to evolve standards for human rights and human relations.

Third, global education programs must engage students in the study of *global problems and issues*. For all of us, part of reality consists of being bombarded by international problems and issues, since each day brings news of the latest crisis or threat on some part of the planet. If young people are to be truly informed about their world, their education must engage them in inquiry about the causes, the effects and the potential solutions to the great problems of our time. As in the study of systems, they must see how they affect and are affected by these problems. Ultimately they deserve to see how they may be part of the problem and how they can contribute to its solution.

In the study of problems and issues, our programs must engage students with the struggles of peoples and nations to meet their basic human needs; to achieve national economic growth; and to expand their political, economic and social independence. The study of these development issues will focus on the widening gap between the rich and the poor peoples of the world and the inequality and suffering this gap represents.

Closely related is the study of the whole range of environmental issues having to do with human exploitation and management of the earth and its lands, oceans and elements. Problems associated with the consequences of human activity on the environment are not new, but because of a rapidly expanding human population and a worldwide increase in consumerism, these consequences have been magnified, in some cases, into problems of crisis proportions. Our students need to see the importance of these problems, which transcend national boundaries and require international solutions, to all human beings and to all the species with whom we share this planet.

So too, our students need to see the importance of human rights as one of the persistent issues of our time. In spite of the UN Declaration and other efforts of international bodies, large numbers of

people are still denied basic human rights around the world. Genocide, apartheid, political repression and imprisonment, persecution of indigenous peoples, censorship, religious persecution, torture, and denial of homelands are still facts of life. A global education would be incomplete if it did not engage students in coming to grips with this paradox—the global community embraces in principle the concept of universal rights, while widespread denial and abuse of these rights continue.

Finally, the study of global problems and issues should help our students understand that the world in which we live is one in which national security is nearly a global obsession as evidenced by the expenditure of 6 percent of global gross national product on arms. Global education must focus the inquiry of students on a number of basic questions: What is security? What alternatives to armed conflict and mutual destruction are available in providing security? What is the relationship among security policies and policies related to other issues such as development, the environment and human rights? How can individual citizens influence the security policies of their nations?

The fourth essential element in our framework for a global education is the study of the *history of the earth*. This means, first of all, bringing a historical perspective to all of the other elements so that students understand the development of global systems over time, the evolution of human values and cultures, and the antecedent conditions and causes of contemporary global problems and issues.

It also means avoiding the teaching of "world" history as if it were only the history of Western civilization or the spread of Western influence to the rest of the world. In the United States, and perhaps in Canada, as well, world history often is taught as the history of separate regions with little attention given to relations among them. Usually these histories, going from Plato to NATO, focus on the development of the states that are most powerful in the contemporary world. The approaches we take to history must contribute to understanding today's worldwide interdependence by emphasizing the historical roots of that interdependence.

Such an approach will emphasize the historical contact, borrowing and interdependent relationships among people and their civilizations and cultures, which were accelerated through trade, warfare and land migration and are transformed in today's world of global air travel and satellite communication. This perspective gives our students a basis for understanding present world relations in their historical context. This is particularly true for understanding relations between East and West, between North and South, and between Canada and the United States. To build such a perspective, we need to provide our students with a broad, historic panorama which includes conditions, contacts, colonization and dependencies that are the antecedents for today's international relationships.

This framework, with its four major elements, is meant to stimulate thought and dialogue about what we want our students to know as the basis for developing a global perspective. Its major function is to offer a tool for assessing the adequacy of existing programs and a guide for developing new programs for a global education.

The implications for program development cut across the entire school curriculum and all grade levels. Obviously, all of the elements are essential parts of instruction in history, geography and the other social sciences. But literature, music and the arts also have a great deal to contribute to the understanding of human values, the experience of people in coping with persistent problems, and the development of a historical perspective. Not only is the study of systems fundamental to science and mathematics, but the application of scientific knowledge is basic to solving our persistent problems. In the final analysis, school programs will be truly global when the distinctive content of a global education is reflected across the entire curriculum. □

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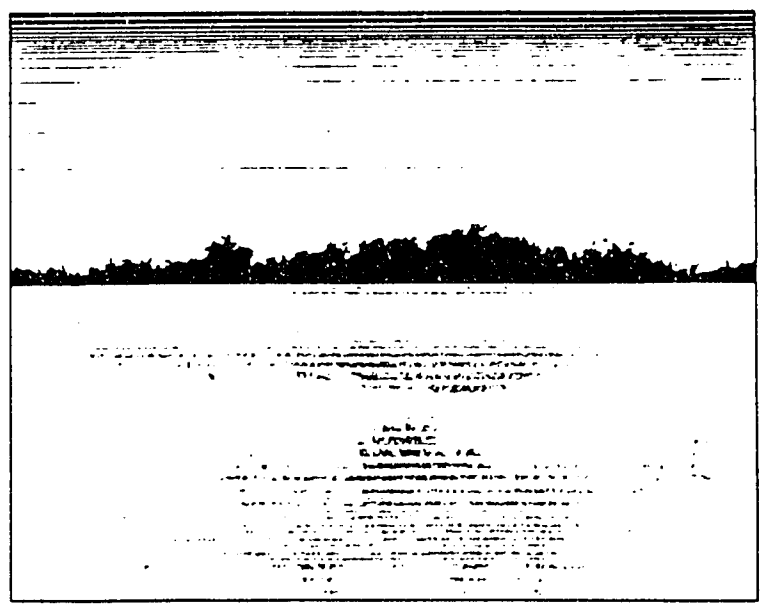

Schools for the Twenty-First Century

Leadership Imperatives for Educational Reform

Phillip C. Schlechty

Foreword by Governor Bill Clinton

Jossey-Bass Publishers • San Francisco

35

Contents

Foreword xi
by Bill Clinton, Governor of Arkansas

Preface xv

The Author xxv

Part One: The Purpose of Schools 1

1. A Future in Jeopardy: Why the Schools of Today Must Change 3

2. How the Past Has Shaped the Present: The Shaky Foundation of School System Structures 17

3. New Purposes for a New Era: Reinventing Our Schools 34

Part Two: The Ingredients of Invention 47

4. The Power of Vision: Creating and Sharing the Seeds of Innovation 49

5. The Capacity to Respond Quickly: Building Adaptability into the System 63

6. The Ability to Rally Support for Change: Managing to Satisfy the Needs of Constituents 83

7. The Creation of Change Systems: Tackling Problems at Their Source 96

8. A Focus on Results: Evaluating Performers and Performances 111

Part Three: Leadership for the Twenty-First Century 125

9. Leading a School System Through Change: Key Steps for Moving Reform Forward 127

10. A Bright Future Secured: Developing Strong Leaders for Our Schools 150

References 155

Index 159

3

New Purposes for a New Era

Reinventing Our Schools

Much of the initial force behind the present school reform movement grew out of concern that American education was not preparing students to compete in the emerging information-based global economy. Given that our present system of schooling was designed to meet the needs of first an agrarian rural society and then an urban industrial society, it should not be surprising to find there is a need to redesign our schools. Such a redesign must begin, I believe, with a fundamental reconceptualization of the purpose and vision that will provide the framework out of which restructured schools might emerge to meet the needs of the twenty-first century. This chapter indicates a direction that might be pursued in the quest for a new vision of schools and schooling.

The Knowledge-Work Society

Nowadays it is commonplace for management theorists, journalists, and futurists to argue that America is becoming an information-based society and economy. There is, unfortunately, a great deal of misunderstanding regarding the term *information-*

based and the related terms *knowledge-based, knowledge work,* and *learning-based.* At present there is no standard meaning for these terms, so I will explain my intent when I use them. Following Drucker's lead (Drucker, 1974, for example), I define the term *knowledge work* as putting to use ideas and symbols to produce some purposeful result. Work is simply physical or mental effort expended to produce something. Thus the term *knowledge work* focuses attention on the idea of expending mental effort. At this moment, the reader is engaged in knowledge work in an effort to understand my meaning. As I write these words for the anonymous reader, I too am engaging in knowledge work, for I am trying to construct a pattern of symbols (words and ideas) that will convey what I intend.

To say that American society is shifting from an industrially based society to an information-based society is to say that the means of production increasingly involves the use of information (a form of knowledge) to increase wealth and improve living standards, health standards, and education standards as well. In an information-based society, knowledge work is the primary mode of work, since information provides the primary means by which work is accomplished.

To many people, unfortunately, the argument that America is becoming an information-based, service-oriented society means that manufacturing will play an increasingly small part in the U.S. economy. Such a view is misguided. The point is that the basis for manufacturing will shift from an emphasis on machinery and muscle to an emphasis on the management and use of knowledge.

Consider, for example, that at present fewer than 2 percent of Americans farm, yet America's farms produce more today than they did when the country was agriculturally based and over half the population was employed in farming. What accounts for this fact? Obviously, the American economy's shift from an agricultural base to an industrial base accounts for many improvements in farm productivity—at least until recently when the applications of *knowledge* to farm problems (genetic engineering, chemical fertilizers, improved nutrition for livestock) brought about dramatic improvements in yield. Farms did not get more productive because a stronger and faster breed of horse was produced to pull the plow. Farms

became more productive when reapers and tractors were invented. Machine power is different in kind from animal power, not just different in degree. Agricultural production increased even more dramatically when knowledge workers began to turn their attention to agriculture. Knowledge work is different in kind from physical work, not just different in degree. And the application of knowledge can magnify the effects of manual work and the work of machines many times over.

The basic argument that compels many business and labor leaders to commit themselves to improving education in America is the argument that the only possible way for America to compete in a global economy and maintain the present standard of living is to increase the capacity of the citizenry to do knowledge work and to increase the number of citizens capable of such work. Jobs that do not require a significant use of knowledge are too labor intensive to demand the wages American workers are paid. If these jobs are to exist at all, they will exist in lands where labor is cheaper—or American wages will be depressed to the global rate. The alternative is to enrich the knowledge base of work in America and develop a work force that can employ this base effectively and imaginatively.

Thus if manufacturing is to be maintained in America, the basis for the production of goods must shift from investments in machines to investments in knowledge. And investments in knowledge are inherently investments in people, for humankind is the only knowing "kind" so far as we know.

An Important Aside

The images I will shortly explore cause me to use words that I know from experience make some educators, journalists, and university professors uneasy if not outraged. I will, for example, refer to students as knowledge workers and customers of knowledge work, teachers as leaders and inventors, the curriculum as raw material, and principals as leaders of leaders or leaders of instructors (rather than instructional leaders). I will equate schools to corporate entities like IBM, and I will suggest that superintendents might better be thought of as CEOs of the largest knowledge-work business in

the community rather than as priests to be treated with respect or plant managers to be bossed around.

For many this image is at once too commercial and inherently anti-intellectual. The idea of the student as worker suggests to many the idea of drudgery and compliance rather than excitement and creativity. The view of the school as a knowledge-work enterprise suggests that one is simply legitimating the schools as handmaidens to business interests, just as Marxist and neo-Marxist scholars have long asserted is already the case with schools in America.

Are not words like *student* and *teacher* perfectly good words, critics will rightly ask? Should the effort not be to invest these words with respect, rather than invent new words and a new jargon? The problem is that these words now convey meanings that are antithetical to the way schools should be structured if they are to serve the purposes the twenty-first century will impose. For many, *teacher* is synonymous with instructor and conveyor of knowledge. In schools of the future, teachers will not be sources of information; they will be guides to information sources. Too often the word *student* stirs up the image of a child sitting passively, receiving instruction from an adult. In the school of the future, students will produce knowledge, not simply receive it.

The need to use new language to create new thoughtways seems clear. But the reason I have chosen the language used here has to do, as well, with my view of the nature and effects of knowledge work within the context of a democracy. I will begin my argument there.

Knowledge, Power, Democracy, and Equity

"Knowledge is power," so Francis Bacon's saying goes. Historically such statements have found more basis in the pious hopes of academics and philosophers than in empirical fact. In early colonial days and up through the Civil War, landownership was power in America. Indeed, in many states the right to vote was tied to ownership of land. It was assumed, of course, that landowners would also be among the more knowledgeable in the community, for they had the wherewithal to buy education. But the sons of landowners did not get a college degree to get power. They went to

college to confirm the power they had and the status to which they and their families aspired.

After the Civil War, ownership of the means of production (I am not a Marxist, but I am a realist) became another avenue to power. Certainly inventors like Edison used knowledge as a basis of generating wealth, but many of the most wealthy and (as Edison illustrates) most inventive have had little formal education. Andrew Carnegie built libraries, but he was not a graduate of the academy. Certainly there has been a high correlation between education and income, but it is debatable whether education produces income or income produces education. Certainly the link between education and income, and between education and power, is not as direct as some would have had the young believe. Now, however, it is becoming clear that as American society becomes more information-based, those who have knowledge and know how to use it do have power. Indeed, the major democratic revolution that many reformers have looked for may come about precisely because the means of production in an information-based society is based on knowledge and the ability to put it to work to create, to invent, and to solve problems. Those who have knowledge-work skills will have access to the levers of power and those who are denied knowledge will be denied access—just as those who owned no land were denied the vote in the early days of America's democratic experiment.

Put differently, unlike land that one can get through inheritance, luck, or fraud, as well as through hard work, planning, and initiative, knowledge is not as easily controlled (though despots try and nation-states sometimes succeed). Above all, the ability to use knowledge is a private and personal possession. Companies can, perhaps, buy knowledge workers, but they can never own them; this is one of the reasons why large companies do so much to engender employee loyalty and are so fearful of industrial espionage and corporate raiders. Knowledge workers, if they are good at what they do, are of much more value to employers—and to the body politic—than those who have no means to amplify their own importance and power other than the withdrawal of muscle and brawn.

Knowledge workers, to be effective, require a much more open environment than despotic states and nondemocratic regimes are likely to tolerate. Indeed, a reasonable argument can be made

that one of the compelling forces behind the current wave of reform in the USSR is the recognition that the Russian economy, like the American economy, can only succeed on the basis of effective applications of knowledge and that the tools of the despot do not nurture the growth of knowledge or the growth of knowledge workers.

As numerous observers have noted, those who work with ideas and symbols are less tolerant of authoritarian leaders than those who are ill at ease in the world of ideas. These well-educated people—who have been referred to as "gold-collar workers" (Kelley, 1985)—are as interested in life-style as in standard of living. Certainly, few youngsters who graduate from high school and go no further with their education would be considered gold-collar workers. But the kind of work now being done by gold-collar workers, and the values that this form of work seems to engender, will surely be taken into account by corporate America. And what affects the structure of corporate America will, eventually, affect other institutions as well.

It is reasonable to expect that, as the American economy becomes more information-based and as the mode of labor shifts from manual work to knowledge work, concern with the continuous growth and learning of citizens and employees will increase. Moreover, the conditions of work will require one to learn to function well in groups, exercise considerable self-discipline, exhibit loyalty while maintaining critical faculties, respect the rights of others, and in turn expect to be respected. As I remember my idealized civics lessons, this list of characteristics could as well be a list of the virtues of a citizen in a democracy.

I am personally persuaded that the professional leaders who work in and around many of America's advanced knowledge-work businesses (IBM, the Bell Companies, AT&T) are more socially conscious and ethically sensitive than were the robber barons of the past and many entrepreneurs of today. One need not share my optimistic view of professional executives, however, to accept other parts of the argument. One need not be an admirer of America's corporate leaders (some of whom I admire, some of whom I find abhorrent) to understand that in the information-based society, commitment to human development and creating the conditions of freedom, growth, and respect in the workplace are not simply ethical choices.

Investing in people is simply good business, for in the information society, knowledge and the ability to use it are power. And those who have knowledge are the employees.

The Educator's Choice

Corporate leader after corporate leader, when asked what they "want from the schools," in the end respond, "We need people who know how to learn." Knowing how to learn, to learn on purpose, to learn from class, from books, and from instructors, actively to seek information to solve problems, to use others as resources in solving problems—these are far more complex qualities to develop than simple skill in decoding words and manipulating numerical symbols. Schools may not be teaching all children to read, write, and cipher, but even if schools were perfect in this regard, they would not meet the needs of the information-based society America is becoming. What is wanted is a school system that can ensure that all children will learn to read, write, and cipher and at the same time ensure that all children will learn how to think. This is a challenge that has never before faced public education in America.

The ability to think and solve problems; to take the creative turn; to draw upon a rich vocabulary based on a deep understanding of language and the human condition—these are all attributes that thoughtful business leaders will seek in the future work force. Those who have simply "mastered the basic skills" and those who get through high school by taking courses that call upon them to engage in low-level recall, to be punctual in turning in assignments, and to place their name in the appropriate blank on the test form may get diplomas, but they will not do well in America of the twenty-first century.

Those who are committed to school improvement (as opposed to school reform) have set for themselves the task of assuring that the schools improve their capacity to teach the "basic skills" to all children. Confronted with the failure of schools in this regard, especially with those children that educators now call "at risk," such a goal seems noble and worthwhile. Much has been learned about how such goals can be achieved in the existing structure. There is considerable research evidence, for example, that given the

way schools are now structured, smaller classes, direct instruction, and techniques derived from behavior modification research in laboratories do have positive consequences in the acquisition of basic skills. Indeed, much of the special education enterprise in schools is based on such assumptions, as are many remediation programs.

What would happen if schools were structured differently? One cannot be certain, but there are some hints. Cooperative learning—a technique of putting children in work groups and assuring that children with different backgrounds and differing abilities have experiences in working together in productive ways—has proved to be effective in developing basic skills in youngsters of wide ranges of background and, at the same time, developing skills in thinking, group problem solving, and so on. The National Writing Project (see, for example, Dunham and Mills, 1981), which involves teachers and students in active participation in writing and sometimes results in teacher and student publications, is another example.

The problem with most of these efforts is that the present structure of schools with their emphasis on lockstep grading systems, classes meeting on a regular schedule, standardized grading periods, and skill testing at short intervals (a year is a short interval in the life of a human being) creates conditions in which many of the most promising innovations are difficult to implement and even more difficult to sustain. The present structure of schools simply does not accommodate the new means of doing the job. Indeed, the structure is so impervious to change that new technologies, no matter how promising, are generally rejected. (See Schlechty, 1976, for a detailed discussion of this point.) If schools are to serve the purpose that the emerging information-based society is asking them to fulfill—in brief, to develop students as thinkers, problem solvers, and creators—then the structure of schools must be redefined to accommodate technologies appropriate to the task.

For schools to become the kinds of organizations they need to become, it is first necessary for educational leaders to think of themselves as leading and working in knowledge-work organizations. They must think of themselves as leading organizations whose primary purpose is to invent knowledge work for students so they will learn what they need to know to function in a knowledge-work

world and an information-based society. In addition, standards of performance are high and well established. They must be, for good knowledge-work organizations manage by qualitative results, not by programs and procedures. Leaders in knowledge-work organizations, at least good leaders in good organizations, worry more about doing the right thing than about doing things right (that is, the way things have always been done). Effective leaders know that "if you do what you've always done, you get what you've always got."

The point is that a shift to a knowledge-work metaphor does not lower standards or force one into an anti-intellectual argument. Quite the opposite. The knowledge-work metaphor, properly understood, *insists* on standards, for it is standards, rather than rules and procedures, that govern life among knowledge workers. Moreover, knowledge work demands extreme attention to elements of culture, for it is with cultural elements (ideas, propositions, beliefs, symbols, and modes of explanation) that knowledge workers work. Finally, like the hospital, knowledge-work organizations must be attentive to the needs of the human beings with whom they interact, for these human beings are the most important resource in the organization. Knowledge work is human work.

The School as Knowledge-Work Organization

Implicit in the image of schools as knowledge-work organizations is the idea that there would be a fundamental shift in the way curriculum is conceived. Rather than viewing the curriculum as a body of lore to be passed on to neophytes (usually with the neophytes in a passive, receiving role), rather than thinking of the curriculum as an assembly line down which students go, different tracks for different qualities of raw materials (students being the raw material), and rather than thinking of the curriculum as a prescription to be administered to each student depending on his or her needs and deficiencies, in the knowledge-work school the curriculum becomes a body of material to be worked on by students, processed by students, molded and formed by students. In effect the curriculum becomes the raw material for the knowledge-work process.

Rather than being concerned with scope and sequence, teachers would concentrate on richness and texture. The assumption, of course, is that the richer the curriculum (I did not say the more diverse), the richer the knowledge-work products will be. If the texture of the curriculum is such that students can grasp and handle it (intellectually speaking) as opposed to some of the pallid materials that now confront them, surely more students will be attracted to the field of knowledge work.

In the knowledge-work frame, students are at one and the same time workers and customers. As workers, students are active participants in the knowledge-work process. Their job is to take the knowledge embedded in the curriculum and process it in a way that makes it their own. As customers, students are provided with knowledge work, for the product of school is knowledge work that gets students engaged in working on and with knowledge and keeps them engaged. Getting and keeping customers for knowledge work is as much the business of schools as getting and keeping customers for automobiles is the business of Ford Motor Company.

Teachers become both inventors and leaders. On the one hand, teachers are called upon to invent knowledge work for students at which they will be successful and from which they will learn things that are valued by society and its leaders. On the other hand, teachers are called upon to get students to do knowledge work. And getting other people to do things is the art and science of leadership. Thus the argument regarding the teacher's role in curriculum leadership and instructional leadership becomes moot, for built into the school as a knowledge-work enterprise is the idea that teachers are leaders.

What, then, is the role of the principal, the superintendent, the board of education? In some ways the role of the principal and the superintendent reverts to a bygone era when the schoolmaster was viewed as the chief priest. There are, however, very real differences between knowledge-work organizations and tribal induction centers. In knowledge-work organizations, good ones at least, top leaders and middle-level leaders, in this case superintendents and principals, view themselves as leaders of leaders, creators of conditions in which other leaders thrive, and developers of leaders. In the school organized to pass on traditions and lore—that is, the school as tribal center—tradition and paternalism create a system of rights

and privilege that make it difficult for innovative arrangements to emerge.

Leaders in knowledge-work organizations manage by values and results. They do not manage by programs or tight supervision; they direct, not control. Leaders in knowledge-work organizations cause others to decide, they orchestrate, they coach and encourage. In knowledge-work organizations, leaders lead through teaching and sometimes preaching. Leaders of leaders in knowledge-work businesses—well-run knowledge-work businesses—express visions and assess results. Such is the role of the principal and superintendent in the school envisioned as a knowledge-work environment.

In specific terms, the principal becomes a middle-level executive in a corporate enterprise (Indiana calls its school systems "school corporations" and has done so for years) and the superintendent is the CEO. And as with other top leaders, one role of the superintendent is to educate others, including other community leaders, about the nature of the education enterprise, its problems, and its prospects. The superintendent in fact becomes the chief educator of the community, for the superintendent's role is to educate the community about education.

For superintendents to carry out such a role, the conventional relationship between the school board and the superintendent must change. The job of the board would be, as it should be in any case, to make the superintendent successful, not simply to set policy and monitor performance. If the superintendent fails or the school system fails, then the board has failed. Indeed, any board that hires a superintendent with whom it is later dissatisfied should look to its hiring procedures or its own lack of clarity in expectations. Perhaps the greatest test of a board's competence—and a condition for which board members should be held most accountable—is the employment and support of top leaders who succeed. Top executives do fail, but good top executives seldom fail if they have a strong and knowledgeable board. If the top leadership of a school system fails, either the board has failed to select wisely or it has failed to support a good leader. In either case, the failure of top leadership in schools, as well as in other enterprises, is a failure in those who hired them. (See Schlechty, 1987, for a detailed discussion of school board/superintendent relationships.)

Concluding Remarks

Assuming that the reader is convinced, as I am convinced, that there is a need to bring about fundamental reform in schools and assuming that the reader agrees that the knowledge-work metaphor provides a useful frame for discussion, what else is needed? There are, I think, three imperatives. First, some mechanism must be created for articulating and disseminating a vision of schools that is compelling within the local context. Second, a strategy must be created for developing and marketing the vision in a way that meets local needs. Finally, decisions must be made about which structural elements must be changed to pursue the vision, and a strategy must be devised for ensuring that these changes are made and institutionalized. The rest of this book is addressed to the issues raised by these three imperatives.

SOUNDVIEW Executive Book Summaries™

FILE: MANAGEMENT

The Art of the Learning Organization

THE FIFTH DISCIPLINE

By Peter M. Senge

THE SUMMARY IN BRIEF

Have you ever been involved with a team of people who functioned together superbly? It may have been in business, school, or sports, but it probably happened only once or twice in your lifetime. People trusted each other, complemented each other's strengths, compensated for each other's weaknesses, aimed for goals higher than anyone might have dared individually — and as a result produced an extraordinary outcome.

Such teams display special characteristics: Each member is committed to continual improvement, each suspends judgment as to what's possible and so removes mental limitations, each shares a vision of greatness, and the team's collective IQ is far greater than any individual's. Team members also recognize and understand the system in which they operate and how they can influence it.

These characteristics describe the essence of a learning organization. As with any team, the organization doesn't start off great, it *learns* to be great. In this summary you'll begin to see how you can recreate that special atmosphere through the practice of each of five disciplines: systems thinking, personal mastery, mental models, shared vision, and team learning.

Sound unconventional? Well, if you have trouble motivating your troops or working with your counterparts in other functions, then you'll probably agree that traditional top-down management has outlived its usefulness. The world is too complex for one leader to figure it all out and impose his or her views on the rest of the organization. The organizations that will excel in years to come will be those that understand how to gain the commitment of employees at all levels and continually expand their capacity to learn.

In the new learning organization, your people will aim high, learn to create the results they desire, and reap the bottom-line benefits necessary to sustain success in the global marketplace. Says Arie De Geus, head of planning for Royal Dutch/Shell, "The ability to learn faster than your competitors may be the only sustainable competitive advantage." Read on for a new view of what the corporation can be.

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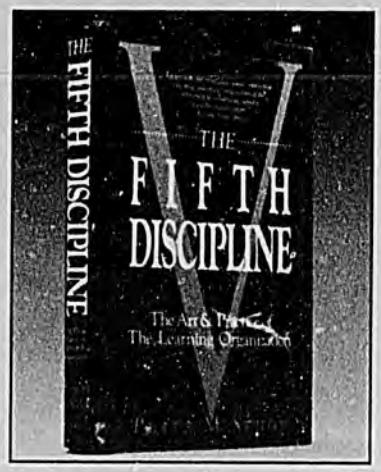

SELECTED BY SOUNDVIEW AS AN OUTSTANDING BOOK FOR BUSINESS PEOPLE

The author: Peter M. Senge, cofounder of Innovation Associates, Inc., a Framingham, MA-based consulting and training company, directs the Systems Thinking and Organizational Learning Program at MIT's Sloan School of Management.

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THE SUMMARY

From an early age, we're taught to break apart problems in order to make complex tasks and subjects easier to deal with. But this creates a bigger problem — we lose the ability to see the consequences of our actions, and we lose a sense of connection to a larger whole.

In this summary, you'll begin to learn how to see the whole again through systems thinking, the fifth discipline. You'll also learn how to gain and sustain an advantage by practicing its sister disciplines: personal mastery, mental models, shared vision, and team learning.

THE FIVE DISCIPLINES

Learning organizations learn to innovate constantly by paying attention to five "component technologies." These disciplines are never mastered; the best organizations practice them continuously. And while organizations develop them separately, the presence of each is critical to success:

Systems Thinking. Systems thinking helps us see patterns and learn to reinforce or change them effectively. Unfortunately, we usually focus on isolated parts of the system instead and then wonder why our efforts at solving problems or perpetuating success fail. Systems thinking also fuses the other four disciplines into a coherent whole that keeps them from turning into fads or gimmicks, which is why it's the all-important "fifth" discipline.

Personal Mastery. Mastery implies a high level of proficiency, and the proficient can consistently bring about the results they desire. In seeking personal mastery, we clarify and deepen our vision, focus our energy, develop patience, and, in general, approach life as an artist approaches the creation of a work of art.

Mental Models. We understand the world and take action in it based on notions and assumptions that may reside deeply in the psyche. We may not be aware of the effect these models have on our perception and behavior, yet they have the power to move us forward or hold us back.

Shared Vision. No organization becomes great without goals, values, and missions that become shared throughout the organization. A "vision statement" or the leader's charisma is not enough. A genuine vision breeds excellence and learning because people in the organization want to pursue these goals.

Team Learning. Often it seems that teams made up of individuals with IQs exceeding 120 have a collective two-digit IQ. Why? They haven't really learned to work together. True learning begins with dialogue, in which members suspend assumptions and think together to solve problems or chart the future.

SEE THE WORLD ANEW

Systems thinking is a discipline for seeing wholes, a framework for seeing patterns and interrelationships. It's especially important to see the world as a whole as it grows more and more complex. Complexity can overwhelm and undermine: "It's the system. I have no control." Systems thinking makes these realities more manageable; it's the antidote for feelings of helplessness. By seeing the patterns that lie behind events and details, we can actually simplify life.

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44

Seeing Circles of Causality

Though we may see straight lines, reality is made up of circles. Our language and its subject-verb-object structure actually encourages us to see straight lines, so the first step is to overcome its limitations.

THE LAWS OF THE FIFTH DISCIPLINE

The fifth discipline — systems thinking — is the cornerstone of the learning organization. An analysis of systems thinking reveals its laws:

1. *Today's problems come from yesterday's solutions.* We're often puzzled by the causes of our problems, but remembering solutions to past problems provides insight. For instance, why are salespeople spending 20 percent more time dealing with angry customers' late shipments? Because a new manager "solved" the problem of high inventory costs some time ago by depleting the inventory.

2. *The harder you push, the harder the system pushes back.* We've all felt it — the more you try to improve things, the more effort is required. For instance, say your product starts to lose market share. Your inclination is to market it more aggressively, so you spend more money on advertising or lower the price. But in doing so, you take away resources from other parts of the company, and quality declines. In the long run, you lose even more customers.

3. *Behavior grows better before it grows worse.* If you intervene to improve things, you succeed, but only in the short term. When you increased advertising for your product in the last example, for instance, its sales may have improved. When your short-term success turns into long-term decline, however, it's hard to recognize the connection between the two.

4. *The easy way out usually leads back in.* When we stick to what we know best and apply familiar or textbook solutions to problems, we find comfort. Relying on familiar solutions even while problems persist indicates nonsystemic thinking — the "what we need here is a bigger hammer" syndrome.

5. *The cure can be worse than the disease.* The familiar solution is sometimes not just ineffective, it can be dangerous. For instance, it's tempting to call in a consultant to deal with a personnel problem. She comes in, solves the problem, and leaves. But you've simply shifted the burden to an intervenor, who becomes more necessary and powerful as problems recur.

Any long-term solution must permit the system to solve its own problems.

6. *Faster is slower.* All natural systems, whether ecosystems or organizations, have an optimal rate of growth that is far slower than the fast pace most of us think is desirable. The system will compensate for fast growth by slowing down, even if it means death.

7. *Cause and effect are not closely related in time and space.* Most of us assume that cause and effect occur close together. That makes it hard to find the causes that effects — like sagging profits or drug abuse — indicate exist. The first step in learning how to view reality systemically is to dispense with simple cause-and-effect thinking and learn to see that often *we* are at the root of our problems, not external adversaries or events.

8. *Small changes can produce big results, but the areas of highest leverage are often the least obvious.* Small, well-focused actions can produce solid improvements — but only if done in the right place. This is called *leverage*. Unfortunately, it's hard for most people in a system to see where these high leverage points lie. Learning to see the structure rather than the events it produces is a good beginning.

9. *You can have your cake and eat it too, but not at once.* Sometimes knotty dilemmas, from a systems point of view, aren't dilemmas at all. Once you change from a "snapshot" to a "process" mode of thinking, they appear differently.

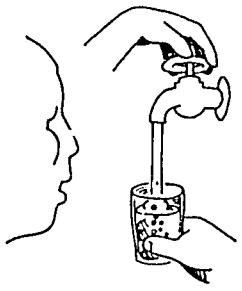
For instance, for years American manufacturers thought the choice was simple: high quality or low cost, but not both. In fact, manufacturing process improvements can lead to less rework, fewer quality inspections, lower warranty costs, and reduced advertising expenditures, all of which lead to lower production and marketing costs, and higher quality. Manufacturers who discovered this, however, learned they couldn't have both immediately — they had to wait months if not years for the cost benefits of a quality program to become clear.

10. *Dividing an elephant in half does not produce two small elephants.* Systems are alive, and their character depends on the whole. To understand difficult managerial problems or plot strategy, you'll have to see the whole system that generates the issues.

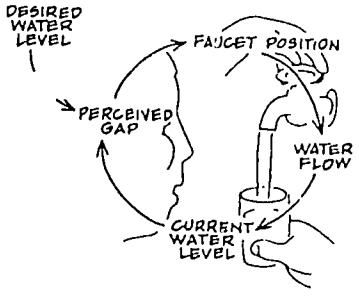
An old Sufi tale makes the point: Three blind men happen along an elephant in the road, and each touches it to see what it is. The first man feels an ear and decides "it is broad, like a rug." The second man holds the trunk and decides it is a straight and hollow pipe. The third man touches the front leg and decides it's "mighty and firm, like a pillar."

These men are like the heads of manufacturing, marketing, and research in a large organization. All have a hold on a different aspect of the system and have trouble seeing how their functions interact.

These diagrams show that even so simple a concept as "filling a glass of water" is a system. Normally we view the event like this:



But as we fill the glass, we watch the water level rise and monitor the gap between the present level and the level to which we want it filled. In this "water regulation system," there are five variables: our own desired level, the current water level, the gap between the two, the faucet position, and the water flow. These variables are organized in a circle or loop of cause-effect relationships called a feedback process, a process that works continuously to bring the water to the desired level:



In English we might say "I am filling the glass of water," which implies one-way causality. Even more precisely: "My hand on the faucet is controlling the rate of water flow into the glass." Yet that describes only half of the process — the linkages from faucet position to water flow to water level.

You can see from the diagram that it would be just as true, though just as incomplete, to say, "The level of water in the glass is controlling my hand." Most complete: "My intent to fill a glass of water creates a system that causes water to flow in when the level is low, then shuts off the flow when the glass is full." The structure, in other words, causes the behavior.

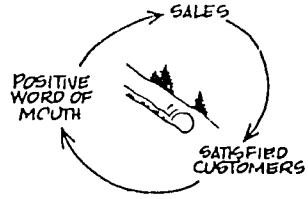
Seeing the world in terms of causality ("I am filling the glass of water") shows that we believe ourselves to be at the center of reality and operating in a world of inanimate objects. From a systems perspective, however, humans are part of the feedback process, not apart from it.

Seeing the world from this point of view causes a major shift in awareness, because now you are conscious of how you continually influence — and are influenced by — reality.

Linear thinkers are always looking for a thing or person who is responsible. Systems thinkers take on greater responsibility for events, because their perspective suggests that everyone shares responsibility for problems generated by a system.

Reinforcing and Balancing Feedback, Delays

Reinforcing feedback in systems is an engine for growth or decline, and understanding how it operates permits you to influence the system. A simple example is the "virtuous" cycle, or snowball effect. Many good products build word-of-mouth sales. And the more products sold, the more mouths there are to talk about the product, which leads to greater sales.



Accelerating growth or decline (the "vicious" cycle) usually does not run unchecked by nature, of course, because reinforcing processes don't occur in isolation. Limits are encountered, which are a form of *balancing* feedback, the second basic element of systems thinking.

Balancing systems seek stability. If you like the system's goals, you'll be happy. If not, you'll have to change the goal or weaken its influence or else all your efforts to change matters will come to naught.

Such systems seem to have their own agenda, because self-correction mechanisms try to maintain a goal. For instance, take a manager forced by budgetary constraints to trim staff. Because the work level remains the same, the savings are lost through farming out the work or paying overtime. This balancing system's agenda? To get a certain amount of work done.

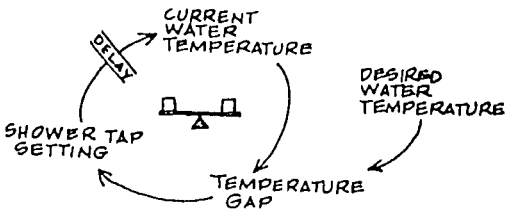
Delays, interruptions between actions and their consequences, are the third building block in systems language. Delays in particular make it seem as if systems have minds of their own. You meet delays everywhere: You invest now to gain future benefits, you hire a person who may not be productive for a few months, or you spend money on a project that may take years to develop.

These delays are easy to see, though most aren't. The delay between planning and then building new office space, for instance, often results in an overbuilt market that bankrupts developers.

Consider this diagram. It represents adjusting the water temperature in a shower. If there's a ten-second delay in temperature change after

46

you've turned the knob, you're sure to over- or undercompensate until you get the temperature just right. If you're too aggressive, you may scald yourself — which is why aggressive moves in the business world may do exactly the opposite of what you intended. Each adjustment in this balancing process leads you to your goal of a desired water temperature.



SYSTEMS ARCHETYPES

Now let's see these principles in action.

You'll often find that the patterns controlling the events you encounter recur time and again. When you start to recognize them, they'll provide insight into your personal and business affairs by permitting you to see the whole system that generates a problem and not just an aspect of it. Moreover, recognizing such "archetypes" suggests leverage points where one can change the system and therefore the events it generates.

The "Limits to Growth" Archetype

One archetype (of many) is called Limits to Growth, and it's a familiar pattern to business people. What follows is an analysis of it.

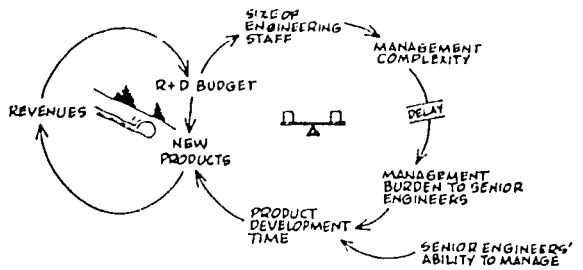
Definition: In a limits-to-growth pattern, a reinforcing process moves to produce a desired result. It creates success but also secondary effects (seen in balancing processes) that slow down the process of success.

Management Principle: Don't push growth. Try to find and remove the factors that limit it.

Where It Is Found: Your organization may grow swiftly, then get bogged down and stop growing. A farmer may increase his yield by adding more and more fertilizer, but then his crop grows larger than the rainfall can sustain. A person may lose a lot of weight in a crash diet, then gain it all back. You might initially solve overload problems by working more hours, but as stress and fatigue set in, your productivity plummets.

In each of these cases, a reinforcing process of improvement operates for a time, then runs up against a balancing process that limits growth.

Understanding and Using the Structure: You'll find this archetype working at all levels in your organization. A high-tech firm, for instance, grows because it can pump out new products very fast. But as the number of products and revenue grow, so do the R&D staff and its budget. The staff becomes increasingly hard to oversee, and the burden falls on the engineers themselves to manage it. As a result, they spend less time on engineering, which leads to longer development times and a slowdown in the very factor that created the success — the rapid introduction of new products.



The balancing factor, as you can see, is the engineers' ability to manage given their time constraints and training.

Pattern of Behavior: Over time, the limit becomes more powerful, and after the initial boom, growth levels off or slows so much that the reinforcing spiral works in reverse and turns into a vicious cycle (revenue falls, so R&D spending falls, so product introduction slows, and revenue falls still lower . . .).

How to Achieve Leverage: Most people try to solve limits-to-growth problems by pushing harder. In this case they might work longer hours, begin even more development projects to offset those that are bogged down, add salespeople to sell more, or increase the advertising budget. Early in the process these strategies may seem to be effective — you start introducing new products at a faster rate and revenues begin to rise again. Nonetheless, the harder you push, the more the balancing process resists your efforts.

The point of leverage lies in the balancing loop, not the reinforcing loop, so the task is to identify and change the limiting factor. In the example, the high-tech firm won't pull out of its decline until it recognizes that a complex research and engineering firm requires skillful management. It can solve its problem in a number of ways: Decentralizing, finding managers skilled in handling engineers, or by training engineers who would prefer the challenge of managing.

PERSONAL MASTERY

Organizations can learn only if the individuals in them are learning. "Personal mastery" is the phrase used to describe the discipline of personal growth, the goal of which is to expand one's ability to produce desired results.

Personal mastery embodies two concepts: First, those engaged in the discipline continually clarify

what's important to them. Second, they constantly attempt to see current reality more clearly.

Those with a high level of personal mastery feel a sense of purpose behind their goals; for them, a vision is a calling, not just a good idea. Lifelong learners, they are inquisitive and feel connected to others and to life itself. They feel part of a larger process which they can influence yet not entirely control.

The Discipline of Personal Mastery

It's best to approach personal mastery as a discipline, a series of practices and principles that must be used to be useful. Here are some of the elements:

1. **Personal Vision**. Most people have goals and objectives, but no sense of a real vision. Maybe you'd like a nicer house or a better job, or a larger market share for one of your products. These are examples of focusing on the means, not the result. For instance, maybe you want a bigger market share in order to be more profitable in order to keep your company independent in order to be true to your purpose in starting it. The last goal has the most value, while the others are means to an end — means that might change over time. The ability to focus on ultimate desires is a cornerstone of personal mastery.

Vision differs from purpose. Vision is a definite picture of a desired future, while purpose is more abstract. Vision: Put a man on the moon by the end of the 1960s. Purpose: Advance man's capacity to explore space.

Nothing happens until there is vision, but vision without a sense of purpose is equally futile. Personal mastery, then, is a discipline of continually focusing and refocusing on what one truly wants — the vision.

2. **Holding Creative Tension**. There are unavoidable gaps between one's vision and current reality. You may want to start a company but lack the capital, for instance. Gaps discourage us, but the gap is itself the source of creative energy. It provides creative tension.

There are only two ways to resolve the tension between reality and the vision. Either vision pulls reality toward it, or reality pulls vision downward (i.e., you lower the vision). Individuals and companies often choose the latter, because it's easy to "declare victory" and walk away from a problem. That releases the tension. But these are the dynamics of compromise and mediocrity. Truly creative people use the gap between what they want and what is to generate energy for change. They remain true to their vision.

3. **Commitment to the Truth**: A relentless willingness to uncover the ways we limit and deceive ourselves, and a willingness to challenge the way things are characterize those with a high degree of mastery. Their quest for truth leads to a deepening awareness of the structures that underlie and generate events, and this awareness leads to the ability to change the structure to produce the results they seek.

MENTAL MODELS

Why do good new ideas rarely get put into practice? Often because they conflict with deep-seated internal images of how the world or the company works. These mental models limit us to familiar ways of thinking and acting, much to our detriment. That's why managing mental models — discovering them, testing their validity, and improving them — can be a breakthrough concept for learning organizations.

Mental models govern how we make sense of the world and how we take action in it. An easy example is the generalization "people are untrustworthy." Such a sentiment shapes how we act and how we perceive the acts of others.

Mental models can be much more complex, especially in business settings. For years these widely held "mental models" among General Motors managers shaped the way GM designed and produced cars:

— "GM is in the business of making money, not cars."

— "Cars are primarily status symbols. Styling is therefore more important than quality."

— "The American car market is isolated from the rest of the world."

— "Workers do not have an important impact on productivity or product quality."

These principles served the industry well for years, but instead of recognizing that they were assumptions that worked well in response to particular conditions, GM felt they were facts — the rules for success in *any* time or place. When Japanese and German automakers taught the American public to appreciate quality, GM lost significant market share.

Incubate a New Business Worldview

Royal Dutch/Shell, among others, has discovered that just as mental models can impede learning and business growth, so too can they accelerate them. Shell understands that by helping managers identify their assumptions, look for contradictions in them, and dream up new strategies based on new assumptions, it can maintain a real competitive advantage.

In 1973, a Shell planning group researched the mental models that shaped the actions of its man-

ORGANIZATIONAL LEARNING DISABILITIES

Most organizations don't live as long as a person. A 1983 survey showed that a third of the companies in the 1970 *Fortune* 500 had vanished. Why?

The following corporate learning "disabilities" — which arise when we view the world in linear, and not systemic, ways — explain the high mortality rate for all companies. The antidote for any of them is to begin to practice the five disciplines of a learning organization.

1. **"I am my position."** Most people confuse their jobs with their identities ("I'm an accountant"). While they understand their daily tasks, people don't understand the purpose of the organizational enterprises they take part in. Instead, they see themselves in a system in which they have little power and no need to take responsibility for poor results.

2. **"The enemy is out there."** Some organizations and people find an external agent to blame when problems arise, a result of looking at the world in non-systemic ways. Focused on our positions, we can't see how our actions have an effect beyond their boundaries. Focusing on an external enemy is almost always a mistake — usually "out there" and "in here" are part of the same system.

3. **The illusion of taking charge.** "Proactive" managers are encouraged and admired when they tackle problems fast, but is taking action against an enemy on the "outside" really proactive? "Proactiveness" is disguised reactiveness. Being truly proactive means seeing how we contribute to our own problems and solving those first.

4. **The fixation on events.** We're dominated by events: last month's sales, the new budget cuts, who got fired, product introductions, and so on. "Events" distract us from seeing long-term patterns of change that lie behind them. That, of course, inhibits us from understanding these patterns. Slow, gradual processes like environmental decay, the erosion of the education system, or a general decline in product quality are much more destructive than sudden events.

5. **The delusion of learning from experience.** We may learn best from experience, but people often never experience the consequences of many of their most important decisions directly. It may take years, for instance, to see the consequences of R&D decisions.

6. **The myth of the management team.** In most organizations, a valiant, experienced, and savvy management team stands ready to battle with problems and dilemmas. Nevertheless, teams in the business world tend to fight for turf and avoid anything that will make them look bad. To keep up the appearance of a cohesive team, they hide disagreement and come up with watered-down decisions that everyone can live with.

agers. The group then showed the managers how their prevailing view — that the oil business would continue as usual — was based on certain assumptions concerning the nature of the political world and the oil industry. The planners also showed how none of these assumptions would hold true in the years to come.

As a result, managers began to construct new mental models based on new assumptions: that oil exploration would have to expand; refinery building would have to slow; and that because different nations would respond differently to events in the world to come, local control for each division would be the best policy.

When the OPEC embargo of 1973-74 hit, Shell was much better prepared than other oil companies to adapt. Competitors reigned in divisions and centralized control, as many companies do in a crisis. Shell did the opposite, which gave their operating companies much more freedom to maneuver, and the company left the 1970s as the strongest of the top seven oil companies — in no small part a result of dissolving tired, outdated mental models and constructing new ones.

SHARED VISION

"What do we want to create?" The answer to that question is the vision you and your people come together to build and share. Unlike the concept of vision that's bandied about these days — the "vision" that emanates from one person or a small group and is imposed on the corporation artificially — shared visions create a commonality that gives a sense of purpose and coherence to all the activities the organization carries out. Few forces in life and the business world are as powerful as shared vision.

Shared vision is vital for learning organizations that want to provide focus and energy for its employees. People learn best when they strive to accomplish things that matter to them. In fact, you can't have a learning organization without shared vision. The overarching goal that the vision establishes brings about not just commitment but new ways of thinking and acting. It fosters risk-taking and experimenting. It also encourages a commitment to the long term.

Building Ford Motor Company or Apple Computer would not have been possible without

shared vision. Henry Ford envisioned everyone, and not just the wealthy, owning cars. The founders of Apple believed in the ability of the computer to empower people. These visions, shared by the employees of each organization, focused energy and created a common identity among different people, which led to great success. A commonly held vision creates the spark that lifts an organization to great heights.

Encouraging Vision

Shared visions emerge from personal visions. Bill O'Brien, CEO of Hanover Insurance: "My vision is not what's important to you. The only vision that motivates you is your vision." Personal visions, of course, are rooted in an individual's values, concerns, and aspirations. Personal mastery, the commitment to truth and creative tension, is the material of personal and thus shared vision.

Mastering the discipline of shared vision means you have to give up the idea that visions come from top management or from an institutionalized planning process. To begin the process of encouraging vision, leaders must instead share their personal visions and ask that employees follow them. Leaders must ask for support, then be patient as the shared vision takes time to emerge. It will grow as people interact with their own visions — as people express their dreams and learn how to listen to the dreams of others. When listening, new insights and beliefs into what's possible will surface.

Bill O'Brien offers insight into the true nature of vision: "Being a visionary leader is not about giving speeches and inspiring the troops. How I spend my day is pretty much the same as how any executive spends his day. Being a visionary leader is about solving day-to-day problems with my vision in mind."

TEAM LEARNING

Team learning is the process of aligning a team to avoid wasted energy and to create the results its members want. Team learning builds on the disciplines of shared vision and personal mastery, because talented teams are, necessarily, made up of talented individuals.

Because the IQ of a team can be much higher than that of any of its members, teams are becoming the key learning unit in organizations.

Dialogue and Discussion

The discipline of team learning involves mastering the practices of dialogue and discussion. In dialogue, team members explore complex issues creatively. They listen to each other with deep regard and suspend their own views to better hear those of others.

In discussion (a word with the same roots as percussion and concussion) views are presented and defended and the team searches for the best view to support decisions. Participants in a discussion often want to win and see their view prevail. While dialogue and discussion can be complementary, most teams can't distinguish between t[illegible]n.

The o[illegible]ginal meaning of the word *dialogue*, according to physicist David Bohm, suggests a free flow of meaning between people. Bohm contends that in dialogue a group accesses a "larger pool of common meaning" that can't be accessed by individuals alone. The purpose of dialogue, then, is to go beyond the understanding held by each team member, and to explore difficult issues from many points of view.

Bohm identifies three conditions for real dialogue to occur:

- All participants must suspend their assumptions both figuratively and literally — to learn to view them *as* assumptions and not fact, and to "hold" them in front of the group as if suspended for all to see;
- All participants must regard one another as colleagues;
- A facilitator, who "holds" the context of the dialogue, must be present.

After dialogue, decisions must be made and thus comes the need for discussion, where action is the focus.

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PRODUCTIVE WORKPLACES

Organizing and Managing for Dignity, Meaning, and Community

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51

Contents

Preface xiii

Acknowledgments xxi

The Author xxv

Prologue: Discovering Theories X and Y 1

Part One: The Search for Productive Workplaces 21

1. Scientific Management Revisited: A Tale of Two Taylors 24

2. The Consulting Engineer: Taylor Invents a New Profession 50

3. Lewin: The Practical Theorist 70

4. The Learning Organization: Lewin's Legacy to Management 88

5. McGregor and the Roots of Organization Development 106

52

6. *The Human Side of Enterprise* Revisited: A New Look at Theories X and Y 123

7. Undoing Taylorism: Emery, Trist, and the Sociotechnical Revolution 142

8. Open Systems and the New Paradigm: How Emery and Trist Redefined the Workplace 161

Part Two: Transforming Theory into Practice and Practice into Theory 179

9. Adding Action to Research: Lewin's Practice Theory Road Map 183

10. Methods of Diagnosis and Action: Taking Snapshots and Making Movies 196

11. Rethinking Organizational Improvement: New Perspectives on Consultation 219

12. Improving Whole Systems: Alternatives to the Report-in-the-Drawer Phenomenon 237

Part Three: Learning and Applying New Practice Theories 253

13. "Third Wave" Managing and Consulting: A New Practice Theory 260

14. Inventing the Future: Search Strategies for Whole Systems Improvement 281

15. Transforming Teamwork: Work Relationships in a Fast-Changing World 296

16. Designing Work: New Structures for Learning and Self-Control 311

53

17. Managing and Consulting Beyond the Design Limits: A "Third Wave" Action Project 337

Epilogue: Caught Between Paradigms: Where Do We Go from Here? 366

References 381

Index 397

54

Chapter Fourteen

Inventing the Future: Search Strategies for Whole Systems Improvement

On the way to the moon the Apollo astronauts made tiny "mid-course corrections" that enabled them to land at an exact predetermined spot. The corrections were small, but because the moon was far away they made a big difference. It is like that with us. Some of the changes we make in society, in our lives, or in our organizations seem insignificant, but over the years they can have major impact.

——Edward B. Lindaman and Ronald Lippitt, *Choosing the Future You Prefer*, 1979, p. 4

Planner Russell L. Ackoff (1977), of the University of Pennsylvania, once observed that corporate planning was like rain dancing: whether or not it brought rain, it made the dancers feel better. Ackoff's point was that extending past trends to predict the future is an exercise in futility. Economists can't do it, politicians can't do it, scientists can't do it, nor, alas, can you and I.

The Future Search Conference

What are corporate alternatives to rain dancing on the crest of the third wave? In this chapter I want to describe an extremely promising method for getting whole systems in one room and focusing on the future—the search conference. Like so

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many workplace innovations, its origins are traceable to creative extensions of Kurt Lewin's insight that you steer a ship by feedback from outside, not by how the rudder, engines, or crew are behaving. Innovators in both Europe and the United States began extending Lewin's work to larger systems many years ago, responding to the psychological stresses of accelerating change.

In the late 1950s in Great Britain, for example, a forced merger led to a serious market crisis in the Bristol/Siddeley aircraft engine company. Eric Trist and Fred Emery were asked to help. The pair had recently begun work on the managerial dilemmas of increasingly turbulent environments (see Chapter Eight). To the firm's top managers, suffering, in Trist's words, from "stiff upper-lip paralysis," they proposed a week-long collaborative inquiry. The group of managers undertook an intense marathon dialogue on changes in the world, their industry, and their own company—to search for new possibilities. The managers later made crucial strategic choices, including a new product line integrating the capabilities of the merged companies. In that historic conference Emery and Trist (1960) invented a new group orientation to help people integrate economics and technology—the whole open system—in a fast-changing environment, and turned around a serious crisis.

From this experience evolved the "environmental scan"—an integral step in sociotechnical work design in which people describe the network of outside pressures on their organization. More, Emery, collaborating with his wife Merrelyn, began an extraordinary conceptual and practical expansion of the methodology, teaching it to aspiring conference managers on several continents (Emery, 1982). The procedure has been used repeatedly to create common visions among disparate stakeholders within corporations, cities, towns, industries, unions, and trade associations. More than 300 search conferences have been held in Australia, and dozens more in Africa, Britain, Canada, India, and Scandinavia.

The Emerys' conference typically lasts two or three days. They begin by mapping the networks of people and external pressures linked to the institution under study, what they call the "extended social field." They end with action planning for the

future. In between they draw on a flexible menu—history, desirable and undesirable features, constraints on change, values to be carried forward, desirable futures—based on data produced and analyzed solely by the participants. Many adaptations have been made, from downsizing business firms (Hirschhorn and Associates, 1983) to refocusing social service agencies (Clarkson, 1981).

Ludwig von Bertalanffy, author of general systems theory, once observed that the same ideas spring up in parallel in diverse fields (see Chapter Seven). From the late 1940s on Ronald Lippitt, Lewin's American colleague and a founder of NTL Institute, had sought, like Emery and Trist, to extend group dynamics learning to large organizations, networks, and communities. Lippitt too had moved from small-group problem solving to future-oriented conferences for huge networks. What started Lippitt down this road were tape recordings he secured (some with Douglas McGregor's help) of thirty planning groups in action.

Lippitt was appalled as he heard people build long problem lists, set priorities, generate solutions—a direct extension of his own pioneer work in group dynamics. He was struck most by how voices grew more depressed as people attributed problems to causes beyond their control. They used words like "hopeless" and "frustrating." Action steps tended to be short-term, designed to deal with symptoms and reduce anxiety. The motivation, noted Lippitt (1983), was to escape the pain induced in part by the method itself: the piecemeal listing of problems, the solution of any one of which might create still more problems.

In the 1950s Ronald Fox, Lippitt, and Eva Schindler-Rainman (1973) began speaking of "images of potential"—envisioning what could be instead of lamenting what was. In the 1970s Lippitt teamed with the late futurist Edward Lindaman, who had directed planning for the Apollo moon shot. Lindaman believed that the future was created by our present ways of confronting "events, trends and developments" in the environment. The "preferred future"—an image of aspiration—could be a powerful guidance mechanism for making far-reaching course corrections. Lindaman and Lippitt (1979) found that when people plan present actions by working backward from what is really desired, they develop energy, enthusiasm, optimism, and high commitment.

So "futuring" focused awareness away from interpersonal relationships and toward the experiences and values affecting everybody. Lippitt adapted that insight to national voluntary organizations like the YMCA, and to conferences for more than eighty cities, towns, and states (Schindler-Rainman and Lippitt, 1980). Diverse interest groups could jointly envision desirable futures, for example, the PTA, manufacturers' association, doctors, community activists, juvenile authorities, chamber of commerce, and school board all at once. Searching together gave organizations more dependable anchor points for their own planning. It tied everybody to reality through taking joint snapshots, and became the basis for a more truthful movie based on mutual interest.

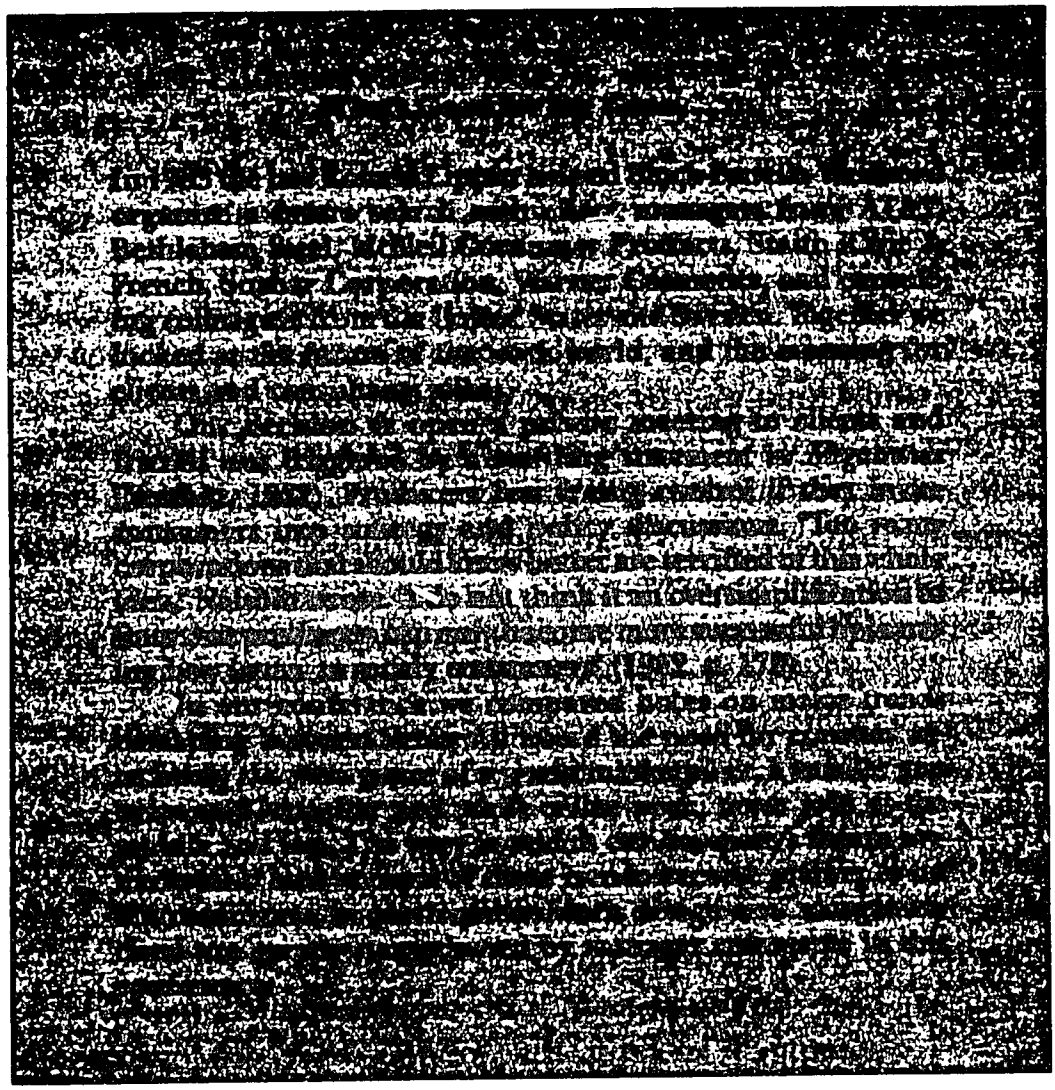
People learned to think of the future as a condition created intentionally out of values, visions, and what's technically and socially feasible. Such purposeful action greatly increased the probability of making the desired future come alive. Repeating the process over and over again with relevant others, what Ackoff (1974) calls "interactive planning" could become a way of life for corporate planners if they could bring the whole system into the room.

Lippitt and Lindaman typically used one-day conferences to trigger systemwide planning that might then continue indefinitely. They too devised a menu of activities geared to the past, present, and future: a history, a list of events, trends and developments shaping the future, "prouds and sorries" of present operations, and detailed ideal future scenarios. Eric Trist (1987 memo to author) notes the recent emergence of several new search models, for example, Michel Chevalier's search position conferences in Canada for executives who can't be away more than a day a month, and Russell Ackoff's idealized design sessions.

A Conference Model

The model I will describe is another example of this evolution. For several years my colleagues and I have experimented with a future search conference that integrates ideas from both developmental streams. From Lippitt and Lindaman we learned

58



tation by nutritionists. The principle has never been improved upon.

A forty-eight-hour investment in a search conference may reduce misunderstanding and raise commitment way beyond previous levels. It may also uncover new possibilities that can't be born in any other forum. The typical conference brings together thirty to sixty people for two to three days. Together they do a series of structured tasks, looking at the organization's past, present, and preferred future. Tasks are cumulative. Each session builds on previous ones. The last event involves everybody in action planning for the future.

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the importance of going "back to the future." From the Emerys we learned concepts and processes for managing conferences consistent with democratic values. We have used variations in steel, textile, and financial services industries, medical education, service organizations, schools, colleges, and an agricultural co-op in Sweden. We have managed search conferences lasting as little as half a day (unsatisfying) and up to three days (very exciting). We have witnessed little or no followup, and extensive activities carried forward for a year or more. We have worked with as few as a dozen people (too few) and as many as a hundred (hard and doable). We have found that within forty-eight hours people often generate important new learnings that influence their organization's future course for years.

Search conferences excite, engage, produce new insights, and build a sense of common values and purpose. They have been especially attractive to organizations faced with significant change: markets, mergers, reorganizations, new technologies, new leadership, the wish for a coherent culture and corporate philosophy. We have used the conference to set the stage for work design. We also have used it at turning points when people knew they had to do something new and were not sure what.

We base the future search on three assumptions:

1. Change is so rapid that we need *more*, not less, face-to-face discussion to make intelligent strategic decisions. Teleconferencing won't do. As John Naisbitt wrote in *Megatrends*, "Talking with people via television cannot begin to substitute for the high touch of a meeting, no matter how rational it is in saving fuel and overhead" (1982, p. 46).

2. Successful strategies—for quality goods and services, lower costs, more satisfying ways of working—come from *envisioning preferred futures*. Problem solving old dilemmas doesn't work under fast-changing conditions. Each narrow solution begets two new problems.

3. People will commit to plans they have helped to develop. Lewin and anthropologist Margaret Mead showed that during World War II when they found that housewives were more likely to change their food habits through discussion than exhor-

60

Getting Organized

Below I describe one typical version. My goal is not to "cookbook" the conference but to indicate its ingredients as evolved within the firm I know best and I encourage you to make up your own menu. The conference fully embodies third-wave managing and consulting—getting the whole system in the room, focusing on the future, having people do the work themselves.

How? You can't wing it. You have to spend a day or more in planning, and another day preparing materials. The search is best planned by the conference managers (consultants) and a voluntary committee of four to six potential participants. They decide participant-selection method, place, schedule, meals and breaks, group tasks, and goal focus, for example "Designing XYZ Corporation for 1995." Each task is structured to support the overall focus. Worksheets are provided so that small groups can organize their tasks without special facilitators.

Who? We seek to involve *only* people who have a stake in the sponsoring organization's future. They must be active participants. Any group important to implementation should be there. Top management always participates, with people from as many functions and levels as feasible. The guideline is diversity, the whole system to the extent possible. Business firms, for example, should consider customers, suppliers, union leaders, all dimensions of sex, age, racial, and ethnic backgrounds of employees, and all functions and levels of management.

We prefer groups of fifty or sixty people, which permit great diversity of views, knowledge, and experience, a higher potential for creative solutions, more likelihood of follow-through, more linkages with outside. For logistical reasons an organization may run a series of conferences. A few volunteers from each meet afterward to sort through the data and ideas and prepare a combined scenario or discussion paper.

Schedule. I like Merrelyn Emery's idea (1982) that the conference

start with dinner on a Wednesday evening, followed by the first work session. This makes use of the Zeigarnik effect (see Chapter Three)—the tendency to recall unfinished tasks—and ensures a fast startup next morning. It's desirable to end a future search on a Friday afternoon. That gives people a weekend to collect their thoughts, review key events, and digest important ideas rather than plunge into paperwork at the office.

People are invited to bring newspaper and magazine clippings describing events and trends they believe are shaping their organization's future. These clippings will be displayed on a bulletin board and used in the discussion. Sometimes a planning group will request artifacts and mementos from the past—old ads, news clips, uniforms, photographs, awards, brochures, posters, trophies—that symbolize and embody history. People display and discuss these materials, making them a foundation for imagining desirable futures.

Startup. People usually sit at tables of six to eight, each with its own easel, colored markers, and tape. Who sits where depends on the conference's purpose. During the two days, we will have no more than three groupings—one by function or common interest, another with maximum diversity of levels, functions, ages, and so on, perhaps a third of self-selected volunteers—in addition to the total group.

A few ground rules are discussed at the start. One, this is *not* a problem-solving conference. It's an exercise in learning, awareness, understanding, and mutual support. Two, every idea and comment are valid. People need not agree. Every contribution is written on flip charts in words as close to the speaker's as possible. Three, it's a task-focused meeting. Every task has output, and all output is recorded and discussed. Four, we stick to time. Groups are responsible for completing tasks on schedule. Five, the consultants manage time and structure tasks. Participants generate and analyze information, derive meanings, propose action steps, take responsibility for output. Consultants may add their two cents, but only as another contribution to the discussion. There are no lectures.

Steps in the Process

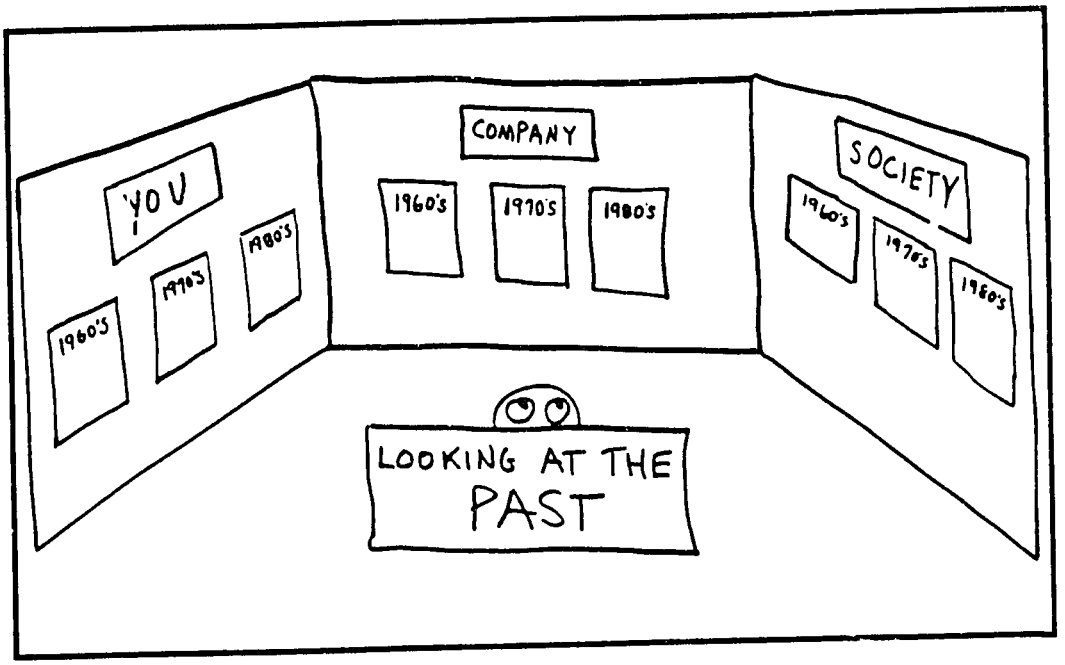
There are four or five major segments, lasting up to half a day each. Each one requires that people (a) build a data base, (b) look at it together, (c) interpret what they find, and (d) draw conclusions for action. The last task includes action proposals and a structure—task forces, assignments—for carrying them out. A successful search conference always uncovers important shared values and leads to congruent action plans. All this is discussed at the start.

Past. The first activity focuses on history. People examine their collective past from three perspectives: self, company (or industry, or town), and society.

Task: Alone, make notes on significant events, milestones, highlights, or activities you recall during each decade. When ready, take a magic marker and transfer your memories to the appropriate sheets on the wall.

This task gets everybody participating and quickly experiencing success. There is no way to do it wrong. It takes about thirty minutes for everybody to write on flip charts scattered around the room. With two sheets for each topic in each of three decades, eighteen people can write at once. See "Looking at the Past" for the flip chart array. Simple contributions make a potent whole. As the data go up, reluctance turns to interest, then surprise, as people rediscover and interpret how much change they have lived through together and how much this influences the present. The activity is a powerful community builder. People see that for a long time they have been in the same boat. Younger members learn much they never knew about the past, older members about youthful values and commitments.

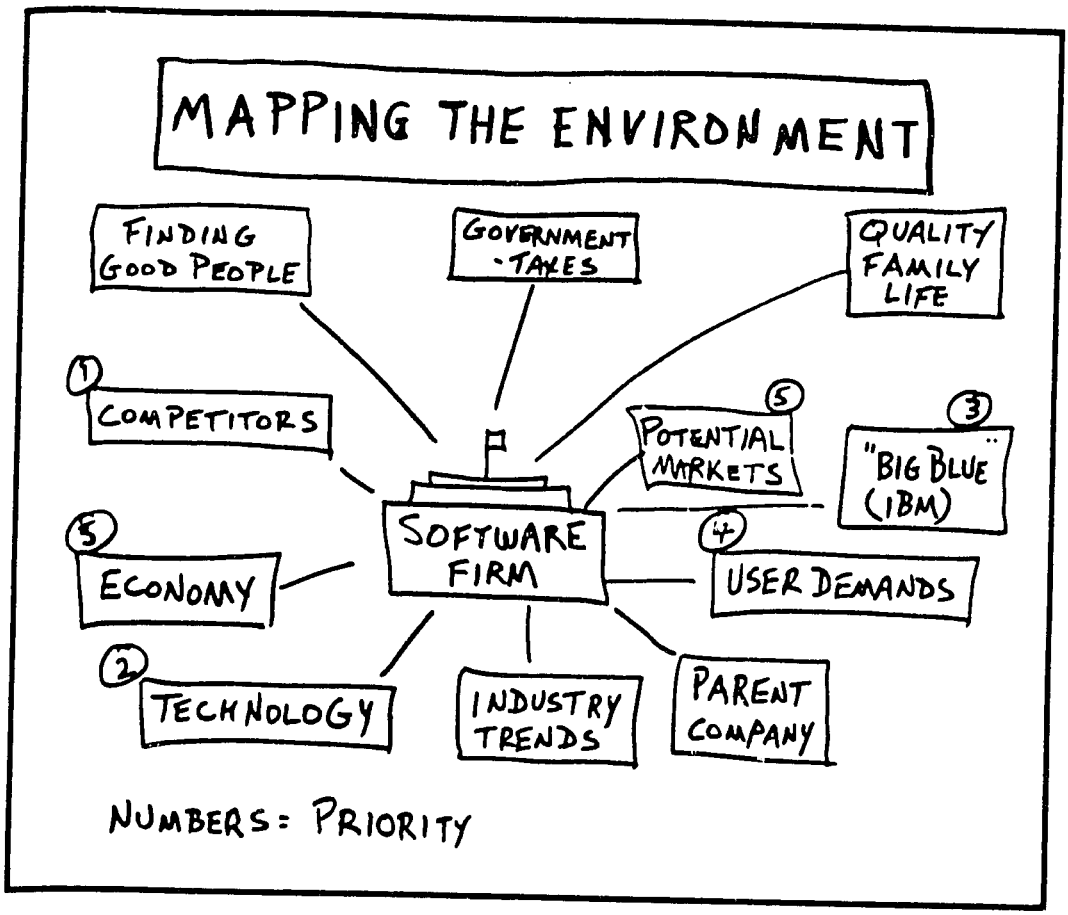
Each table analyzes one theme across three decades—one table looks at all the items under "myself," another "company," a third "society"—for patterns and meanings. As tables report, a consultant notes emerging trends. The whole group then inter-



prets good and bad trends and the direction of movement of each, a way of discovering important values. Those who brought mementos say a few words about them, adding to the sense of continuity, anchor points in the sea of change.

Present, from Outside and Inside. The present is examined from two perspectives. One is a list of external events, trends, and developments shaping the future right now. This analysis is helped along by the news clippings and articles. We ask all participants to tell their table group why their clipping is important. A recorder notes each person's remarks. Then people select priorities from the group list. A poll of priorities reveals several common themes shared by all tables. Pooling these creates a map much like what Emery calls "the extended social field," the relevant outside network of forces and institutions demanding attention. Group analysis reveals what these trends and forces mean to us, and what we believe will happen in the future that cannot be ignored now. See "Mapping the Environment" for an example.

We also look at the present from a second, internal perspective, using a simple Lippitt exercise that surfaces values. People are asked to generate lists of "prouds" and "sorries," the things going on right now within their organization about which they



feel good and bad. This leads to a shared appreciation of present strengths, needs, and hopes. It also results in a mutual owning up to mistakes and shortcomings and builds commitment to do something about them.

People cast votes for their "proudest prouds" and "sorriest sorries." These are toted up, displayed, and discussed. This step often leads to a productive dialogue across levels, and the sharing of a good deal of new information in the total group. Conference managers actively probe, summarize, and note key statements on flip charts during the dialogue.

Future. Now it is time to generate future images. People either form new voluntary groups based on their own needs or work in groups set by the steering committee. They are given one to two hours to create a rough-draft "preferred future" scenario. They are asked to imagine the most desirable, attainable future five years out. (Futurists consider five years short term, twenty or thirty

years as long. The important thing is to disconnect people from the present so that dreams and ideals take over.)

The more imaginative the method, the better the scenarios. People have ridden magic carpets or rocket ships into the future, floated on clouds, written newspaper stories or TV documentaries. Plenty of media—crayons, colored paper, scissors, tape—stimulate new ideas. Background music helps. One conference ran a county fair, with each group building a booth to display the future. Others have put on segments of "60 Minutes" or written a cover story for *Time*.

As a final step people are asked to reflect on what they have learned and to make three lists: suggested actions for themselves, their function, and the whole organization. Suggestions are reviewed and discussed over a two-hour lunch break on the last day. People keep "action steps for myself" for personal use. Departments sit together, review members' functional proposals, and decide on next steps. Meanwhile the steering committee or top manager group engages in an intense work session, recording "action proposals for the organization"—policy or systems matters that cut across departmental lines and cannot be handled within one group. They are compiled, discussed, and prioritized, and an action plan is prepared. In the final large group meeting, the functions and the steering group present and discuss their action plans.

Before closing, volunteers are recruited to document the meeting, communicate to others, and carry forward next steps. In one search a dozen task forces were organized to search out new markets and explore new technologies. In another, a group undertook to merge future scenarios into a philosophy and an action plan for an entire company.

Search Conferences Build Community

One way to appreciate the future search is to compare it with traditional business conferences. Some organizations, for example, organize three to five days of guest speakers as a way of stimulating top executives. Speakers are picked for charisma, ability to entertain, or reputation as authors of best-selling books.

66

Guest-speaker audiences like to be amused and stimulated. They do not expect to do any work, and might resent it if asked without warning to become active. They enjoy watching the dance and do not expect rain.

Or consider the statistical business review, a two-hour slide show of budgets, costs, product lines, and variances. Data, of course, help meet people's needs for feedback and information. In a "data dump," though, there are too many numbers and too little time to digest them. People become overloaded, their circuits clogged. Rarely is time given to discussing ways to make the numbers come up differently.

Neither expert input nor data dump takes advantage of the significant resources present in the room. Neither accesses the thoughts, ideas, perceptions, attitudes, and reactions of the audience. If future action is desirable, there are better ways to use the time and energy of those fifty people.

Search conference participants receive advance briefing on their involvement. They know that they are actors and audience both. True, the work is paradoxical and seems confusing at first. But as people sort out the past and present, they become more focused and purposeful. By devising whole future scenarios, they create a new perspective on optimistic, value-based action. Traditional meeting formats subtly reinforce dependency and passivity. The search conference promotes dignity, meaning, and community.

A few years ago I organized a search as part of an NTL laboratory in Bethel, Maine. Townspeople, lab participants, and NTL staff joined in looking at their mutual interests—from the standpoint of stores, restaurants, churches, schools, medical facilities, hotels, banks. NTL's summer labs provide local income and jobs, and the local community offers important support services. Among the problems noted was a culture gap between lab participants and service people in stores and restaurants, leading to misunderstanding and mutual irritation.

Several good ideas were proposed, not just for reducing the tension but for creative steps that would benefit everybody. One central insight was that townspeople had lived for years with persistent rumors that NTL planned to pull out. NTL leaders

realized that this chronic headache could be cured only by a committed policy. NTL took a public stand on remaining in Bethel, and has since invested in improving its conference facilities—a key ingredient in community building. Townspeople took over the writing of the summer participant guide to services. A joint committee of townspeople and NTL staff has continued to build a productive community of interest. Only in a face-to-face discussion of the future by many stakeholders could this new spirit be infused into an old relationship.

The future search fits any organization and strategic situation: manufacturing, sales, voluntary, retail, government, health care, education, staff or line. It doesn't matter whether people see each other once a day, once a year, or have never met. Given a few simple tools and instructions, they are able to search out desirable futures together. The governing board of a prestigious medical specialty, for example, meets only once a year. Using a day and a half of their annual meeting for a future search, they established policies that unified curriculum development efforts in many medical schools. Two years later members continued to build on the work done in that conference.

The search has proved to be a powerful tool of productive workplaces. Far from requiring conformity in thought and action, it provides a forum and norms that respect individual differences. Personal attitudes, thoughts, feelings, and styles are honored. People sometimes fear past disagreements will intrude and prove disruptive. Under the guidance of experienced conference managers working with a committed steering group, this does not happen. A major strength of the search conference is its unifying effect on people even when they fear divisiveness. It is a sort of town meeting structured toward output and productivity.

The conference is not personally threatening. It does not focus on how people feel about each other but rather how they feel about the future. It tends to bring people closer together in their goals and attitudes, rather than heighten their differences. Instead of gazing inward, or being problem centered, the search links strong personal feelings to external realities—the events, trends, and developments shaping the world. Problem solving, as Lippitt's research showed, depresses. A future search energizes. It

"THE UNSCHOOLED MIND"

Howard Gardner, Harper Collins, 1991

Résumé:

Howard Gardner is Professor at the Harvard Graduate School of Education and affiliated with the Boston University School of Medicine and Boston Veterans' Administration Medical Centre. He is also associated with the long-standing research projects, both based at Harvard: Project Zero, which seeks to assess the state of scientific knowledge concerning human potential and its realisation, and Project Spectrum, an action-research programme on early childhood education.

Gardner's research background has been in cognitive psychology and neuro-psychology. His accumulated works have drawn together insights from the whole range of cognitive sciences (philosophy, psychology, artificial intelligence, linguistics, neuro-science and anthropology) to address central problems concerning the nature of knowledge and its representation in the human mind. Most recently he has sought to follow and apply his provisional conclusions into the field of educational practice. His work has won world-wide renown and numerous awards, including a MacArthur Prize Fellowship, the National Psychology Award for Excellence in the Media and the Grawemeyer Award in Education.

His early works included:

The Quest for Mind (1973)
The Arts and Human Development (1973)
The Shattered Mind (1975)
Developmental Psychology (1978)
Art, Mind and Brain (1982)

These have been followed by three further books of great significance to Education:

Frames of Mind : The Theory of Multiple Intelligences
The Minds New Science : A History of the Cognitive Revolution
The Unschooled Mind : How Children Think and How Schools Should Teach

Basic Thesis:

The basic thesis rests upon what occurs in the mind of the child in the early years of life, before it enters the world of school and education.

Pre-school children develop models, beliefs and incipient theories from their earliest encounters with the physical and social worlds in which they live. They learn a vast array of knowledge, skills and capabilities quite naturally. They seem endlessly to pursue new learning and to develop intuitive understandings of how to interact with their experience.

All normal young children growing up in a reasonably secure environment use two means of learning and of representing knowledge: the sensory-motor, acquired through the sense organs and by actions upon the world; a symbolic form of knowing in which they use the various symbol systems which have evolved over millennia within the human cultures in which they live. Their achievements in these two forms of knowing may be exemplified in their riding, and steering, a bicycle and in their acquisition of their native language. The conceptions which evolve in children's minds at this stage are often flawed, inadequate or plainly wrong. But they are perfectly adequate to make sense of their everyday world. If they believe, for example, that, self-evidently, the sun and the moon revolve about the earth, nothing changes.

So that, "Children by the age of five or six have evolved a quite robust and serviceable set of theories, about mind, about matter, about life, about self."

The problem which provides the substance of all the consequent analysis and argument is this:

Conceptions about the world, its rules, stereotypes and values which become embedded in the 'Unschooled Mind' of the five-year old child are remarkably robust and resistant to change. There is an overwhelming body of research evidence, accumulated in recent decades, that schooling (and later education) has little impact upon these intuitive and common-sense understandings.

"In this book I contend that even when school appears to be successful, even when it elicits the performances for which it has apparently been designed, it typically fails to achieve its most important purpose." Which is to establish in every student some 'genuine understanding' of what the curriculum offers in its various domains. "**We have failed to appreciate that in nearly every student there is a five-year-old 'unschooled' mind struggling to get out and express itself.**" And that this remains the case after all the scholastic endeavour is done.

For detailed discussion of the following examples see Chapters 8 and 9.

"Students with science training, when questioned about the phases of the moon, the reasons for the seasons, the trajectories of objects through space or the motions of their own bodies fail to evince the understandings that science teaching is supposed to produce. Indeed in dozens of studies of this sort, young adults trained in science continue to exhibit the very same misconceptions and misunderstandings that one encounters in primary school children.

"The same situation has been encountered in every scholastic domain..... In mathematics, college students fail simple algebra problems when they are expressed in wording that differs slightly from the usual form. In biology, the most basic assumptions of evolutionary theory elude otherwise able students who insist that the process of evolution is guided by a striving towards perfection. College students who have studied economics offer explanations of market forces that are essentially identical to those proffered by students who have never taken an economics course.

"Equally severe misunderstandings pervade the humanistic segment of the curriculum from history to art. Students who can discuss in detail the complex causes of the First World War explain equally complex current events in terms of the simplest 'good guy - bad guy' scenario. Those who have studied --- poetry --- show little capacity to distinguish masterworks from amateurish drivel, once the identity of the author is hidden from view.

'The Unschooled Mind' : A Synopsis

Introduction

The introduction articulates 'The Central Puzzles of Learning'; those issues which have emerged as central in the dissonance between 'common-sense', 'everyday' learning and the scholastic learning which pervades the whole of ed ·ation.

1. The first puzzle is 'the facility with which young humans learn a range of performances which scholars themselves have not yet come to understand.'

2. 'The very young children who so readily master symbol systems like language and art forms like music ..... often experience the greatest difficulties upon their entry into school ..... Somehow the natural, universal emergence of intuitive learning that takes place in one's home or immediate surroundings during the first years of life seems of a totally different order from the school learning that is now required throughout the literate world.'

3. Three levels of learner competence:

   First, the intuitive learner whose 'natural' or 'naive' learnings and performances which, although often immature, and misconceived, prove serviceable enough within their immediate conditions.

   Second, the 'traditional students' aged between seven and twenty, roughly, whose learning may satisfy the standard requirements of the school. But once they are removed from the context of the classroom revert in many ways to the kinds of thinking prevalent among pre-school or primary school youngsters.

   Third, there is the 'disciplinary expert', individuals of any age whose mastery of the concepts and skills of a discipline or domain of knowledge allows them to apply such knowledge in new situations. They really understand.

   The puzzle here is to know why so few reach the level of genuine understanding and why the journey is made so tortuous.

4. Constraints

Gardner proposes five constraints on the developing mind which influence, guide or restrict the child in any educational experience; species membership, the physical constitution of the world, the structure of the nervous system, and more specific facets of individual personality and socio-cultural background. 'Recent insights reveal ..... how difficult it is for most children to master the agenda of the school, particularly to the extent ..... that it clashes with the constraints which have emerged in the first five years of life'.

5. Seven Intelligences

Gardner refers to his previously described theory of multiple intelligences* to propose the final puzzle. Different human beings possess different kinds of minds and therefore learn, remember, perform and understand in different ways. These different profiles and preferences affect the learner's response to particular forms of knowledge in a way which is largely unacknowledged within education. They also complicate the examination of human learning and understanding. Equally, they provide multiple entry points to particular learning contents and learners can move back and forth between them.

Gardner proposes a theory of multiple intelligences based on evidence from a wide range of previously unrelated sources: studies of prodigies, gifted individuals, idiots savants, brain damaged patients, normal children and adults, experts in various fields and individuals from different cultures. His criteria for inclusion in his selection include : the extent to which it can be found in relative isolation in special populations; the extent that it may become highly developed in specific individuals or cultures; and to the extent that experts in particular disciplines, psychometric and experimental researches can identify core abilities which, in effect define the intelligence.

He sees all humans as endowed with these intelligences, but developed to different degrees in individuals, so that each presents a profile of development and use. He suggests that in ordinary life these intelligences work in harmony, so that their autonomy may be invisible, but he rejects any attempt to conflate or measure them as one single entity.

Finally he selects seven from what he views as a long list of candidates. They are:

Linguistic Intelligence; Musical Intelligence; Spatial Intelligence, logical-Mathematical Intelligence, Bodily-Kinaesthetic Intelligence; and two Personal Intelligences, the Intra-personal (the sense of self) and the Inter-personal (the sense of others).

* *See 'Frames of Mind' Gardner, Heinemann, London 1983*

Part I

Part one presents a detailed review of what is known about the development of mind in young children up to the age of 5 - 7 years. From the first systematic account of a child's mental development by Charles Darwin to the seminal clinical studies by Jean Piaget, Gardner follows the gradual conceptualising of early cognition. Piaget presented a picture of the mind developing in stages through the various domains of intellectual activity. As in physical development, he described a sequence of development constant in all young humans, achieved by a natural maturing process in 'normal' circumstances. The rate of development differed from one individual to the next, but the stages could be roughly linked to chronological age.

Gardner refers to recently acknowledged limitations in Piaget's work, choosing one as particularly important to his own thesis. Piaget believed that, as the child progressed towards ever greater maturity, earlier conceptions and misconceptions were eradicated from the mind never to return. Gardner, on the other hand, suggests that **"they simply travel underground; like repressed memories of early childhood, they reassert themselves in settings where they seem appropriate."**

From these beginnings, Gardner describes later and more contemporary accounts of children's cognitive development. These are the most significant elements in his selection:

(a) From William James 'blooming, buzzing confusion' at birth to the development of the senses and the consequent growth of sensorimotor knowledge in infancy.

(b) The early development of language as a social tool and of social interaction as a stimulant to the growth of cognition.

(c) Knowing the world through symbols: the four ways of symbolisation. The growth of symbol systems in the mind, starting with language and then extending to others, topological, numerical, notational and so on.

(d) Gardner conceives language acquisition as providing not only the primary example of the growth of symbolic knowledge, but also as the prime model for introducing the 'biological perspective' for human learning. In the mid-1960s Naom Chomsky was the first to propose that language should be seen as a biological phenomenon, written into the human genetic programme together with its own principles and rules. Linguistic development could then be triggered within the process of maturing cognition and unfold in the environment of other speakers in a particular culture. This has huge implications for developing conceptions of other features of knowledge and mind which Gardner does not pursue further here.

(e) The emergence of Intuitive understandings; the child's' construction of primitive theories to explain its experience in the world.

(These issues are summarised in a three-page statement "The Powers and Limits of the 5 yr old Mind" (Ps 110-112))

Part II

Part two deals with the procedures by which children are educated all over the world. This includes consideration of the traditions and values of Education, the nature of schools as institutions and the difficulties inherent in the formal and learning curriculum as it has been presented in recent times. A huge agenda.

The central themes of this section may be represented by quotations from its text:

(1) "Schools have assumed burdens far broader than the mastery of written or numerical literacy systems prized in their society. Especially in the pre-modern era, schools were considered a principal venue for the transmission of moral and political values..... More recently, with the accumulation of knowledge, the proliferation of disciplines and the increased importance of having an informed population, schools have taken on further tasks."

(2) "Assessing learning : Enter the test. The test is the ultimate scholastic invention, a 'decontextualised measure' to be employed in a setting which is itself decontextualised. Students learn about scientific principles or distant lands while sitting at their desks, reading a book or listening to a lecture. Then at the end of the week, or month, or year, or their school careers, the same students enter a room and, without the benefit of texts or notes answer questions about the material they are supposed to have mastered."

(3) "So far, my description makes it sound as if the student is alone in school having to learn concepts, draw inferences, or make claims without the help of other people or of reassuring props in the environment. It may be more appropriate, however, to think of the student in school not as being isolated but rather as having to learn to make new, different, and strategic uses of the sources of information around him. The successful student is one who learns how to use research materials, libraries, notecards and computer files, as well as knowledgeable parents, teachers, older students and classmates, in order to master those tasks of schools which are not transparently clear. In a terminology that has recently become fashionable, intelligence is 'distributed' in the environment as well as in the head, and the 'intelligent student' makes use of the intelligence distributed throughout his environment."

(4) "For the most part schools have found it more efficient to operate independently of other institutions (family, home or other community institutions). This practice proves particularly problematic in the contemporary society where powerful educational (and non-educational) forces are constantly at work; in the media, in the commercial sector and on the streets..... Precisely because they are so powerful and ubiquitous these forces may well overwhelm the lessons and themes of the school."

(5) "Even though educational systems may pay lip-service to goals like 'understanding' or 'deep knowledge' they, in fact, prove inimical to the pursuit of these goals.

(6) In summary : "..... until now, we have not fully appreciated just how difficult it is for schools to succeed in their chosen, or appointed tasks..... we have not been cognisant of the ways in which basic inclinations of human learning turn out to be ill-matched to the agenda of the modern secular school."

Part III

Part three sets out a range of possible approaches in the search for an education which promotes genuine understanding.

Gardner begins with a review of the two positions so often used to characterise opposing philosophies of education : the 'traditional' and the 'progressive'. He offers no easy compromise. The logic of the general argument leads him to a broadly progressive position. However, he is anxious to distance himself from what he sees as the limitations of this orientation : "..... its excessive faith in the capacity of students to educate themselves, its reluctance to engage in assessment, and the risk of confusing worthy goals with successful achievement.....".

On the other hand : "..... the emphasis it places on richly structured activities and projects, student initiative and 'stake', constructive forms of learning and meaningful involvement with the school and wider community, all point towards an education that seeks and perhaps yields understanding". He then reviews some approaches (or analogies) which from his own engagement or his witness seem to him to embody the principles which he espouses. Principal among these are the following:

Apprenticeship : The chief attraction of the apprenticeship model - both historical and present day - is that the learning is closely contextualised. Learners see the reasons for learning in the practice around them; they see the development of procedures and skills in the context of design and achievement. The goals are clear and the efficiency of the process and the quality of the product are evident. The assessment of performance is in the hands of practised experts whose judgement is a positive inducement to improvement towards eventual mastery.

> "Indeed apprenticeships may well be the form of instruction that builds most effectively on the ways in which most young people learn."

Museums : Closely associated with Gardner's enthusiasm for the apprenticeship model is the experience which may be derived from well-focused attendance at a children's museum, discovery-centre or exploratorium. Here the particular features of the learning are in contrast to much of what happens in school. The learning is both active and interactive. Most of the learning and of the assessment are done co-operatively. And, because the students are enrolled from the first in a meaningful and challenging activity, they come to feel a genuine stake in the outcome of their own (and their peers) activity.

(Children's museums in the U.S. are very different from the general museums in Britain. They offer a great deal of task engagement and group participation, organised and monitored by adult instructors.)

Projects : The project approach enables young students to range across disciplines by bringing different perspectives to the study of broadly based themes. Gardner sees this as a necessary part of the 'understanding' curriculum. It allows students to follow their interests individually or co-operatively within a structured framework. It also provides meaningful purpose and presentation. "Students present their projects to their classmates, describing the project's genesis, purpose, problems and future implications; they then answer questions raised by their classmates and by the teacher." Gardner extends the issue of the continuous presentation of students' achievements into the context of exhibitions of their work and what he calls the 'process-folio' procedure. Like the artist's portfolio the 'process-folio' is a collection of the students work in any domain, but the emphasis is upon development, process, rather than finished project.

"A complete student process-folio contains initial brainstorming ideas, early drafts, and first critiques, journal entries on 'pivotal moments' when ideas gelled; interim and final drafts; self critiques and critiques by peers, informed mentors and outside experts; and finally some suggestion of how one might build upon the current project in future endeavours."

Technological Innovations : Gardner refers to a wide range of examples drawn from the use of learning technologies in innovatory practice across the United States. He sees rapidly developing potential to provide the three essential ingredients of learning programmes designed to promote understanding. These are: to confront and challenge prior conceptions and misconceptions; to interpret concepts into a range of examples and connected explanations, and to allow time for adequate reflection and assessment. New learning technologies promise to transform the range of learning capabilities at every level, when their power becomes better understood and harnessed.

This brief summary of approaches does scant justice to the wealth of argument and exemplary description which Gardner provides. He is careful to emphasise that in his view understanding is rooted in the disciplines and that disciplined understanding is the ultimate objective. That this is not achieved, except by those few who reach the highest reaches of the education system, is his central concern.

He does not advocate a wholesale replacement of current practices. "Some materials must be learned by drill; others are more readily presented by classroom lecture or text-book reading. What I call for ..... is the shrewd and judicious introduction (of new approaches) in contexts where their strengths can pay off. When these approaches are pursued over a significant period of time they should lead to an education that makes sense to the various participants and that leads to more robust and more flexible forms of learning."

CONCLUSION: In conclusion we can best allow Gardner to speak for himself:

"If we are to achieve a milieu in which understanding is prized, it is necessary for us all to be humble about what we know and to move away from our present, invariably inadequate perspectives....."

"It is necessary both to respect the conceptions that students of all ages bring to the schools and to be aware of our own predilections towards strongly held but unfounded beliefs....."

"I have sought to challenge the conception that one can get students to understand simply by presenting them with good models or with compelling demonstrations, as well as the idea that student who do not understand must simply work harder or adhere to the correct-answer compromise."

"In contrast to these straightforward views, I have presented a far more complex and vexed picture. At the same time, I have tried to avoid the presentation of recipes for understanding. The various examples and models presented have reflected an effort to describe the kinds of procedures that may prod education in a positive direction. It is never the models per se that are important, however, but the thinking and reflective facets thus captured that will determine whether students gain from their use - whether students will be stimulated to assume 'risks for understanding'."

"raygardn"

What Research on Learning Tells Us About Teaching

Three insights — that there are multiple forms of learning, that students must build on prior knowledge, and that learning is a social act — have important implications for teachers.

GAEA LEINHARDT

What's new in the research on learning that affects teaching? Over the last decade, we've seen a plethora of new terms, approaches to research, and evidence on the nature of learning. *Authentic activity, apprenticeship learning, case-based research, conceptual change, constructivism, distributed knowledge, narrative/episodic knowledge structure,* and *socially shared cognition* are terms that abound in the literature. Three constructs are fundamental to these new terms: (1) the multiple forms of knowledge, (2) the role of prior knowledge, and (3) the social nature of knowledge and its acquisition.

Multiple Kinds of Knowledge

The first finding is that there are both different kinds and amounts of knowledge. This does not simply mean, as it did with Bloom's taxonomy, that there are different levels or depths of knowledge. It means that there are both knowledge of actions and skills and knowledge of concepts and principles. The student's task is to connect strategic action knowledge with specific content knowledge.

In classrooms that reflect learning's social nature, students are active constructors of knowledge. Shown here are students from Douglas County School District's Higher Literacy Project.

When we examine the kinds of information and generative power we expect students to develop, we realize that knowledge varies both *within* and *across* subject-matter areas. Knowledge varies *across* subject matter because subjects have different arrangements of facts, concepts, notations, and patterns of reasoning. Knowledge varies *within* subjects because some academic subjects have elaborate and importantly constraining notational systems. A map is not like a musical score, which is not like the equation for a function, which in turn differs from an evolutionary tree.

Other disciplines have intricately layered ways of developing arguments and handling evidence (for example, history and literature), while still others require documentation of procedures in highly codified ways (chemistry and biology). In organic chemistry, the facts and rich combination of taxonomy, algebra, and geometry form a conceptual basis of knowledge and a powerful clue as to the actions that a chemistry student performs. That knowledge simply does not look or feel like the knowledge necessary to form an historical argument or to construct an explanation in biology.

In addition to knowledge of parts of

83

a subject, knowing what you know (metaknowledge) and how well you know it is also important. As research has pointed out, skilled performers within a knowledge domain have extensive awareness of their own knowledge. A competent reader is aware of character, plot, and prediction. A competent science student constantly constructs personal explanations of new material, forcing it to be consistent with the fundamental design of the prior information.

These multiple forms of knowledge render learning and performing tasks more complex. Consider a social studies class discussing why in the move westward of American pioneers, the Midwest was settled after the West Coast. One explanation might include the following arguments: News of the gold rush in California prompted the pioneers to bypass this territory. Further, severe conditions in the Midwest — for example, extreme weather conditions and hostile interactions with Native Americans — made it appear undesirable for settlement. The task for students is to construct an explanation of this pattern of settlement that synthesizes various kinds of information. To do so, students need to understand the principles of forming an explanation in social studies; the history of the time and the geography of the United States; be able to use the representational systems of maps; and monitor their own oral discussions as they produce the explanation.

This example points up the particular use of different kinds of knowledge in performing a relatively simple and common school activity. The existence of different kinds of knowledge has implications for both teaching and learning. Any one of these types or forms of knowledge can be taught and learned in a way that results in inert, disconnected information rather than principled, generative ideas. Simply saying that different disciplines have different notational systems, rules of evidence, or deductive properties does not give teachers or students much to go on in terms of issues of sequence, complexity, or active experiences for learning.

In addition to knowledge of a subject, knowing what you know (metaknowledge) and how well you know it is important.

One pedagogical problem is how to transform what has traditionally been regarded as a linear process of knowledge acquisition into a multifaceted system. Such a system must include the content of a field such as history or mathematics (for example, the gradual elimination of slavery or the number system) and the actions of the field (explaining and interpreting, or posing problems).

Another difficulty is how to help develop in students a focus on deeply principled aspects of knowledge as opposed to shallower ones. Clearly, teaching the underlying principles alone does not improve performance, but, equally clearly, performance proficiency does not produce conceptual understanding. One suggestion is to consistently teach these different kinds of knowledge together in action, explicitly acknowledging how the different forms of knowledge work together. The pieces of needed knowledge are seen as working together when the acts of problem posing, solution, and learning are public and shared.

Role of Prior Knowledge

What kinds and amounts of knowledge one has before encountering a given topic in a discipline affect how one constructs meaning. The impact of prior knowledge is not a matter of "readiness," component skills, or exhaustiveness; it is an issue of depth, interconnectedness, and access. It includes all of the kinds of knowledge described above and their interrelationships — and is the source of both conceptions and misconceptions. Learning outcomes are determined jointly by what was known before and by the content of the instruction.

Prior knowledge also dramatically influences the processing of new information. It affects how students make sense of instruction both in a facilitative sense and in a dysfunctional sense. For example, how we read a text is influenced by what we expect (from previous experience) to find there and how that material is parsed. Thus, a headline such as *Vikings Cream Dolphins* has a different meaning depending on whether we are thinking about the eating habits of ancient seafarers or about U.S. football teams. Similarly, if one believes that light emanates from an object (as many naive science students seem to believe), then science textbook diagrams such as those showing dotted lines between the human eye and a perceived object have a different meaning and interpretation than they would if one believed objects are seen because of reflected light

Robert Kalman

Knowledge is a complex network of ideas, facts, principles, actions, and scenes; therefore, prior knowledge is more than a building-block of information. It can facilitate, inhibit, or transform a common learning task. Consider the common use of base-ten blocks (Dienes blocks) in teaching arithmetic. Dienes blocks are often used to provide a concrete representation of "regrouping" in addition. Students work carefully through several different mathematical tasks in which they trade Dienes blocks of different values (for example, 9 single blocks and 7 single blocks may be traded for 1 tens block and 6 ones blocks). When students then encounter the use of Dienes blocks in an introductory lesson for another piece of mathematics, such as the regrouping necessary in some subtraction problems, students who have prior knowledge of the actions and meanings of the blocks are no doubt in better shape than those who do not have this prior knowledge and who must learn both the meaning of the concrete representation and the arithmetic simultaneously.

Suppose, on the other hand, a student who has worked extensively with these base-ten blocks in the whole number domain is asked to use them for decimal fractions. Although this is often recommended, it can be problematic. The switch from the large cube's familiar representational meaning of one thousand (with 10 small cubes on each row of each face and 100 cubes on a face) to a new meaning of one whole is possibly confusing. When the large thousand cube represents thousandths, its construction suggests that decimals can only go down to one thousandths. Further, the very thing that makes decimals different from whole numbers, the shift from the infinite to the infinitesimal, is blurred. In this case, the prior knowledge of the representational system — the Dienes blocks — could inhibit the learning of the new material.

Finally, consider a student who has no knowledge of either the blocks or the rules of working with them. For that student, demonstrations with the blocks and their trading of tens for ones and hundreds for tens becomes an object for learning in and of itself. Further, learning the analogical mapping between the blocks and the symbolic number system becomes a second task, requiring serious revising of the learner's initial understanding. Subtracting with blocks involves no place value, in the sense of right or left placement; the value is in the blocks themselves. Using the blocks for subtraction with regrouping requires a "bank" to which one can go for denominational exchanges.

Both of these circumstances are reversed when a student is working in the symbolic number system. The student who is to use the blocks to learn subtraction with regrouping and to gain a deeper insight into mathematical concepts faces a complex task if both representational systems are used. The student needs to understand that the use of the blocks is analogical, that the task is not simply to use the blocks but to use them to understand the symbol system. Further, the student needs to realize that some explicit parts of each "world" connect; this is representational knowledge. Finally, he or she needs to know that results in each world need to correspond in their outcomes — the "answers" should be the same. This is what is meant by action and epistemic knowledge.

For each new learning situation, the student may have one or more of these pieces in place. The teacher needs to know not just how much is in place but in what configuration. Under traditional conceptions of teaching, gaining this knowledge for every student would be difficult, even

impossible. However, as is discussed in the next section, there are some proposed alternatives.

The task for students is to continuously connect their own prior knowledge with new information. A teacher may easily, and a textbook by necessity does, enter a topic in a place that is somewhere in the middle of the student's existing knowledge, which may be robust and correct, or robust and quite incorrect (much of the naive physics knowledge is of this type). More often, however, in fields such as biology or even history, the knowledge is vague and ill-formed. In still other cases, such as mathematics, the right knowledge is only partly defined so that the right sets of actions (for example, adding) or fundamental conceptions (whole numbers) are used in the wrong situation (adding fractions).

Prior knowledge about a topic has a major impact on what a student learns

Edward A. Wynne

Of all of the "new" ideas, the social nature of learning and teaching is probably the most radical.

from a particular instructional exchange. The question for teachers is what to do about it. They can ignore prior information and build a new set of knowledge, parts of which might be expected to overlap with previous knowledge. The difficulty here is that deep misconceptions may seriously hamper future knowledge growth or application of knowledge. Alternatively, teachers can help students build up from existing knowledge, making explicit their own prior knowledge and then incrementing it. Teachers can help students actively confront their own beliefs and revise them, for example, through class discussion. The disadvantage is that there may be socially negative consequences if the confrontation becomes personal. Magdelene Lampert, among others, shows how to prevent this by capitalizing on the energy and creativity among students, letting them, under stringent social rules, pose and refute ideas in a social arena.

Social and Cultural Roles

The discussion about multiple types of knowledge and the role of prior knowledge in learning leads to consideration of the social nature of learning and teaching. Of all of the "new" ideas, this is probably the most radical. It is a dramatic departure from the approaches that grew out of behaviorism and its emphasis on individualization. Recognizing that knowledge is, to a large extent, both individual and community property suggests that attention be given to both a student's own individual growth of information and the growth of shared knowledge. Public and shared definitions of problems, tasks, and solutions have a number of potential advantages.

Many modern researchers share several core assumptions about learning. First, learning is an active process of knowledge construction and sense-making by the student. Second, knowledge is a cultural artifact of human beings: we produce it, share it, and transform it as individuals and as groups. Third, knowledge is distributed among members of a group, and this distributed knowledge is greater than the knowledge possessed by any single member.

One pedagogical problem is how to use knowledge of facts, principles, actions, and representations that is available within the group — or the classroom — to help individuals and groups gain more knowledge

Proposed solutions include an emphasis on "authentic" tasks. A task can be authentic because it is part of the world outside of school (for example, a grocery store) or because it is a part of the culture of a particular discipline (such as mathematics or chemistry).

Another view on this, though, is to consider a school as having its own social system with its own artifacts and sense of authenticity. In such a culture of ideas and meanings, thought and reasoning are valued for themselves, not only for what they can do in the "real world." Both conceptions, however, suggest powerful changes in the dynamics of classrooms, changes that lead to learning.

By building upon the social nature of learning, we may be able to solve some of the problems of mechanistic and fragile knowledge that seem to have plagued the American educational system.

In classrooms that recognize their inherently social nature, talk, public reasoning, shared problem solving, and shared projects all play a vital role. For example, in a class trying to understand the Declaration of Independence, the words must be read and re-read, aloud, in order to discover the meaning of the political concepts and to decipher the meaning of words as they were used in Colonial times. Phrases and sentences have to be discussed and debated. Reflections on the background of the authors, their social settings, and their assumptions have to be made. Prior actions and meetings of the men who wrote the document could be discussed. Far more depth could be gained from this shared experience than would be possible if each student were required to read all of the background material.

In this kind of classroom, the role of the teacher is that of a highly knowledgeable member of the community — a guide, not simply an interactive textbook. Teachers and students together track the progress of the group's understanding (meta-knowledge); accept or refute proposed interpretations of others (background factual knowledge); propose interpretations of their own (reasoning); and both increase the demand of the task and reduce its difficulty by sharing it.

Using the classroom as a social arena for the public examination of ideas does three important things. First, students gradually gain competence in using terminology and in generating actions within a discipline — in this case, interpreting an historical document (thus rehearsing the facts, actions, and competencies of a discipline). Second, in the course of dialogue, students naturally build on or refute old ideas as they are merged with new knowledge (thus activating and using prior knowledge). Third, and most important, actions of discussion, proof, and explanation are merged with the network of concepts and principles that are a part of a particular subject matter. Thus inert, isolated information is transformed into more generative, usable knowledge.

There Really Are Some Changes

Notable progress has occurred in the research on learning. I have focused here on three ideas that have consequences for teaching. First, the recognition that there are multiple kinds of knowledge suggests that neither teaching simple hierarchies of actions nor simply having students work with hands-on materials in an unfocused way will result in the deep, conceptual kind of learning that we hope students gain.

Second, the recognition that students bring prior knowledge to new learning suggests that teachers need to make this knowledge explicit, then build upon it or, if necessary, challenge it.

The third idea is the social nature of knowledge and learning. When students talk to each other, they rehearse the terminology, notational systems, and manner of reasoning in a particular domain, thus reducing the individual burden of complete mastery of material while keeping the vision of the entire task in view. By building upon the social nature of learning, we may be able to solve some of the problems of mechanistic and fragile knowledge that seem to have plagued the American educational system.

These three constructs have important implications for transforming the way teaching and learning occur in our classrooms.

Suggested Readings

Types of Knowledge

Chi, M. T. H., and S. Ceci. (1987). "Content Knowledge: Its Role, Representation and Restructuring in Memory Development." In *Advances in Child Development and Behavior*, edited by H. W. Reese. Vol. 20, pp. 91-142. New

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York: Academic Press.
Hiebert, J., ed. (1986). *Conceptual and Procedural Knowledge: The Case of Mathematics.* Hillsdale, N.J.: Erlbaum.
Lampert, M. (1986). "Knowing, Doing, and Teaching Multiplication. *Cognition and Instruction* 3, 4: 303-342.
Leinhardt, G. (1988). "Getting to Know: Tracing Students' Mathematical Knowledge from Intuition to Competence." *Educational Psychologist* 23, 2: 119-144.
Polya, G. (1954). *Induction and Analogy in Mathematics.* Princeton, N.J.: Princeton University Press.
Schoenfeld, A. H. (1989). "Teaching Mathematical Thinking and Problem Solving." In *Toward the Thinking Curriculum: Current Cognitive Research,* edited by L. B. Resnick and L. E. Klopfer, pp. 83-103. Alexandria, Va.: Association for Supervision and Curriculum Development.
Scribner, S. (1984). "Studying Working Intelligence." In *Everyday Cognition: Its Development in Social Context,* edited by B. Rogoff and J. Lave, pp. 9-40. Cambridge, Mass.: Harvard University Press.

PRIOR KNOWLEDGE

Bereiter, C., and M. Scardamalia. (1985). "Cognitive Coping Strategies and the Problem of "Inert" Knowledge." In *Thinking and Learning Skills: Current Research and Open Questions,* edited by S. F. Chipman, J. W. Segal, and R. Glaser, Vol. 2, pp. 65-80. Hillsdale, N.J.: Erlbaum.
Bransford, J. D., and M. K. Johnson. (1972). "Contextual Prerequisites for Understanding: Some Investigations of Comprehension and Recall." *Journal of Verbal Learning and Verbal Behavior* 11: 717-726.
Confrey, J. (1990). "A Review of the Research on Student Conceptions in Mathematics, Science, and Programming." In *Review of Research in Education,* edited by C. Cazden, Vol. 16, pp. 3-56. Washington, D.C.: American Educational Research Association.
McKeown, M., I. Beck, G. M. Sinatra, and J. A. Loxterman. (In press). "The Contribution of Prior Knowledge and Coherent Text to Comprehension." *Reading Research Quarterly.*
McCloskey, M. (1983). "Intuitive Physics." *Scientific American* 122-129. [March issue]
Minstrell, J. (1982). "Explaining the 'At Rest' Condition of an Object." *The Physics Teacher* 10-14. [January issue]
Pearson, D. P., J. Hanson, and C. Gordon. (1979). "The Effect of Background Knowledge on Young Children's Comprehension of Explicit and Implicit Information. *Journal of Reading Behavior* 11, 3: 201-209.
Roth, K. J. (1989-90). "Science Education: It's Not Enough to 'Do' or 'Relate.' " *American Educator* 13, 4: 16-22, 46-48.
Schank R., and R. Abelson. (1977). *Scripts, Plans, Goals, and Understanding: An Inquiry into Human Knowledge Structures.* Potomac, Md.: Lawrence Erlbaum Associates.
Smith, D. C., and D. C. Neale. (1991). "The Construction of Subject-Matter Knowledge in Primary Science Teaching." In *Advances in Research on Teaching,* edited by J. Brophy, Vol. 2, pp. 187-243. Greenwich, Conn.: JAI Press.
Spilich, G., G. Vesonder, H. Chiesi, and J. Voss. (1979). "Text Processing of Domain-Related Information for Individuals with High and Low Domain Knowledge." *Journal of Verbal Learning and Verbal Behavior* 18: 275-290.

SOCIAL NATURE OF LEARNING

Brown, J., A. Collins, and P. Duguid. (1989). "Situated Cognition and the Culture of Learning." *Educational Researcher* 18, 1: 32-42.
Carraher, T. N., D. W. Carraher, and A. D. Schliemann. (1983). "Mathematics in the Streets and in Schools." *British Journal of Developmental Psychology* 3, 1: 21-29.
Cognition and Technology Group at Vanderbilt. (1990). "Anchored Instruction and Its Relationship to Situated Cognition." *Educational Researcher* 19, 6: 2-10.
Greeno, J. G. (1988). *Situations, Mental Models, and Generative Knowledge.* (IRL Rep. No. IRL88-0005). Palo Alto, Calif.: Institute for Research on Learning.
Leinhardt, G. (1988). "Situated Knowledge and Expertise in Teaching." In *Teachers' Professional Learning,* edited by J. Calderhead, 146-168. London: Falmer Press.
Newman, D., P. Griffin, and M. Cole. (1989). *The Construction Zone: Working for Cognitive Change in School.* Cambridge, England: Cambridge University Press.
Palincsar, A., and A. Brown. (1984). "Reciprocal Teaching of Comprehension-Fostering and Comprehension-Monitoring Activities." *Cognition and Instruction* 2: 117-175.
Resnick, L. B. (1987). "Learning in School and Out." *Educational Researcher* 16: 13-20.
Resnick, L. B., and L. E. Klopfer, eds. (1989). *Toward the Thinking Curriculum: Current Cognitive Research.* See especially: "A Perspective on Cognitive Research and Its Implications for Instruction," pp. 173-205, by J. D. Bransford and N. J. Vye; and "Research on Writing: Building a Cognitive and Social Understanding of Composing," pp. 104-128, by G. A. Hull. Alexandria, Va.: Association for Supervision and Curriculum Development.
Rogoff, B., and J. Lave, eds. (1984). *Everyday Cognition: Its Development in Social Context.* Cambridge, Mass.: Harvard University Press.
Säljö, R., ed. (1991). *Learning and Instruction* 1, 3. [special issue on culture and learning]

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Cognitive Apprenticeship: Making Thinking Visible

By Allan Collins, John Seely Brown, and Ann Holum

In ancient times, teaching and learning were accomplished through apprenticeship: We taught our children how to speak, grow crops, craft cabinets, or tailor clothes by showing them how and by helping them do it. Apprenticeship was the vehicle for transmitting the knowledge required for expert practice in fields from painting and sculpting to medicine and law. It was the natural way to learn. In modern times, apprenticeship has largely been replaced by formal schooling, except in children's learning of language, in some aspects of graduate education, and in on-the-job training. We propose an alternative model of instruction that is accessible within the framework of the typical American classroom. It is a model of instruction that goes back to apprenticeship but incorporates elements of schooling. We call this model "cognitive apprenticeship" (Collins, Brown, and Newman, 1989).

While there are many differences between schooling and apprenticeship methods, we will focus on one. In apprenticeship, learners can see the processes of work: They watch a parent sow, plant, and harvest crops and help as they are able; they assist a tradesman as he crafts a cabinet; they piece together garments under the supervision of a more experienced tailor. Apprenticeship involves learning a physical, tangible activity. But in schooling, the "practice" of problem solving, reading comprehension, and writing is not at all obvious—it is not necessarily observable to the student. In apprenticeship, the processes of the activity are visible. In schooling, the processes of thinking are often invisible to both the students and the teacher. Cognitive apprenticeship is a model of instruction that works to make thinking visible.

In this article, we will present some of the features of traditional apprenticeship and discuss the ways it can be adapted to the teaching and learning of cognitive skills. Then we will present three successful examples—cases in which teachers and researchers have used apprenticeship methods to teach reading, writing, and mathematics.

In the final section, we organize our ideas about the characteristics of successful teaching into a general framework for the design of learning environments, where "environment" includes the content taught, the pedagogical methods employed, the sequencing of learning activities, and the sociology of learning.

Toward a Synthesis of Schooling and Apprenticeship

Although schools have been relatively successful in organizing and conveying large bodies of conceptual and factual knowledge, standard pedagogical practices render key aspects of expertise invisible to students. Too little attention is paid to the reasoning and strategies that experts employ when they acquire knowledge or put it to work to solve complex or real-life tasks. Where such processes are addressed, the emphasis is on formulaic

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91

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methods for solving "textbook" problems or on the development of low-level subskills in relative isolation.

As a result, conceptual and problem-solving knowledge acquired in school remains largely inert for many students. In some cases, knowledge remains bound to surface features of problems as they appear in textbooks and class presentations. For example, Schoenfeld (1985) has found that, in solving mathematics problems, students rely on their knowledge of standard textbook patterns of problem presentation rather than on their knowledge of problem-solving strategies or intrinsic properties of the problems themselves. When they encounter problems that fall outside these patterns, students are often at a loss for what to do. In other cases, students fail to use resources available to them to improve their skills because they lack models of how to tap into those resources. For example, students are unable to make use of potential models of good writing acquired through reading because they have no understanding of how the authors produced such text. Stuck with what Scardamalia and Bereiter (1985) call "knowledge-telling strategies," they are unaware that expert writing involves organizing one's ideas about a topic, elaborating goals to be achieved in the writing, thinking about what the audience is likely to know or believe about the subject, and so on.

To make real differences in students' skill, we need both to understand the nature of expert practice and to devise methods that are appropriate to learning that practice. To do this, we must first recognize that cognitive strategies are central to integrating skills and kowledge in order to accomplish meaningful tasks. They are the organizing principles of expertise, particularly in such domains as reading, writing, and mathematics. Further, because expert practice in these domains rests crucially on the integration of cognitive strategies, we believe that it can best be taught through methods that have traditionally been employed in apprenticeship to transmit complex physical processes and skills.

Traditional Apprenticeship

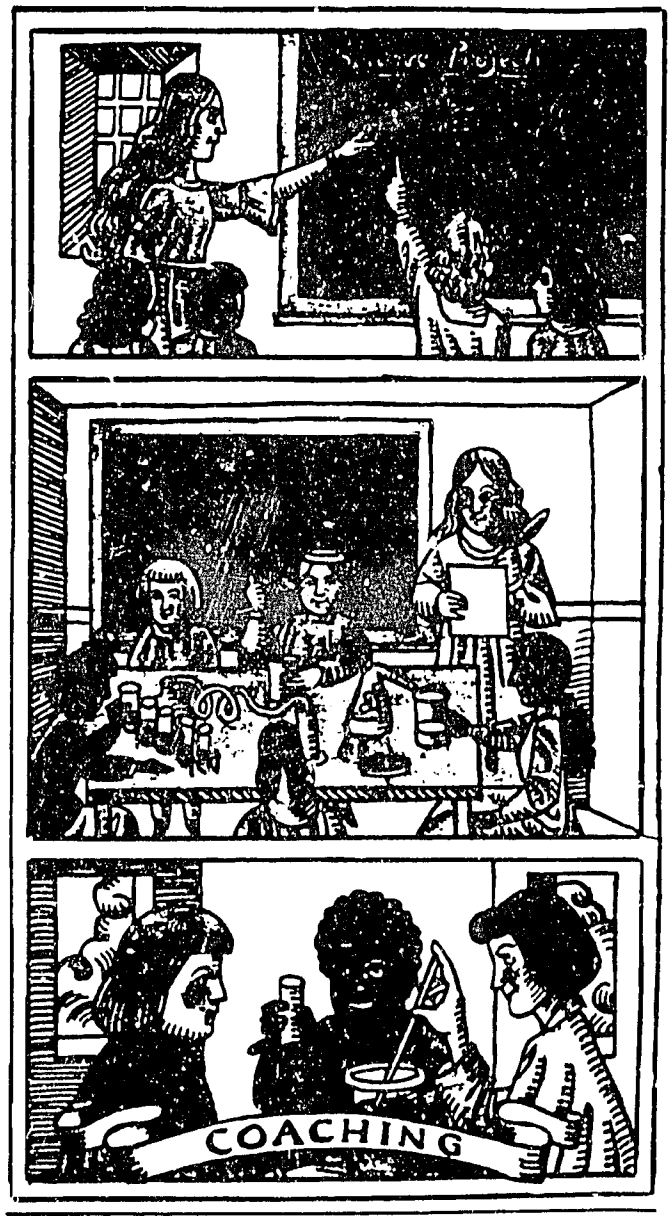
In traditional apprenticeship, the expert shows the apprentice how to do a task, watches as the apprentice practices portions of the task, and then turns over more and more responsibility until the apprentice is proficient enough to accomplish the task independently. That is the basic notion of apprenticeship: showing the apprentice how to do a task and helping the apprentice to do it. There are four important aspects of traditional apprenticeship: modeling, scaffolding, fading, and coaching.

In modeling, the apprentice observes the master demonstrating how to do different parts of the task. The master makes the target processes visible, often by explicitly showing the apprentice what to do. But as Lave and Wenger (in press) point out, in traditional apprenticeship, much of the learning occurs as apprentices watch others at work.

Scaffolding is the support the master gives apprentices in carrying out a task. This can range from doing almost the entire task for them to giving occasional hints as to what to do next. Fading is the notion of slowly removing the support, giving the apprentice more and more responsibility.

Coaching is the thread running through the entire ap-

Coaching is the thread running through the entire apprenticeship experience.



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prenticeship experience. The master coaches the apprentice through a wide range of activities: choosing tasks, providing hints and scaffolding, evaluating the activities of apprentices and diagnosing the kinds of problems they are having, challenging them and offering encouragement, giving feedback, structuring the ways to do things, working on particular weaknesses. In short, coaching is the process of overseeing the student's learning.

The interplay among observation, scaffolding, and increasingly independent practice aids apprentices both in developing self-monitoring and correction skills and in integrating the skills and conceptual knowledge needed to advance toward expertise. Observation plays a surprisingly key role; Lave (1988) hypothesizes that it aids learners in developing a conceptual model of the target task prior to attempting to execute it. Giving students a conceptual model—a picture of the whole—is an important factor in apprenticeship's success in teaching complex skills without resorting to lengthy practice of isolated subskills, for three related reasons. First, it provides learners with an advanced organizer for their initial attempts to execute a complex skill, thus allowing them to concentrate more of their attention on execution than would otherwise be possible. Second, a conceptual model provides an interpretive structure for making sense of the feedback, hints, and corrections from the master during interactive coaching sessions. Third, it provides an internalized guide for the period when the apprentice is engaged in relatively independent practice.

Another key observation about apprenticeship concerns the social context in which learning takes place. Apprenticeship derives many cognitively important characteristics from being embedded in a subculture in which most if not all, members are participants in the target skills. As a result, learners have continual access to models of expertise-in-use against which to refine their understanding of complex skills. Moreover, it is not uncommon for apprentices to have access to several masters and thus to a variety of models of expertise. Such richness and variety help them to understand that there may be multiple ways of carrying out a task and to recognize that no one individual embodies all knowledge or expertise. And finally, learners have the opportunity to observe other learners with varying degrees of skill; among other things, this encourages them to view learning as an incrementally staged process, while providing them with concrete benchmarks for their own progress.

From Traditional to Cognitive Apprenticeship

There are three important differences between traditional apprenticeship and the kind of cognitive apprenticeship we propose.

As we said, in traditional apprenticeship, the process of carrying out a task to be learned is usually easily observable. In cognitive apprenticeship, one needs to deliberately bring the thinking to the surface, to make it visible, whether it's in reading, writing, problem solving. The teacher's thinking must be made visible to the students and the student's thinking must be made visible to the teacher. That is the most important difference between traditional apprenticeship and cognitive apprenticeship. Cognitive research, through such methods as protocol analysis, has begun to delineate the cognitive and metacognitive processes that comprise expertise. By bringing these tacit processes into the open, students can observe, enact, and practice them with help from the teacher and from other students.

Second, in traditional apprenticeship, the tasks come up just as they arise in the world: Learning is completely situated in the workplace. When tasks arise in the context of designing and creating tangible products, apprentices naturally understand the reasons for undertaking the process of apprenticeship. They are motivated to work and to learn the subcomponents of the task, because they realize the value of the finished product. They retain what they must do to complete the task, because they have seen the expert's model of the finished product, and so the subcomponents of the task make sense. But in school, teachers are working with a curriculum centered around reading, writing, science, math, history, etc. that is, in large part, divorced from what students and most adults do in their lives. In cognitive apprenticeship, then, the challenge is to situate the abstract tasks of the school curriculum in contexts that make sense to students.

Third, in traditional apprenticeship, the skills to be learned inhere in the task itself: To craft a garment, the apprentice learns some skills unique to tailoring, for example, stitching buttonholes. Cabinetry does not require that the apprentice know anything about buttonholes. In other words, in traditional apprenticeship, it is unlikely that students encounter situations in which the transfer of skills is required. The tasks in schooling, however, demand that students be able to transfer what they learn. In cognitive apprenticeship, the challenge is to present a range of tasks, varying from systematic to diverse, and to encourage students to reflect on and articulate the elements that are common across tasks. As teachers present the targeted skills to students, they can increasingly vary the contexts in which those skills are useful. The goal is to help students generalize the skill, to learn when the skill is or is not applicable, and to transfer the skill independently when faced with novel situations.

In order to translate the model of traditional apprenticeship to cognitive apprenticeship, teachers need to:

- identify the processes of the task and make them visible to students;
- situate abstract tasks in authentic contexts, so that students understand the relevance of the work; and
- vary the diversity of situations and articulate the common aspects so that students can transfer what they learn.

We do not want to argue that cognitive apprenticeship is the only way to learn. Reading a book or listening to a lecture are important ways to learn, particularly in domains where conceptual and factual knowledge are central. Active listeners or readers, who test their understanding and pursue the issues that are raised in their minds, learn things that apprenticeship can never teach. To the degree that readers or listeners are passive, however, they will not learn as much as they would by apprenticeship, because apprenticeship forces them to use their knowledge. Moreover, few people learn to be active readers and listeners on their own, and that is where

94

cognitive apprenticeship is critical—observing the processes by which an expert listener or reader thinks and practicing these skills under the guidance of the expert can teach students to learn on their own more skillfully.

Even in domains that rest on elaborate conceptual and factual underpinnings, students must learn the practice or art of solving problems and carrying out tasks. And to achieve expert practice, some version of apprenticeship remains the method of choice.

Cognitive Apprenticeship: Teaching Reading, Writing, and Mathematics

In this section, we will briefly describe three success models of teaching in the foundational domains of reading, writing, and mathematics and how these models embody the basic methods of cognitive apprenticeship. These three domains are foundational not only because they provide the basis for learning and communication in other school subjects but also because they engage cognitive and metacognitive processes that are basic to learning and thinking more generally. Unlike school subjects such as chemistry or history, these domains rest on relatively sparse conceptual and factual underpinnings, turning instead on students' robust and efficient execution of a set of cognitive and metacognitive skills. As such, we believe they are particularly well suited to teaching methods modeled on cognitive apprenticeship.

Reading

Palincsar and Brown's (1984) *reciprocal teaching* of reading exemplifies many of the features of cognitive apprenticeship. It has proved remarkably effective in raising students' scores on reading comprehension tests, especially those of poor readers. The basic method centers on modeling and coaching students in four strategic skills: formulating questions based on the text, summarizing the text, making predictions about what will come next, and clarifying difficulties with the text. Reciprocal teaching was originally designed for middle school students who could decode adequately but had serious comprehension problems; it can be adapted to any age group. The method has been used with groups of two to seven students, as well as individual students. It is called reciprocal teaching because the teacher and students take turns playing the role of teacher.

The procedure is as follows: Both the teacher and students read a paragraph silently. Whoever is playing the role of teacher formulates a question based on the paragraph, constructs a summary, and makes a prediction or clarification, if any come to mind. Initially, the teacher models this process and then turns the role of teacher over to the students. When students first undertake the process, the teacher coaches them extensively on how to construct good questions and summaries, offering prompts and critiquing their efforts. In this way, the teacher provides scaffolding for the students, enabling them to take on whatever portion of the task they are able to. As the students become more proficient, the teacher fades, assuming the role of monitor and providing occasional hints or feedback. The transcript below shows the kind of scaffolding and group interaction that occurs with children during reciprocal teaching.

SAMPLE RECIPROCAL TEACHING DIALOGUE

(from Palincsar, 1986)

Text from which students are working:

Crows have another gift. They are great mimics. They can learn to talk and imitate animal sounds. Some have been known to learn 100 words and even whole phrases. They can imitate the squawk of a chicken, the whine of a dog, or the meow of a cat.

Games have a certain fascination to crows. In a game of hide and seek, a crow hides in the hollow of a tree and then sounds a distress caw. The others rush to the spot, look around, then flap away. This may be done over and over, after which the young crow pops out of its hiding place and caws gleefully. Far from being annoyed at this, the flock bursts into loud cawing themselves. They seem to like the trick that has been played on them.

T: Chantel, you're our teacher, right? Why don't you summarize first? Remember, just tell me the most important parts.

S1: Crows have a hundred words they can learn by imitation. They can imitate chickens, the whine of a dog, and cats.

T: Okay. We can shorten that summary a bit.

S2: You could say they can imitate other animals.

T: Oh! Good one! There's a list there, Chantel, did you notice that? It says they can imitate the squawk of a chicken, the whine of a dog or the meow of a cat; and you could call that "animal sounds." Can you ask us a question?

S1: Ain't no questions in here.

S3: The words (sic) that need to be clarified are (sic) "mimics."

S4: That means imitate, right?

T: Right. How did you figure that out, Shirley?

S4: The paragraph.

T: Show us how somebody could figure out what "mimic" means.

S5: They are great mimics. They can learn to talk and imitate animal sounds.

T: Yes, so the next sentence tells you what it means. Very good, anything else needs to be clarified?

All: No.

T: What about that question we need to ask? (pause) What is the second paragraph about, Chantel?

S1: The games they play.

S3: They do things like people do.

S4: What kinds of games do crows play?

S3: Hide and seek. Over and over again.

T: You know what, Larry? That was a real good comparison. One excellent question could be, "How are crows like people?"

S4: They play hide and seek.

T: Good. Any other questions there?

S2: How come the crows don't get annoyed?

S5: Because they like it, they have fun. If I had a crow, I'd tell him he was it and see what he'd do.

T: Let's summarize now and have some predictions.

S1: This was about how they play around in games.

T: Good for you. That's it. Predictions anyone?

S2: Maybe more tricks they play.

S4: Other games.

T: Maybe. So far, they have told us several ways that crows are very smart, they can communicate with one another, they can imitate many sounds, and they play games. Maybe we will read about another way in which they are smart. Who will be the next teacher?

Reciprocal teaching is extremely effective. In a pilot study with individual students who were poor readers, the method raised their reading comprehension test scores from 15 percent to 85 percent accuracy after about twenty training sessions. Six months later the students were still at 60 percent accuracy, recovering to 85

In classroom studies with groups of four to seven students, reading comprehension test scores increased from about 40 percent to 80 percent correct, with only a slight decline eight weeks later.

percent after only one session. In a subsequent study with groups of two students, the scores increased from about 30 percent to 80 percent accuracy, with very little change eight weeks later. In classroom studies with groups of four to seven students, test scores increased from about 40 percent to 80 percent correct, again with only a slight decline eight weeks later. These are very dramatic effects for any instructional intervention.

Why is reciprocal teaching so effective? In our analysis, which reflects in part the views of Palincsar and Brown, its effectiveness depends upon the co-occurrence of a number of factors.

First, the method engages students in a set of activities that help them form a new conceptual model of the task of reading. In traditional schooling, students learn to identify reading with the subskills of recognizing and pronouncing words and with the activities of scanning text and saying it aloud. Under the new conception, students recognize that reading requires constructive activities, such as formulating questions and making summaries and predictions, as well as evaluative ones, such as analyzing and clarifying the points of difficulty. As Palinscar points out (1987), working with a text in a discussion format is not the same as teaching isolated comprehension skills—like how to identify the main idea. With reciprocal teaching, the strategies students learn are in the service of a larger purpose: to understand what they are reading and to develop the critical ability to *read to learn.*

The second factor that we think is critical for the success of reciprocal teaching is that the teacher models expert strategies in a shared problem context. What is crucial here is that students listen in the context of knowing that they will soon undertake the same task. After they have tried to do it themselves, and perhaps had difficulties, they listen with new knowledge about the task. That is, they can compare their own questions or summaries with the questions or summaries generated by the group. They can then reflect on any differences, trying to understand what led to those differences. We have argued elsewhere that this kind of reflection is critical to learning (Collins and Brown, 1988).

Third, the technique of providing scaffolding is crucial in the success of reciprocal teaching for several reasons. Most importantly, it decomposes the task as necessary for the students to carry it out, thereby helping them to see how, in detail, to go about it. For example, in formulating questions, the teacher might want to see if the student can generate a question on his or her own; if not, she might suggest starting with a "Why" question about the agent in the story. If that fails, she might generate one herself and ask the student to reformulate it in his or her own words. In this way, it gets students started in the new skills, giving them a "feel" for the skills and helping them develop confidence that they can do them. With successful scaffolding techniques, students get as much support as they need to carry out the task, but no more. Hints and modeling are then gradually faded out, with students taking on more and more of the task as they become more skillful. These techniques of scaffolding and fading slowly build students' confidence that they can master the skills required.

The final aspect of reciprocal teaching that we think

(Continued on page 38)

SCIENTIFIC AMERICAN November 1988 Volume 259 Number 5

Educating Poor Minority Children

Schools must win the support of parents and learn to respond flexibly and creatively to students' needs. A successful program developed in New Haven points the way

by James P. Comer

Thomas Jefferson and other advocates of free public schools believed fervently that an educated populace is the lifeblood of democracy. In their view the school clearly had a political purpose: to socialize children to become good citizens. Jefferson wrote, "I know no safe depository of the ultimate powers of the society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion."

It is a long fall from this lofty ideal to the grim reality facing youths at the margins of today's society. Poor minority children are undereducated in disproportionate numbers across the country. Academically such children may lag behind the national average by up to two years. In large cities as many as 50 percent of minority children drop out of school. The failure to educate these children makes ever harder the task of rectifying economic and social inequities. Job opportunities increasingly reside in service and technology industries, but poor minority youths are the least likely to have the social and academic skills these jobs demand. Unless schools can find a way to educate them and bring them into the mainstream, all the problems associated with unemployment and alienation will escalate.

The task seems overwhelming. And yet it can be done. In 1968 my colleagues and I at Yale University's Child Study Center started an intervention project at two inner-city schools in New Haven. Unlike many of the reforms that are now being tried or proposed, which focus on academic concerns such as teacher credentials and basic skills, our program promotes development and learning by building supportive bonds that draw together children, parents and school. By 1980 academic performance at the two New Haven schools had surpassed the national average, and truancy and disciplinary problems had declined markedly. We have now begun to duplicate that success at more than 50 schools around the country.

The perceptions underlying our approach are partly rooted in my own childhood. In 1939 I entered an elementary school in East Chicago, Ind., with three other black youngsters from a low-income community. The school was considered one of the best in the district; it was racially integrated and served the highest socioeconomic group in town. All four of us were from two-parent families, and our fathers made a living wage in the local steel mill. We were not burdened by any of the disadvantages—school segregation, inadequate schools, single-parent families, unemployment—commonly cited as causes of educational underachievement in poor black children. Yet in spite of the fact that we had similar intellectual potential, my three friends have had difficult lives: one died prematurely from alcoholism, a second spent a large part of his life in jail and a third has been in and out of mental institutions.

Why did my life turn out better? I think it was largely because my parents, unlike those of my friends, gave me the social skills and confidence that enabled me to take advantage of educational opportunities. For example, I became friendly with my third-grade teacher, with whom I would walk hand in hand to school every day. My parents took me to the library so that I could read many books. My three friends, however, never read books—which frustrated and angered their

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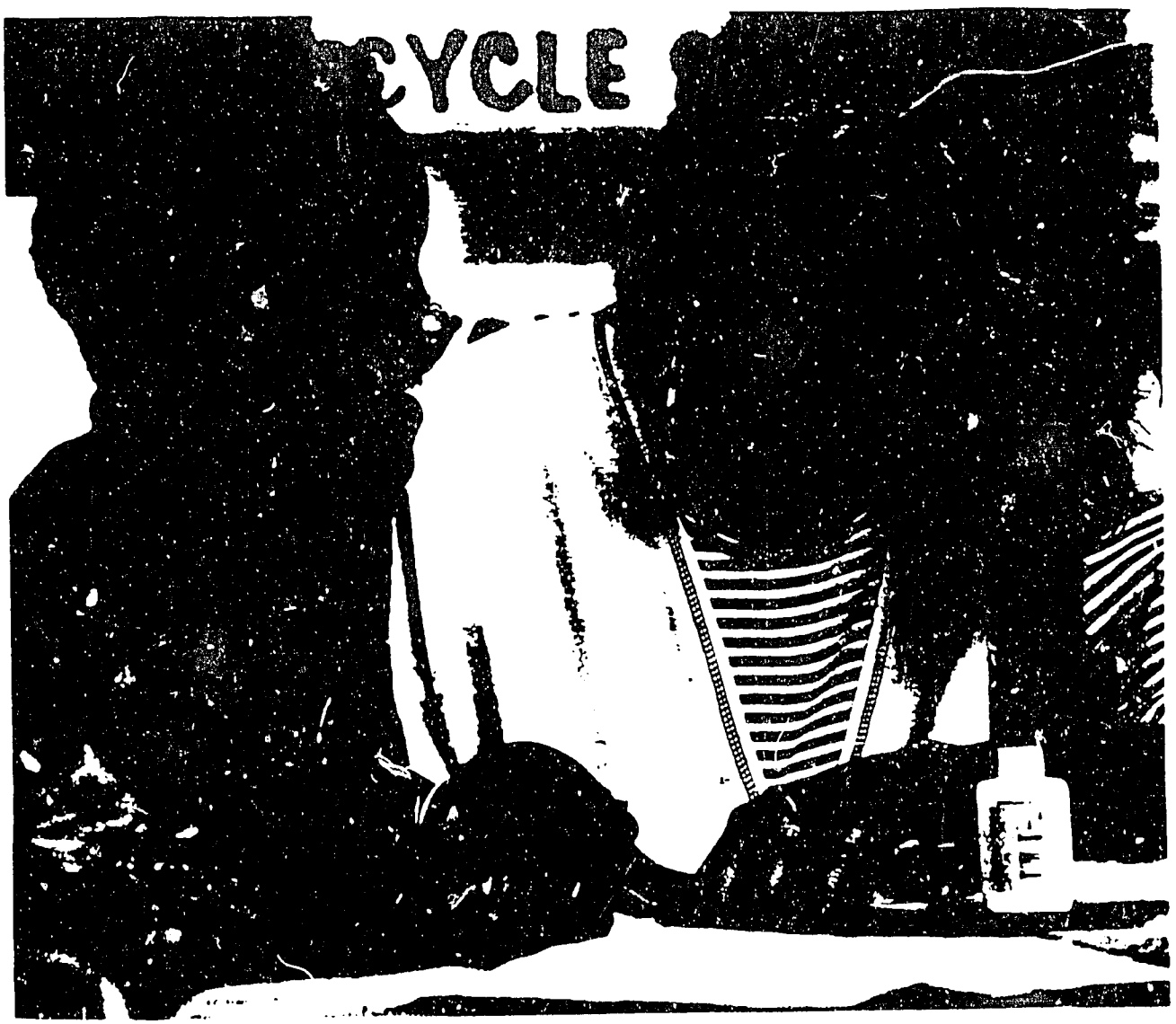
97

teachers. What the teachers did not realize was that their parents were afraid to go to the library; indeed, they were uncomfortable around white people in general and avoided them.

In the 1960's I began to speculate that the contrast between a child's experiences at home and those in school deeply affects the child's psychosocial development, and that this in turn shapes academic achievement. The contrast would be particularly sharp for poor minority children from families outside the mainstream. If my hunches were correct, then the failure to bridge the social and cultural gap between home and school may lie at the root of the poor academic performance of many of these children.

Yet current educational reforms de-emphasize interpersonal factors and focus instead on instruction and curriculum. Such approaches reveal a blind spot: they assume that all children come from mainstream backgrounds and arrive at school equally well prepared to perform as the school expects them to. Reading, writing, arithmetic and science are delivered to students in much the same way as tires, windows and doors are attached to the frame of an automobile on an assembly line. Yet students do not come in standardized frames that passively receive what is delivered. Most educators do not challenge this assumption, however, and the approach has never been systematically evaluated or modified through direct experiments in schools.

In contrast, Albert J. Solnit and his colleagues at Yale's Child Study Center believed educational reformers should develop their theories by directly observing and intervening in schools over long periods of time. Solnit's ideas inspired the school-intervention research project that was begun by the center and the New Haven school system in 1968 and continued until 1980. I was asked to direct the project and to work with a social worker, a psychologist and a special-education teacher from the center. We decided to immerse ourselves in the schools to learn how they function and then, on the basis of our findings, to develop and implement a model for improving the schools. We were guided by our knowledge of public health,



SMILE REWARDS A JOB WELL DONE in teacher Nancy McManus' first-grade class at the Katharine Brennan School in New Haven, Conn. The school, one of two elementary schools in which the author and his colleagues intervened, serves a nearby low-income housing project that suffers from rampant joblessness and crime. The staff is alert to the special needs of developing children, particularly those from marginal homes, and works hard to get parents involved; 92 percent of the parents visited the school 10 times or more in the past year. The school is now academically one of the best in the city.

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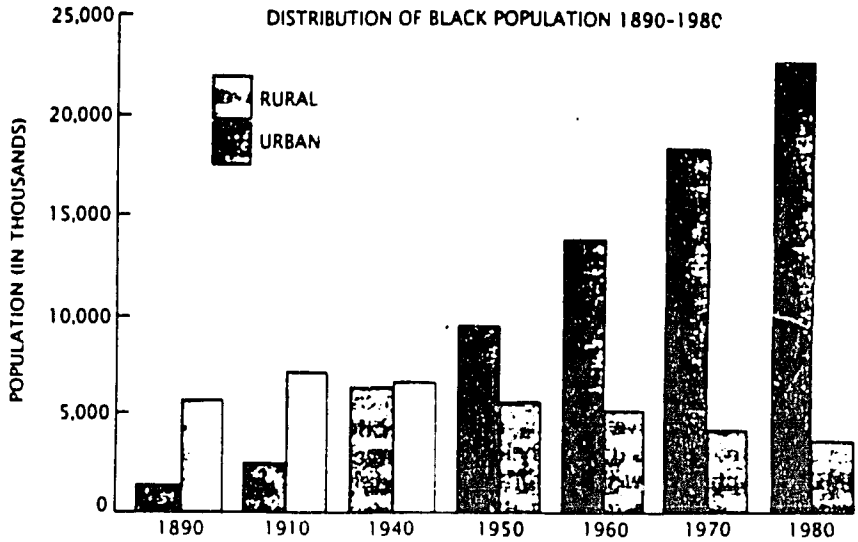
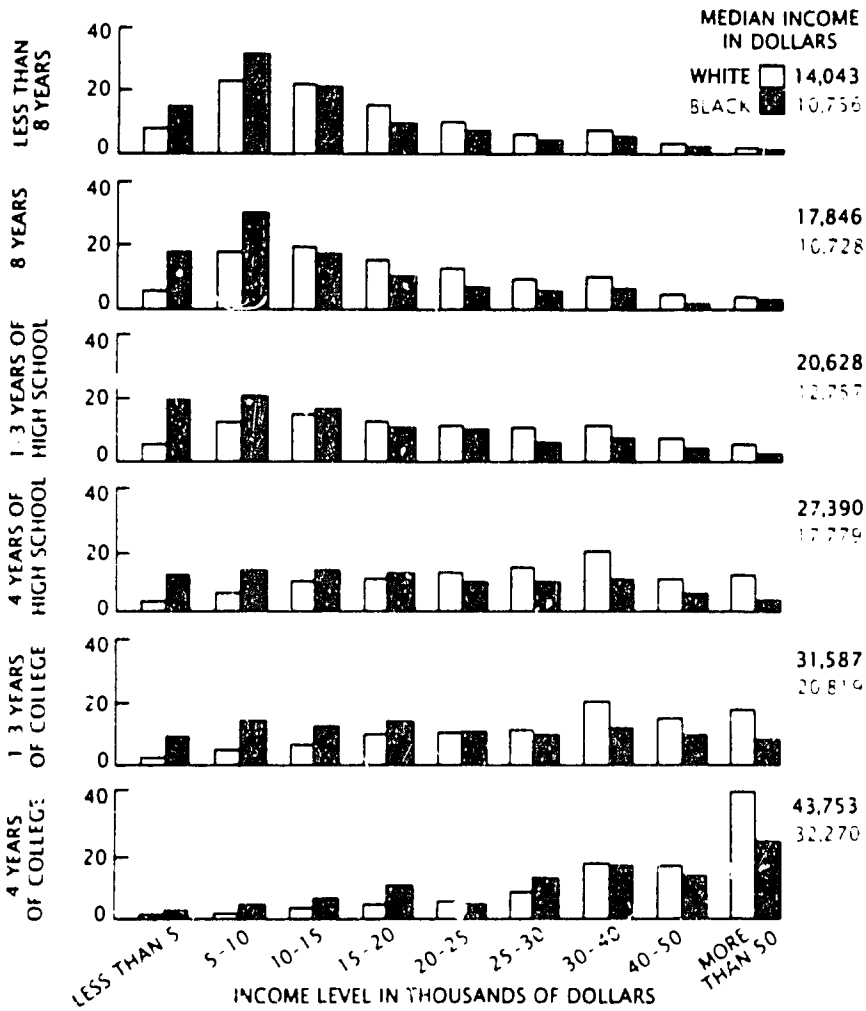
98



BLACK MIGRATION into urban communities (towns of more than 2,500 people) accelerated after World War II. The rural black population once greatly outnumbered the urban population, but the postwar economic boom led large numbers of blacks to move to the cities in search of jobs. Discrimination and lack of adequate education, however, denied many blacks access to the primary urban job markets.



EDUCATION LEVEL correlated to family income for whites and blacks shows that black incomes are at least a third less than the incomes of whites with equivalent schooling. For a given level of schooling completed by the family head, the graph indicates the percentage of families within each income bracket. Lack of education reduces the income of blacks more than that of whites, and black income rises more slowly with education than white income does. The data, for 1984, are from *Statistical Abstract of the United States 1987*, issued by the U.S. Department of Commerce.

human ecology, history and child development—and by common sense.

Our model evolved in two schools the Martin Luther King, Jr., School, which had about 300 pupils from kindergarten through fourth grade, and the Katharine Brennan School, which had more than 350 pupils from kindergarten through fifth grade. The pupils were 99 percent black and almost all poor: more than 70 percent were from families receiving Aid to Families with Dependent Children. At the beginning of the project the pupils were ranked near the bottom in achievement and attendance among the 33 schools in the city. There were serious problems with attendance and discipline. The staffs were discouraged, their turnover rate was 25 percent. Parents were dejected, distrustful, angry and alienated.

Both staff and parents approached the first year of the project with high expectations. But because teachers and administrators could not agree on clear goals and strategies, we had a difficult school opening. Some new teachers tried to have open classrooms, but the children soon became uncontrollable. Teachers blamed the administration for not providing adequate resources, and parents became angry—angry enough to march on one of the schools. Needless to say, the students did not learn much.

We, on the other hand, learned a great deal. The spectacular deterioration of the schools illuminated their social dynamics, something that would otherwise have taken us many years to perceive. We learned, first of all, that both the schools and our project needed more structure; we established regular meetings so that the staff could coordinate plans and set goals. More important, our analysis of interactions among parents, staff and students revealed a basic problem underlying the schools' dismal academic and disciplinary record: the sociocultural misalignment between home and school. We developed a way to understand how such misalignments disrupt beneficial relations and how to overcome them in order to promote educational development.

Our understanding is based on the fact that a child develops a strong emotional bond to competent caretakers (usually parents) that enables them to help the child develop. Many kinds of development, in social, psychological, emotional, moral, linguistic and cognitive areas, are critical to future academic learning. The attitudes, values and behavior

99

of the family and its social network strongly affect such development.

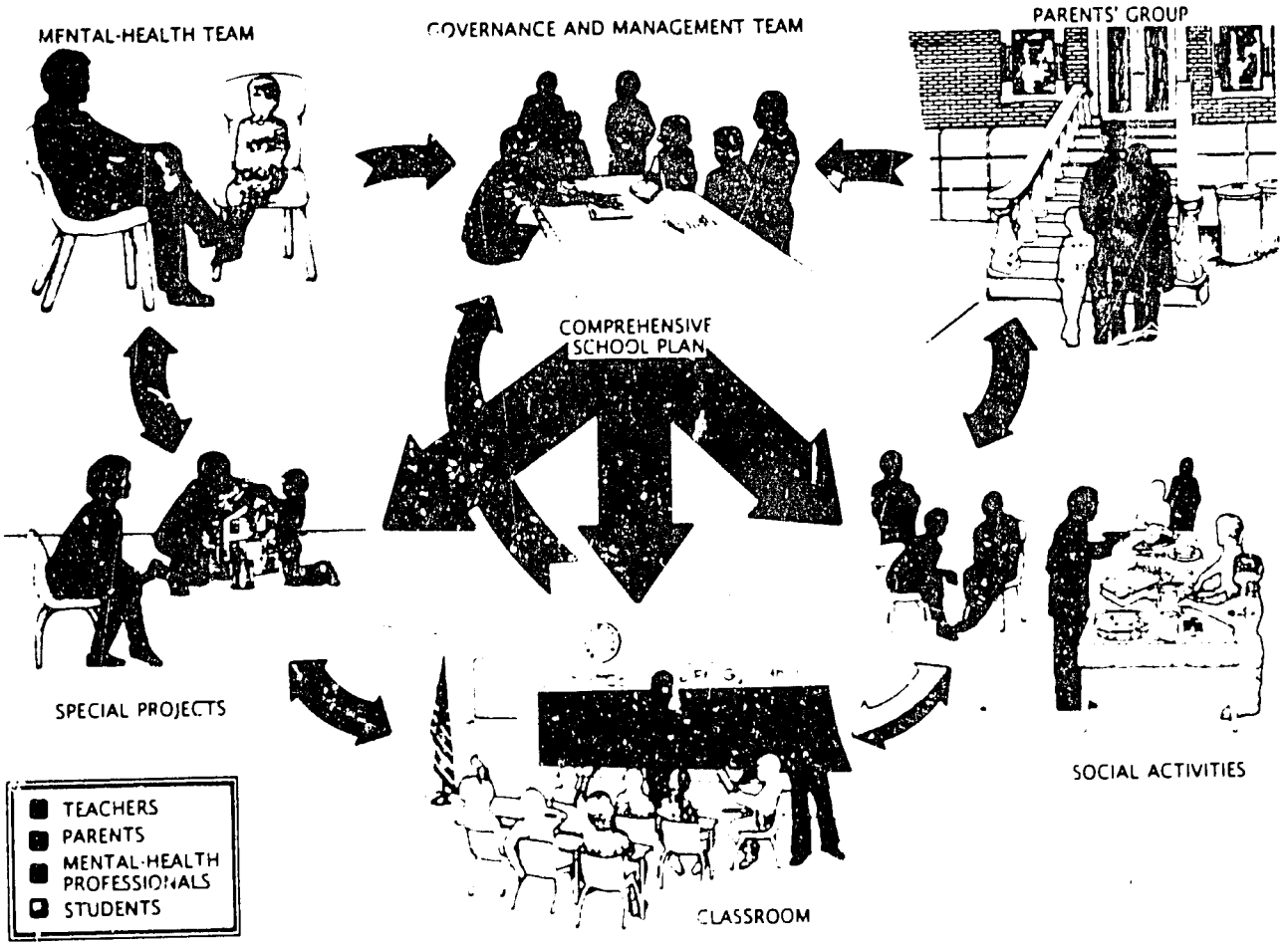
A child whose development meshes with the mainstream values encountered at school will be prepared to achieve at the level of his or her ability. In addition the meshing of home and school fosters further development: when a child's social skills are considered appropriate by the teacher, they elicit positive reactions. A bond develops between the child and the teacher, who can now join in supporting the overall development of the child.

A child from a poor, marginal family, in contrast, is likely to enter school without adequate preparation. The child may arrive without ever having learned such social skills as negotiation and compromise. A child who is expected to read at school may come from a home where no one reads and may never have heard a parent read bedtime stories. The child's language skills may be underdeveloped or nonstandard. Expectations at home and at school may be radically at odds. For example, in some families a child who does not fight back will be punished. And yet the same behavior will get the child into trouble at school.

Such lack of development or development that is at odds with the mainstream occurs disproportionately often among children from the minority groups that have had the most traumatic experiences in this society: Native Americans, Hispanics and blacks. The religious, political, economic and social institutions that had organized and stabilized their communities have suffered severe discontinuity and destruction. Furthermore, these groups have been excluded from educational, economic and political opportunity. These themes are particularly vivid in the black experience.

Blacks arrived in this country forcibly uprooted from their own culture, and they had another culture—that of slavery—imposed on them. Slavery was a state of enforced dependency and inferiority, which offered no future. The dominant Anglo culture, in contrast, placed a high value on independence and personal advancement. The dominant culture devalued the imposed black culture, and many blacks in turn developed a negative self-image. After the abolition of slavery, widespread discrimination denied blacks access to education and to the political and economic mainstream. Yet in spite of these psychological and social handicaps many poor black families, particularly in rural areas, were able to develop strong religious and cultural support systems and to function reasonably well.

After World War II opportunities for rural work diminished and many black families migrated to cities, but as a result of discrimination they were largely shut out of the primary job markets. Moreover, urban jobs de-



SCHEMATIC of the school-intervention program shows its key components and the relations among them. A governance and management team, consisting of the principal, parents, teachers and a mental-health worker, develops a comprehensive school plan covering academics, social activities and special programs, such as a Discovery Room for children who have lost interest in learning. Social activities, such as potluck suppers, teach children social skills and enable parents to meet teachers. Some parents become teachers' aides. The mental-health team assigns a member to work with a child who is having difficulty. It also tries to prevent behavior problems by recommending changes in school procedures. By reducing behavior problems and improving relations with parents, the program creates a school climate conducive to learning.

MENTAL-HEALTH TEAM of the Katharine Brennan School meets weekly under the direction of principal Dietria Wells (*center*). Members track the progress of students who are having problems and discuss intervention strategies, which often involve the children's families. Participants include staff member Bridget Hardy (*left*), speech pathologist Judith Campbell (*right*) and psychologist Karen McCleu (*far right*).

manded a higher level of education than rural ones, and blacks, undereducated in prewar years, were at a disadvantage. At the same time, they experienced severe stress resulting from the loss of supportive communities. For all these reasons, many black families began to function less well and could not provide their children with preschool experiences that would enable them to succeed in school.

Furthermore, blacks were able to achieve mainstream success only in limited professional areas. Thus they could not gain a significant share of political, economic and social power in the larger society and thereby help to advance socially marginal blacks. With time, marginal blacks came to resent mainstream blacks and whites for being unable—and apparently unwilling—to help them, and they defensively rejected the mainstream.

In spite of their alienation from the mainstream, many poor black parents still look to the school as their hope—indeed, their only hope—for the future, even though at the same time they expect the school to fail them and their children as other mainstream institutions have. And in fact the schools often do fail them. Typical schools, with their hierarchical and authoritarian structure, cannot give underdeveloped or differently developed students the skills and experiences that will enable them to fulfill expectations at the school. Instead such students are labeled "bad," unmotivated or stupid. Staff people punish the children and hold low expectations for them, often blaming the students, their parents and their communities for the problems. Parents, for their part, take the problems as a personal failure or as evidence of animosity and rejection by the mainstream. They lose hope and confidence and become less supportive of the school. Some parents, ashamed of their speech, dress or failure to hold jobs, become defensive and hostile, avoiding contact with the school staff.

The result is a high degree of mutual distrust between home and school. A black first-grade teacher in an inner-city school with a nearly all-black student body recalled explaining classroom rules on the first day. When she finished, a six-year-old raised his hand and said, "Teacher, my mama said I don't have to do anything you say." Fortunately this teacher understood the underlying problem, but most teachers would have reacted angrily, whereupon any chance of gaining parental cooperation would have quickly evaporated. This degree of alienation between home and school makes it difficult to nurture a bond between child and teacher that can support development and learning.

The consequences of alienation become most apparent when these children reach the age of about eight. Around this age they are expected to progress academically at a rate that begins to exceed their level of development. In addition the children begin to understand how they and their families differ in income, education and sometimes race and style from other people in the school. At this age, moreover, children seek to decrease their dependence on adults and on the approval of adults.

Unable to achieve in school, these children begin to see academic success as unattainable, and so they protect themselves by deciding school is unimportant. Many seek a sense of adequacy, belonging and self-affirmation in nonmainstream groups that do not value academic achievement. Such children are at risk for dropping out, teen-age pregnancy, drug abuse and crime. On the other hand, the decision to pursue academic achievement and to join the mainstream also exacts a heavy price: such a choice means rejecting the culture of one's parents and social group.

Our analysis of the two New Haven schools suggested that the key to academic achievement is to promote psychological development in students, which encourages bonding to the school. Doing so requires fostering positive interaction between parents and school staff, a task for which most staff people are not trained. Such changes cannot be mandated or sustained from outside the school. Our task, then, was to create a strategy that would overcome the staff's resistance to change, instill in them a working understanding of child development and enable them to improve relations with parents.

From our experience during the first difficult year it was obvious that we would make no progress until we had reduced the destructive interactions among parents, teachers and administrators and given cohesiveness and direction to the schools' management and teaching. To this end we created in each school a governance and management team of about a dozen people led by the principal and made up of elected parents and teachers, a mental-health specialist and a member of the nonprofessional support staff—all the adults who had a stake in the outcome. The teams decided issues ranging from the schools' aca-

101

demic and social program to changes in school procedures that seemed to engender behavior problems.

Several rules guided these teams. First, team members had to recognize the authority of the principal but, equally important, the principal could not push through decisions without weighing the concerns of the team members. Second, we agreed to focus efforts on problem solving and not waste time and energy in placing blame. Third, we made decisions by consensus rather than by vote; this promoted cooperation by reducing the harmful tendency of groups to polarize into "winners" and "losers."

The teams were not fully accepted at first, nor were they immediately effective, because we at the center were viewed as outsiders (from Yale, to boot, which working-class people in New Haven have always regarded with suspicion). But as we helped the principals to see that power sharing increased their own ability to manage the school, and as teachers and administrators benefited, the staff became more willing to apply our expertise in social and behavioral sciences to every aspect of the school.

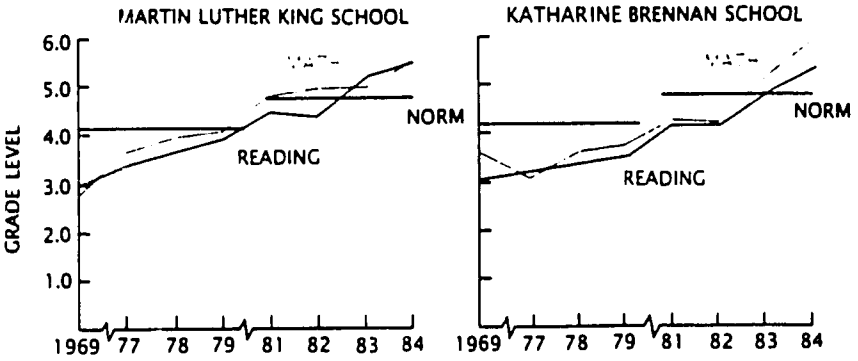
We invited parents from among the group that had protested against us in the first year to join the team. With their input we developed a program that involved parents at three levels: shaping policy through their representatives on the governance and management team, participating in activities supporting the school program, and attending school events.

At one point about a dozen parents worked as classroom assistants and formed the core of the parents' group. (They were paid the minimum wage.) Parents and staff sponsored activities such as potluck suppers, book fairs and graduation ceremonies. These social gatherings fostered good relations between parents and staff, so that when a child was having problems, the staff could discuss the matter with the parents without eliciting defensive reactions. As a result the school climate and student behavior improved, and more parents began to attend school activities.

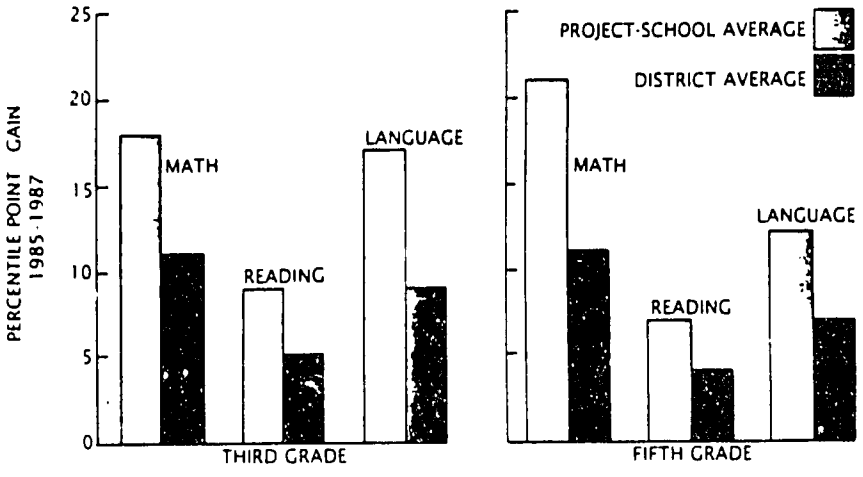
In a typical school, students who have emotional, learning or behavioral difficulties are seen by the school's psychologist, social worker or special-education teacher, who all work independently of one another. In our project, however, they worked as a team. We found this to be more efficient; the team would discuss each case and assign one member to it. The team approach also made it easier to detect patterns of troublesome behavior and to determine whether some aspect of the school was making them worse. Through its delegate on the governance and management team, the mental-health group recommended changes in school policies and practices so that students' developmental needs would be served better and behavior problems prevented.

These actions reduced the sense of failure, the feelings of anger and the loss of confidence that can lead to problem behavior among students. For example, an eight-year-old who was transferred into King from another school was taken directly to the classroom. He panicked, kicked the teacher in the leg and ran out. Usually such a child is punished. If nothing is done to reduce the child's anxiety, the cycle is often repeated until the child is labeled disturbed and referred for treatment. Our mental-health team helped the school staff to understand that the child's anxiety was a natural reaction to being thrust among strangers, and, together with the staff, we developed an orientation program to introduce transfer students and their parents to the school.

In the course of the 12 years we spent in the New Haven schools, other programs emerged in response to students' needs. In one school, children were kept with the same teacher for two years. A Discovery Room enabled "turned off" children to form a trusting relationship with an adult and, through play, rediscover an interest in learning. A Crisis Room provided a



FOURTH GRADERS at the two New Haven schools taking part in Yale University's Child Study Center's intervention program registered steady gains in achievement-test scores from 1969 through 1984. The graphs show mean scores on the Iowa Test of Basic Skills in reading (*red*) and mathematics (*blue*); scores in 1969 are for the Metropolitan Achievement Test. From 1969 through 1979 the tests were given in the fall (when the norm is a score of 4.2); from 1981 through 1984 the tests were given in the spring (norm score 4.8). Scores have stayed near the 1984 levels since then.



AVERAGE PERCENTILE GAINS on California Achievement Test scores from 1985 through 1987 were larger for 10 mainly black schools in Prince Georges County, Md., that use the Comer program than they were for the school district as a whole. Test scores of black students still lag behind those of white students, but the gap is narrowing. The school district, the 15th-largest in the U.S., has 105,000 students, 62 percent of whom are black. The schools using the program are more than 90 percent black; they receive extra staff and funds because they have been hard to integrate.

102

refuge for children who were "out of control." We discovered that this behavior could often be traced to a traumatic home experience, and so staff members helped the children to handle their feelings and regain a sense of control. With each intervention the staff became increasingly sensitive to the concerns of developing children and to the fact that behavior problems result mainly from unmet needs rather than from willful badness—and that actions can be taken to meet these needs.

By 1975 the program was clearly having an effect. Behavioral problems had declined, relations between parents and staff had improved and the intelligence of the children had become manifest. In that year we drew up a formal School Development Program based on the key ingredients of our success: the governance team, the parents' program and the mental-health team.

Having established a way to achieve and maintain a smoothly functioning school, we decided to see whether the school might also play a role in redressing the problem of social misalignment. We argued that it should be possible to teach our nonmainstream students the social skills that are expected of them in school, and that the acquisition of these skills would help them to succeed academically.

Staff and parents devised a curriculum of social skills, with instruction in the subjects children would need to know: politics and government, business and economics, health and nutrition, and spiritual and leisure activity. The staff chose specialists to help develop the program. Children learned how to write invitations and thank-you notes, how to serve as hosts, how the body functions, how to write checks, how to plan concerts, and so on. Each activity combined basic academic skills with social skills and an appreciation of the arts. These activities were an immediate and dramatic success. Students, parents and staff alike all felt a surge of excitement and a growing sense of participating in the mainstream.

The intervention program in New Haven produced significant academic gains. The students had once ranked lowest in achievement among the 33 elementary schools in the city, but by 1979, without any change in the socioeconomic makeup of the schools, students in the fourth grade had caught up to their grade level. By 1984 pupils in the fourth grade in the two schools ranked third- and fourth-highest on the Iowa Test of Basic Skills. By the early 1980's attendance rates at King were either first or second in the city. There have been no serious behavior problems at either school in more than a decade.

In 1980 our group left the schools. The program was fully integrated into the normal practices of the staff, who continued to carry it out. In the same year we began to develop a way to apply our program in other schools. We left intact the key elements of our success in New Haven—the governance and management team, the parents' program and the mental-health team, along with our operating rules—while allowing specific social and academic activities to vary with the needs of a particular school. In a sense the program enables school personnel to engage in a "clinical practice": armed with theories of child development and education, together with observations of children and school systems, they can diagnose problems in the school and develop solutions.

The Prince Georges County, Md., and Benton Harbor, Mich., school districts, which serve mainly low-income black children, have been using the program for several years; they have achieved successes on a par with those of the two New Haven schools. The program is being introduced to all New Haven schools, as well as to three other districts: Norfolk, Va., Lee County, Ark. (both also serving mainly poor black children), and Leavenworth, Kans. The program is now being implemented in more than 50 schools around the country, including two middle schools and one high school.

All the money and effort expended for educational reform will have only limited benefits—particularly for poor minority children—as long as the underlying developmental and social issues remain unaddressed. Yet most teachers and administrators are not trained to organize and manage schools in ways that support the overall development of students. Nor does their training enable them to analyze, much less solve, the social-misalignment problems of children from outside the mainstream.

The first step toward improving the education of these children, then, is to induce teachers' colleges and schools of education to focus on student development. Teachers who invest time in training will have an incentive to use what they have learned. The efforts of individuals will not be enough; the entire staff of a school must embrace new ways of thinking.

School districts, state and local governments and school boards must actively support these changes. They must recognize that students' social development is as important to society as their academic ability. They must select, certify and reward teachers and administrators who are skilled in nurturing the development of students. They must evaluate schools by their ability not only to produce high test scores but also to prepare students to assume adult responsibilities. And they must provide necessary funds.

The Federal Government must play a leading role in bringing about national educational reforms that can prepare young people to be effective and responsible citizens. Besides appropriating funds and establishing programs, the Government must facilitate the interaction of state and local government, educational authorities and private interests—foundations, businesses, colleges and universities.

To pull all of this together, I believe a National Academy of Education is needed. Its purpose would be to set national priorities, assess current research in education, learn how to implement approaches that work, identify areas for further study and allocate resources effectively. Such an academy must be free from the pressures of political expediency, and the interests of researchers must be balanced against those of educators. It could be created largely from existing Federal programs and governed by those who have a stake in education: educators, parents, government and business. A National Academy of Education could spearhead a process of change that is geared above all to the needs of children and to the national interest. It could set a timetable and move forward at a rational pace that recognizes the urgent need for reform and at the same time is guided by knowledge and common sense.

FURTHER READING

SCHOOL POWER: IMPLICATIONS OF AN INTERVENTION PROJECT. James P. Comer. The Free Press, 1980.

FAMILY LIFE AND SCHOOL ACHIEVEMENT: WHY POOR BLACK CHILDREN SUCCEED OR FAIL. Reginald M. Clark. University of Chicago Press, 1983.

GOOD SCHOOLS: WHAT RESEARCH SAYS ABOUT IMPROVING STUDENT ACHIEVEMENT. Willis D. Hawley and Susan J. Rosenholtz in *Peabody Journal of Education*, Vol. 61, No. 4; Summer, 1984.

WHY THE CURRENT WAVE OF SCHOOL REFORM WILL FAIL. John E. Chubb in *The Public Interest*, Vol. 90, pages 28-49; Winter, 1988.

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Multiplying Inequalities

The Effects of Race, Social Class, and Tracking on Opportunities to Learn Mathematics and Science

Jeannie Oakes
with Tor Ormseth, Robert Bell, Patricia Camp

July 1990

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CONTENTS

PREFACE iii
SUMMARY v
ACKNOWLEDGMENTS xv
FIGURES xix
TABLES xxi

Section

I. THE DISTRIBUTION OF OPPORTUNITY 1
- Organization of the Report 3
- Dimensions of the Distribution of Opportunity 4
- Study Approach 9
- Limitations of the Study 10

II. THE EFFECTS OF STUDENT CHARACTERISTICS ON OPPORTUNITY 13
- The Inseparability of Student Characteristics 13
- The Relative Importance of Race and SES 16
- The Relationships Between Ability Judgments and Opportunity 17
- Race, Social Class, and Ability Classifications 18

III. ACCESS TO SCIENCE AND MATHEMATICS PROGRAMS 26
- Time Spent on Science and Mathematics in Elementary Schools 27
- Science and Mathematics Programs in Secondary Schools 30
- Access to Courses Within Schools 42
- Summary 44

IV. ACCESS TO QUALIFIED SCIENCE AND MATHEMATICS TEACHERS 46
- Shortages of Qualified Teachers 47
- Which Schools Have the Most-Qualified Teachers? 50
- Which Classes Have the Most Qualified Teachers? 62

105

V. ACCESS TO RESOURCES 68
- What Science and Mathematics Resources Are Available? 69
- Do Resource Problems Hamper Instruction? 75
- How Good Are the Textbooks? 77
- Summary 79

VI. CLASSROOM OPPORTUNITIES: CURRICULUM GOALS AND INSTRUCTION 80
- Curriculum Goals and Expectations 80
- Curricular Emphasis Across Schools and Classrooms 82
- Learning Approaches and Activities 88
- Summary 100

VII. IMPLICATIONS 102
- A Context of Diminished Resources and Low Expectations 102
- Three Scenarios for Righting Inequalities 106
- Policies for Equalizing Opportunity and Improving Science and Mathematics Education 107

Appendix: CLASSIFICATION OF COURSES 115

REFERENCES 121

VI. CLASSROOM OPPORTUNITIES: CURRICULUM GOALS AND INSTRUCTION

Thus far, we have considered the distribution of opportunities that create boundaries around what students can learn in science and mathematics—extensiveness, content, and rigor of school programs; access of students judged to be of different abilities to science and mathematics courses; allocation of well-qualified teachers; and the availability of important enabling instructional resources. In each case, we have found distressing patterns of fewer opportunities for students who typically exhibit patterns of low achievement and minimal participation in science and mathematics—low-income, African-American, Hispanic, and inner-city students. In this section, we step inside classrooms to examine whether schools and classes of different types also differ in the curricular goals teachers set for their students and in the type of instruction they provide and explore the implications of differences for students' learning opportunities.

CURRICULUM GOALS AND EXPECTATIONS

Some case-study research suggests that even when course titles are the same, the curriculum taught in predominantly poor and minority schools is essentially different from that taught in predominantly white middle- and upper-class schools. These differences suggest that advantaged, white children are more likely to be exposed to essential concepts (as opposed to isolated facts) and to be taught that academic knowledge is relevant to their future lives (Anyon, 1981; Carnoy and Levin, 1986; Hanson, in press). For the most part, however, these issues have received little research attention.

In contrast, there is considerable evidence of differences in the opportunities to learn science and mathematics content in different classrooms within the same school: On average, high-ability groups in elementary schools progress further in a school curriculum over the course of the year (Rist, 1973; Hanson and Schultz, 1978; Barr and Dreeben, 1983; Rowan and Miracle, 1983; Gamoran, 1986). While we know of no systematic studies of content differences in ability-grouped science and mathematics instruction at the elementary level, low-ability reading groups have been shown to spend more time on

decoding activities, whereas in high-ability groups more emphasis is placed on the meanings of stories (Alpert, 1974; Hiebert, 1983). High-ability-group students do more silent reading and are interrupted less often when reading aloud (Allington, 1980; Eder, 1981). The high-ability-group advantage is presumably cumulative over the years, and as a result, students with a history of placement in high-ability groups cover considerably more material—and distinctively different material—in elementary school.

Differences in pace and quantity of coverage have also been detected at junior and senior high school levels (Ball, 1981; McKnight et al., 1987; Metz, 1978; Page, 1984). McKnight et al. (1987) used data from the SIMS to examine differences in content for eighth graders enrolled in different types of mathematics classes (e.g., remedial, typical, honors, or algebra). Not only did the lower-level courses provide students with access to fewer mathematics topics and skills, students in lower-level classes in the United States had much narrower curriculum opportunities than their counterparts in many other nations (see Kifer, in press). Not surprisingly, the lack of opportunity to learn various topics was reflected in these students' performance on test items.

Low-track classes not only typically offer a limited array of topics and skills, they consistently emphasize *less-demanding* topics and skills, whereas high-track classes typically include more complex material and more difficult thinking and problem-solving tasks (Burgess, 1983, 1984; Hargreaves, 1967; Metz, 1978; Nystrand and Gamoran, 1988; Oakes, 1985; Powell, Farrar, and Cohen, 1985; Sanders, Stone, and LaFollette, 1987).

In an earlier study of 300 junior and senior high school English and mathematics classes, quantitative and qualitative analyses of data from teacher and student questionnaires, teacher interviews, classroom observations, and content analyses of curriculum packages revealed that high-track students were more often presented with traditional academic topics and intellectually challenging skills (Oakes, 1985). Additionally, teachers in high-track classes more often cited having students learn to be competent and autonomous thinkers as among their most important curricular goals. Teachers of low-track classes more often emphasized basic literacy and computation skills and presented topics commonly associated with everyday life and work. Their important curricular goals focused on conformity to rules and expectations.

CURRICULAR EMPHASIS ACROSS SCHOOLS AND CLASSROOMS

The NSSME data provide useful information about the importance teachers place on central goals of science and mathematics education and about how their expectations vary for different groups of students.

Teachers were asked to rate, on a scale from "none" to "very heavy," the emphasis they placed in a particular class on having students achieve the following objectives:

- Become interested in science/mathematics.
- Learn basic science concepts (science only).
- Know mathematical facts, principles, algorithms, or procedures (mathematics only).
- Prepare for further study in science/mathematics.
- Develop inquiry skills.
- Develop a systematic approach to solving problems.
- Learn to communicate ideas in science/mathematics effectively.
- Become aware of the importance of science/mathematics in daily life.
- Learn about the applications of science/mathematics in technology.
- Learn about the career relevance of science/mathematics.
- Learn about the history of science/mathematics.
- Develop awareness of safety issues in the lab (science only).
- Develop skill in laboratory techniques.

Because both school and classroom characteristics can affect students' access to science and mathematics courses, it is important to understand the emphasis teachers place on various curricular objectives both at schools of different types and in classes of different track levels. Then, to evaluate the relative influence of the school and the classes a student is enrolled in within the school, we must compare the emphasis in classes of the same ability levels in different types of schools.

Elementary Schools. At the elementary school level, about the only differences we found were in the emphasis teachers placed on developing awareness of safety issues in the science laboratory. Teachers in inner-city and rural schools reported emphasizing laboratory safety more than teachers in other urban and suburban settings.

There were no school-level differences related to the racial or socioeconomic makeup of the school population.[1]

However, across the sample of elementary schools, we found considerable differences in teachers' emphasis on various objectives in classes that differed in ability level. Table 6.1 shows the strength and direction of these differences.[2]

Table 6.1

ELEMENTARY TEACHERS' CURRICULAR OBJECTIVES: RELATIONSHIP TO CLASS ABILITY LEVEL

Objectives Showing No Significant Positive Relationship with Class Ability Level	Objectives Showing Significant Positive Relationship with High Class Ability Level
Math, facts and principles	Interest *
Math, computations	Science, basic concepts**
Importance in life	Preparation for further study**
Technology applications	Inquiry skills**
History	Problem-solving approach**
Career relevance	Communicate ideas**
Science, lab safety	
Science, lab technique	

NOTE: * = significant at 0.05 level; ** = significant at 0.01 level.

In many respects, teachers have considerably higher expectations for students in high-ability classes. They clearly place more emphasis on some goals that have been widely heralded as critical, not only for future scientists, but for scientifically literate citizens and productive workers in an increasingly technological economy. Such goals as interest in science and mathematics, inquiry skills, and problem-solving are believed to promote essential adult knowledge and competencies; indeed, many science educators suggest that they constitute the core

[1] Where curriculum objectives (or other classroom-level-dependent variables) were analyzed with respect to school characteristics, teachers' responses were averaged within each school and the class weights were summed. In these cases, the number of observations was equal to the number of schools, not the number of teachers surveyed.

[2] The analysis of track level applies only to classrooms with homogeneous grouping; mixed-ability classes were omitted. Class weights were used to provide nationally representative information about differences among classes at different ability levels. Within each category of the respective independent variables, we calculated the teachers' mean response, but because of the difficulty of interpreting the questionnaire's Likert scale responses in absolute terms, we focused primarily on the relative differences in emphasis between categories.

of science and mathematics education.[3] Moreover, teachers place greater emphasis on preparing high-track students for further study in science and mathematics—a goal that might be seen as equally important for the low-track students who are at risk for continuing low achievement and nonparticipation in science and mathematics courses in later grades.

Compounding this unequal access to some important curricular goals, students in low-ability classes are not receiving correspondingly greater emphasis on other curriculum objectives. Teachers of low-ability classes simply seem to set their sights lower than teachers of classes at other track levels.

Secondary Schools. At the secondary level, there are both school and classroom differences in the emphasis teachers place on various objectives. Teachers at high-SES schools emphasize preparing students for further study in mathematics and science, developing inquiry skills and laboratory skills, and acquiring a systematic approach to solving problems.[4] Teachers at lower-SES schools emphasize becoming aware of the importance of science and mathematics in daily life and recognizing the career relevance of these subjects.[5]

We found racial composition to have relatively little effect on teachers' curriculum objectives. At predominantly white schools, teachers place more emphasis on learning basic science concepts; at predominantly minority schools, they place more emphasis on becoming aware of the importance of science and mathematics in daily life.[6]

There are far more differences among classes than among schools. As Table 6.2 illustrates, teachers' emphasis on curriculum objectives differs considerably with the ability composition of their classes. Students in low-track or disproportionately minority classes are disadvantaged in the degree to which teachers emphasize *most* curriculum objectives. Teachers of low-track classes were found to give less emphasis to every curriculum objective except becoming aware of the importance of science and mathematics and performing computations. As at the elementary level, these differences distance students in low-ability classes from some of the most important goals of science and mathematics. Moreover, there is a certain irony to the greater em-

[3]See, for example, Bybee et al., 1989; Champagne and Hornig, 1987.

[4]For preparing students for further study in mathematics and science, $F = 3.63$, $P < 0.05$; for developing inquiry skills, $F = 4.73$, $P < 0.01$; for laboratory skills, $F = 4.32$, $P < 0.01$; for acquiring a systematic approach to solving problems, $F = 6.45$, $P < 0.01$.

[5]For students becoming aware of the importance of science and mathematics in daily life, $F = 5.97$, $P < 0.01$; for the career relevance of these subjects, $F = 4.48$, $P < 0.01$.

[6]For basic science concepts, $F = 3.11$, $P < 0.05$; for becoming aware of the importance of science and mathematics, $F = 3.07$, $P < .05$.

Table 6.2

SECONDARY TEACHERS' CURRICULAR OBJECTIVES: RELATIONSHIP TO CLASS ABILITY LEVEL

Objectives Showing Significant *Negative* Relationship with High Class Ability Level	Objectives Showing No Significant Monotonic Relationship with Class Ability	Objectives Showing Significant *Positive* Relationship with High Class Ability Level
Importance in daily life**	Career relevance	Interest*
Math, computations**		Science, basic concepts**
		Math, facts and principles**
		Preparation for further study
		Inquiry skills**
		Problem-solving approach**
		Communicate ideas**
		Technology applications**
		History**
		Science, lab safety*
		Science, lab techniques**

NOTE: * = significant at 0.05 level; ** = significant at 0.01 level.

phasis teachers of low-ability classes place on developing an appreciation of the importance of science and mathematics in daily life. While few would question the importance of this goal, teachers behave as if they believe that this is all low-track students can do. One might speculate that teachers of low-ability classes work for student appreciation rather than helping their students become knowledgeable and competent.

These track-level differences reveal important nationwide differences in the types of goals teachers emphasize and their expectations for different groups of students. However, because of the uneven distribution of track levels among different types of schools, it is important to understand whether low-track classes receive different curricular emphases partly because they tend to be at schools that emphasize different objectives. In fact, school differences do not appear to account for the ability-level differences noted above. With the influence of school-SES differences accounted for, ability-group differences in teachers' emphasis on preparing students for further study remain.[7] The same is true for developing inquiry skills,[8] laboratory

[7]$F = 95.47$, $P < 0.01$.

[8]$F = 27.83$, $P < 0.01$.

techniques,[9] and a systematic approach to problem solving.[10] However, there is an interesting interaction between school type and track level on some objectives. At the lowest-SES schools, teachers of low-ability classes placed somewhat greater emphasis on inquiry skills and laboratory techniques than did teachers of average classes. In all cases, however, teachers of these two types of classes placed less importance on these objectives than did teachers of high-ability classes.

School differences did not affect the greater emphasis in low-track classes on appreciating the importance of science and mathematics in daily life, but low-SES schools' greater emphasis on the career relevance of these subjects is responsible for ability-group differences. That is, this objective appeared to receive greater emphasis across the sample of low-track classes because it was given greater weight in low-SES schools, and low-track classes were found in far greater numbers in these schools. Thus, track level alone did not produce these differences. Once the differences among schools of different racial compositions were taken into account, ability-group differences in the emphasis placed on learning basic science concepts disappeared. Low-track classes received greater emphasis because there are disproportionately more of them in high-minority schools that place more emphasis on this objective in all types of classes.

Most striking, however, is the finding that teachers of classes at the *same track levels* in very *different types of schools* appear to place similar emphasis on various curriculum objectives.

As shown in Table 6.3, even when the most widely different school types are compared, the curricular emphases in classes at various ability levels are more alike than they are different.[11]

The similarities are particularly noticeable among low-track science and mathematics classes. On only two curricular objectives

[9] $F = 20.01$, $P < 0.01$.

[10] $F = 19.91$, $P < 0.01$.

[11] For these analyses we used two groups of schools: The first included those with at least 30 percent of the students from families that were unemployed or on welfare, those with minority populations exceeding 50 percent, and those located in inner-city or other urban neighborhoods. The second group included those in which at least 30 percent of the students had parents in professional or managerial occupations, those with white populations exceeding 50 percent, and those located in suburban neighborhoods.

Table 6.3

SECONDARY TEACHERS' CURRICULAR OBJECTIVES IN HIGH- AND LOW-ABILITY CLASSES IN SCHOOLS OF DIFFERENT TYPES

More Emphasis in Disadvantaged Schools than in Advantaged Schools[a]	No Significant Difference	More Emphasis in Advantaged Schools than in Disadvantaged Schools[a]
	Low-Ability Classes	
Inquiry skills*	Interest	
History**	Science, basic concepts	
	Math, facts	
	Preparation for further study	
	Problem-solving approach	
	Communicate ideas	
	Importance in daily life	
	Technology applications	
	Career relevance	
	Science, lab safety	
	Science, lab technique	
	High-Ability Classes	
Importance in daily life**	Interest	Science, lab safety**
Technology applications**	Science, basic concepts	Science, lab technique**
Career relevance**	Math, facts	
History**	Preparation for further study	
	Inquiry skills	
	Problem-solving approach	
	Communicate ideas	

NOTE: * = significant at 0.05 level; ** = significant at 0.01 level.
[a]Disadvantaged schools are low-SES, inner-city or urban, and 50–100% minority schools; advantaged schools are high-SES, suburban, and 0–50% minority schools.

did teachers of low-ability classes in low-SES, predominantly minority, urban schools deviate from their counterparts in high-SES, predominantly white, suburban schools. The curricular focus in high-ability classes was also quite similar across school types. The teachers of these classes in the widely different schools differed on only one objective rated high by more than half of the science teachers and about half of the mathematics teachers: The goal of having students become aware of the importance of science and mathematics in daily

life was considered more important in schools serving disadvantaged, minority students.

While school characteristics do influence the curriculum emphases at secondary schools, considerably greater differences result from the judgments educators make about the abilities of their students and the types of class groupings they form. While the NSSME data do not permit causal inferences, school differences appear to stem largely from the disproportionate number of students at high-SES, white schools who are judged to be able learners and the disproportionate number at low-SES, minority schools who are judged to be less able. However, high- and low-track students are generally thought to need much the same curricular focus regardless of where they go to school. The one exception is the more applied and historical curriculum that is offered to low-track students in low-SES, minority schools—a difference that may result from having a less-qualified staff and fewer instructional resources.

LEARNING APPROACHES AND ACTIVITIES

The types of instructional activities that take place in classrooms are useful indicators of *how* teachers go about engaging students in learning. We know of no prior research that has examined differences in instructional practices at the school level or among ability-grouped science and mathematics classes at the elementary level, although considerable case-study and some survey research has investigated the variation in instructional activities with the track level of secondary school classrooms.

Evidence from both American and British ethnographers indicates that teachers describe their expectations for high- and low-track students' classroom participation in different terms (Hargreaves, 1967; Lacey, 1970; Rosenbaum, 1976; Metz, 1978; Ball, 1981; Schwartz, 1981). Hargreaves, for example, found a high-track blackboard with the sign, "We must always remember to behave as an A class," whereas a teacher of a low-ability-level class remarked, "You just can't afford to trust that lot." Such comments seem to be typical of many schools.[12]

Not surprisingly, these differences parallel differences in teaching practices. High-track teachers report spending more time preparing for class, and they appear to be more enthusiastic and more willing to

[12]We are grateful to Reba Page for reminding us of this study.

push their students to work harder (Rosenbaum, 1976; Metz, 1978; Schwartz, 1981; Oakes, 1985). Instruction in low tracks, on the other hand, has been characterized as oversimplified, repetitive, and fragmented. Observers report that teachers of low-track classes use recitation and worksheets to break topics down into minute bits of information, causing lessons to lack overall coherence (Hargreaves, 1967; Keddie, 1971; Metz, 1978; Oakes, 1985; Page, 1987a). Low-track assignments require more rote memory and less critical thinking than work in high-track classes (Hargreaves, 1967; Oakes, 1985). In high-track classes, teachers sometimes pursue serious understanding of complex themes; in low-track classes, instruction is often limited to basic, surface-level understanding of simplified materials (Keddie, 1971; Oakes, 1985; Page, 1987a, 1987b). Even when ostensibly similar materials are used, low-track classes "caricature" other classes in their abbreviated discussions and simplification of ideas. Page (1987b:21) quoted one teacher as saying, "In this particular ninth grade history class, we're less concerned about history and more concerned about improving your reading skills." Thus, students find the "main idea" of a paragraph about the American Revolution, but they do not discuss the implications of the idea itself.

Using national data, Vanfossen, Jones, and Spade (1987) found that college-track students were more likely than others to describe their teachers as patient, respectful, clear in their presentations, and enjoying their work. In earlier work, we found that the use of time also varied by track: In high-track classes, more time and emphasis were devoted to learning activities, and less to behavior management; high-track students also spent slightly more time on-task and were expected to spend more time on homework (Oakes, 1985). In another study, Gamoran (1987) found that high-ability classes were characterized by more open-ended questions, more higher-order cognitive tasks, and more student control over work.

Thus there is strong and consistent evidence of differences in the implementation of curriculum across tracked classes. Reports of fragmentation and rote tasks in low-track classes indicate a consistent pattern of low-quality instruction. This probably also relates to teacher ability and qualifications. Less-qualified teachers have a more limited instructional repertoire and tend to rely on worksheets more often. However, many of the criticisms that have been leveled at low-track classes have also been listed as concerns for the average American classroom. Not only low-track, but also regular classes are described as lifeless, emotionally flat, having fragmented curricula, and including little critical thinking or cognitive challenge (Goodlad,

1984; Powell, Farrar, and Cohen, 1985). Consequently, these differences must be seen within the context of across-the-board classroom instruction that is not very engaging (Gamoran and Berends, 1987).

The NSSME data provide additional insights into how schools and classes enrolling different groups of students vary in the learning activities they provide. The data include the percentages of teachers who used particular types of activities in their last science and/or mathematics lesson and the percentages of class time teachers say students spend on these activities.[13]

Do Learning Activities Differ Among Elementary Schools and Classes?

Elementary teachers were asked which of the following activities they included in the last science or mathematics lesson they taught:

- Lecture
- Discussion
- Student use of computers
- Student use of hands-on materials
- Students doing seatwork assigned from textbook
- Students completing supplemental worksheets

Those reporting on science were also asked whether the following additional activities were included in their most recent lesson:

- Teacher demonstration
- Students working in small groups

Teachers reporting about mathematics lessons were also asked about the following activities:

[13]Teachers were asked to report the instructional activities that took place during the last science or mathematics lesson they taught. While data about a single lesson cannot provide a full picture of time use and activities in any one class, the weighted data can be aggregated to provide representative descriptions for various types of schools (as defined by SES, racial/ethnic composition, and locale). The data also reveal patterns of time use and learning activities among classes of various types (e.g., ability levels). However, the data are limited in that the types of activities listed (e.g., lecture, seatwork, quiz) are *gross* categories, the specific nature of which may differ considerably from class to class. Therefore, analyses of these data cannot begin to portray the subtle differences in the activities or in the teacher-student interactions that take place during instruction—subtleties that can make a tremendous difference in the quality of the instructional opportunities made available to students.

- Student use of calculators
- Tests or quizzes

Teachers at all types of schools reported using basically similar activities in their lessons. Perhaps the most important difference was that a larger proportion of teachers at high-poverty schools used tests or quizzes in their mathematics lessons.[14] Test use also differed among schools of different racial composition, with predominantly minority schools using tests most often.[15] Elementary schools of different types diverged on only one other instructional activity, discussion. A slightly greater proportion of teachers at high-minority schools said that discussion was a part of their most recent lesson.[16]

In addition to reporting the types of learning activities included in their most recent lesson, teachers also indicated how much time they spent on learning activities, daily routines, interruptions, and other noninstructional activities.[17] Science teachers also estimated the time spent on:

- Teacher lecturing
- Students working with hands-on, manipulative, or laboratory materials
- Students reading about science
- Students taking tests or quizzes
- Other science instructional activities

In contrast, mathematics teachers also estimated the time spent in various types of instructional groupings:

- Teacher working with the entire class as a group (e.g., lecture, test, etc.)
- Teacher working with small groups of students

[14]Twenty-three percent, as compared with 17 and 15 percent ($F = 2.90$, $P < 0.05$). Because teacher reports were aggregated at the school level, these percentages represent the average percentages of teachers within schools of each type.

[15]Twenty-five percent of the teachers in high-minority schools and 29 percent of those in schools with between 50 and 90 percent minority populations reported that they used tests or quizzes, compared with 18 and 19 percent, respectively, in majority white and 90 percent or more white schools ($F = 2.94$, $P < 0.05$).

[16]Teachers at high-minority schools included discussion somewhat more often (96 percent) than did teachers at other majority-minority schools (88 percent), majority-white schools (85 percent), or predominantly white schools (90 percent) ($F = 3.23$, $P < 0.05$).

[17]Teachers were asked to report the number of total minutes spent on the last lesson and then divide those minutes among the list of activities.

- Teacher supervising students working on individual activities

Although we found few differences in the total amount of time spent on instruction,[18] science teachers at high-minority schools assigned students only about half as much hands-on and laboratory work as teachers at schools with predominantly white enrollments,[19] and those in predominantly minority schools spent twice the time on tests.[20] Also, mathematics teachers at predominantly minority schools had students spend more time working in small groups than did teachers at majority-white schools.[21] While greater amounts of small-group time may appear to provide students greater opportunities for active, engaged learning interaction, in most cases, small-group work actually decreases the amount of instructional time individual students spend with teachers, since the teacher can work with only one group at a time. Individual students, although grouped, often work alone at seatwork while they are waiting for their group's turn with the teacher. Moreover, these findings may well reflect the slightly smaller percentage of homogeneous ability classes in predominantly minority schools, noted in Section II. The greater percentage of class time spent in small groups in these schools probably represents more within-class ability grouping for mathematics instruction.

School location was not a factor in either the distribution of types of activities or the way time was spent.

We found no differences in the *types* of activities that elementary teachers of high-, average-, and low-track classes included in science and mathematics lessons. However, we did find some small differences in their *allocation of class time;* for example, low-track classes spent the most time in class routines.[22] These differences largely reflect the larger number of low-ability classes in low-SES schools,

[18]For example, teachers at high-poverty and low-poverty schools spent slightly more time on routines and other noninstructional activities (12 and 11 percent of lesson time, respectively) than did those at moderate-poverty and high-wealth schools (9 percent each) ($F = 4.24$, $P < 0.01$).

[19]Twenty-four percent at schools with between 50 and 100 percent minority; 30 percent at schools with 50 to 90 percent white students; and 48 percent at schools with more than 90 percent white students ($F = 2.89$, $P < 0.05$).

[20] Twelve percent at each of the predominantly minority school types, compared with 6 percent at each of the two types of majority-white schools ($F = 3.44$, $P < 0.05$).

[21] Twenty-two and 26 percent for schools with minority populations greater than 90 percent and 50 to 90 percent, respectively. This compares with 17 percent in schools with between 50 and 90 percent white students and 19 percent for schools with more than 90 percent white students ($F = 3.25$, $P < 0.05$).

[22]Teachers of elementary low-track classes said they spent slightly more time on classroom routines (11 percent) than did teachers of average- (9 percent) or high-track groups (10 percent) ($F = 2.93$, $P < 0.05$).

where routines generally consume more time. Even when we controlled for school differences, however, we found that students in low- and average-ability science classes spent less time on testing[23] and more time on reading than high-ability groups did.[24]

Low-track mathematics classes spent considerably less time than did average- and high-track groups in whole class instruction[25] and considerably more time working with the teacher in small groups.[26] However, once again, these differences are largely a reflection of school differences, although the greater time low-ability classes spend in small groups is not entirely explained by the greater small-group time spent in high-minority schools, where disproportionate percentages of low-ability classes are found.

In summary, we find that teachers in high-minority elementary schools less often involve students in hands-on or laboratory activities. And students in such schools spend more lesson time on routines, testing, and working in small groups than do students in other types of schools. Together, these findings suggest that students in less-advantaged schools have less access to active, engaging learning activities. Track-level differences suggest additional instructional disadvantages for students in low-track classes at these and other types of schools, who spend less time than their peers in other classes actively engaged with the teacher in science and mathematics lessons. In racially mixed schools, because of the placement of large numbers of minority students in low-ability classes, these class-level differences have a disproportionate effect on the opportunities of minority students.

Do Learning Activities Differ in Secondary Schools and Classes?

There is little school-related variation in the types of activities secondary teachers include in their lessons. Neither the composition of the student body nor the location of the school has a noticeable effect on the strategies teachers use in science and mathematics classes. In

[23]Five and 7 percent, compared with 12 percent for high-track classes ($F = 3.79$, $P < 0.05$).

[24]Eighteen percent for low-ability, 22 percent for average-ability, and 13 percent for high-ability groups ($F = 5$, $P < 0.05$).

[25]Thirty-five percent, compared with 45 and 47 percent ($F = 8.04$, $P < 0.01$).

[26]$F = 2.96$, $P < 0.05$.

all types of schools, most teachers lecture and few use computers,[27] and most activities specifically related to science or mathematics classes—such as teacher demonstrations,[28] small-group science activities,[29] or the use of calculators in mathematics—are similar across school types.[30]

However, the differences we do find are telling. For example, the percentage of teachers who ask their students to do seatwork is strikingly higher at schools with large concentrations of low-income students—65 percent, compared with 48 percent of teachers at low-poverty/high-wealth schools.[31] Also, nearly half of the teachers in inner-city schools said that they used worksheets in their last lesson, compared with about a third of the teachers in other types of communities,[32] and nearly twice the percentage of teachers in high-minority schools said that their last lesson included a test.[33] The use of hands-on laboratory activities also differed at schools of different SES levels, and seatwork differed with school location. However, the direction and meaning of these relationships are muddy.[34]

There is also considerable divergence in *how much time students spend on different types of activities* at different types of schools. The higher the minority population at schools, the more time teachers spend on daily routines, interruptions, and noninstructional activities, although the size of these differences is small (ranging from 13 percent at schools with minority populations greater than 90 percent

[27]For example, 87 percent of all secondary teachers said they lectured during their last lesson; 85 percent said they included discussion; and only 6 percent reported using computers.

[28]Reported by 44 percent of the science teachers.

[29]Thirty-seven percent.

[30]Twenty-one percent.

[31]$F = 6.98$, $P < 0.01$.

[32]Forty-seven percent of the teachers in inner-city schools, compared with 37 percent of suburban teachers, 35 percent of rural, and 31 percent of other urban ($F = 4.47$, $P < 0.01$).

[33]Thirty-one and 26 percent in high-minority and majority-minority schools, compared with 21 percent and 16 percent in majority-white and nearly all-white schools ($F = 6.20$, $P < 0.01$).

[34]High-poverty and high-wealth schools had the lowest percentages of teachers who said that hands-on or laboratory activities were a part of their most recent lesson (24 and 25 percent, respectively); 33 percent of teachers at moderate-poverty and 28 percent at low-poverty schools reported using such activities ($F = 3.85$, $P < 0.01$). Inner-city and suburban schools had the fewest teachers indicating that their students did seatwork (53 percent at each type of school, compared with 61 and 63 percent, respectively, at rural and other urban schools) ($F = 5.99$, $P < 0.01$). However, the low incidence of seatwork in inner-city schools may be accounted for by the greater use of worksheets, as noted above.

to 11 percent at schools with 90 percent or more white populations).[35] More significant, science teachers in schools with higher concentrations of low-income and minority students have their students spend more time reading than do teachers in other schools. Students in the lowest-SES schools spent 14 percent of their class time reading, while those in the high-wealth schools spent only 4 percent. Consistent with this pattern, students in inner-city schools spent more time reading in science classes than did students in other communities.[36] Additional science time spent on reading may come at the expense of instruction delivered directly by the teacher; teachers at the highest-SES schools spent 43 percent of their time lecturing, while those at the lowest-SES schools spent only 33 percent.[37]

Mathematics teachers in high-poverty and majority-minority schools also have their students spend somewhat more time working alone and less time working with the whole class than do teachers with more-advantaged students. Students in high-poverty schools spent, on average, 53 percent of their class time working with the whole class (e.g., listening to teachers' lectures) and 24 percent working alone; students in high-wealth schools spent 60 and 21 percent of their class time, respectively, in these ways.[38]

Overall, then, while there are more similarities than differences in science and mathematics instruction in various types of schools, the pattern of differences is revealing. Students at higher-income and majority-white schools spend more instructional time on whole-class activities and less time working alone, i.e., reading or doing worksheets, than do those at lower-SES, high-minority schools.

The Links Between Tracking and Classroom Activities

Far more striking than the differences between schools of various types are the differences among tracks within schools. Here, too, the differences in how time is spent are greater than the differences in the types of activities teachers include. But, taken together, the differences reveal quite distinct patterns of students in low-track classes spending more time on routine, less engaging, perhaps even less in-

[35]$F = 3.03$, $P < 0.05$.

[36]For reading and SES, $F = 10.61$, $P < 0.01$; for reading and racial composition, $F = 8.52$, $P < 0.01$; for reading and school location, $F = 7.60$, $P < 0.01$.

[37]For lecturing and SES, $F = 3.11$, $P < 0.05$; for lecturing and racial composition, $F = 2.75$, $P < 0.05$.

[38]For SES and individual activities, $F = 3.18$, $P < 0.05$; for SES and whole-class activities, $F = 4.05$, $P < 0.01$; for racial composition, $F = 4.20$, $P < 0.01$.

structional activities. Table 6.4 shows that although teachers of the three class levels include most types of instructional activities at the same rates, the pattern of more isolated, routine activities in low-track classes is clear. Students in these classes are more often given seatwork, worksheets, and tests.

Table 6.5 shows how time is divided in classes of different track levels. Students in high-track science classes are advantaged by spending less class time on routines and reading and more time on hands-on activities and receiving instruction from teachers. Students in high-ability mathematics classes spend more time on whole-group instruction and less time working alone.

Considerable literature suggests that the instructional patterns we have observed reflect an overemphasis on control processes and a concomitant deemphasis on educative processes in lower-track classes. In an earlier study where similar instructional differences were found, teachers spent more time disciplining than teaching in lower-track classes (Oakes, 1985). These classes focused on passive drill and practice with trivial bits of information, whereas the upper-track classes included more imaginative, engaging assignments. Other studies describe a similar balance between education and order in high-, average-, and low-track classes, both in the United States and in other industrialized nations, and at the elementary as well as the secondary school level (e.g., Ball, 1981; Eder, 1981; Goodlad, 1984; Hargreaves, 1967; Page, 1987a; Powell et al., 1985; Schwartz, 1981). These findings, combined with evidence that active learning strategies are most likely to promote student achievement in science and mathematics (Bredderman, 1983), suggest that the instructional patterns observed in the NSSME data restrict opportunities to learn in low-ability classes.

The track-level differences remain, even when we control for instructional differences among different types of schools. With the effect of school location accounted for, low-ability groups were found to do seatwork as a part of their lessons far more often than students in other track levels.[39] With school differences in racial composition accounted for, low- and average-ability classes were more often made to complete worksheets,[40] and more teachers of low-ability classes gave tests and quizzes.[41]

[39]An average of 63 percent of the lesson time in low-ability classes was spent on seatwork, compared with 45 percent in high-ability classes ($F = 12.44$, $P < 0.01$).

[40]The contrasts between low- and high-track classes and between average- and high-track classes were both significant at the 0.01 level.

[41]Overall ability-group differences were significant at the 0.05 level, $F = 3.04$.

Table 6.4

PERCENTAGES OF SECONDARY TEACHERS INCLUDING VARIOUS INSTRUCTIONAL ACTIVITIES IN LAST SCIENCE OR MATHEMATICS LESSON, BY CLASS ABILITY LEVEL

Instructional Activity	Class Type			Significance of Differences	
	Low	Average	High	F	P <
All classes					
Lecture	89	85	88	2.25	(not significant)
Discussion	88	86	85	1.45	(not significant)
Seatwork	63	61	52	10.20	0.001
Worksheets	43	37	29	16.11	0.001
Small groups	41	37	40	1.17	(not significant)
Hands-on	23	26	27	1.08	(not significant)
Test or quiz	21	18	16	3.07	0.05
Calculators	13	12	25	29.02	0.001
Computers	8	5	6	2.47	(not significant)
Science classes					
Demonstration	46	39	46	3.36	0.05

Table 6.5

PERCENTAGES OF TIME SPENT ON VARIOUS INSTRUCTIONAL ACTIVITIES IN SECONDARY SCIENCE AND MATHEMATICS LESSONS, BY CLASS ABILITY LEVEL

Instructional Activity	Class Type			Significance of Differences	
	Low	Average	High	F	P <
All classes					
Routine	12	12	10	14.08	0.001
Science classes					
Lecture	36	36	41	4.98	0.01
Hands-on	20	20	26	5.85	0.01
Reading	12	10	5	22.58	0.001
Test or quiz	7	7	6	0.26	(not significant)
Other activities	13	14	12	0.96	(not significant)
Mathematics classes					
Class—lecture, test, etc.	48	55	59	18.71	0.001
Small groups	10	9	10	0.65	(not significant)
Individual	29	25	20	14.57	0.001

Ability-group differences in how class time is spent also remain when school characteristics are controlled. The high-track advantage in the smaller amount of time spent on routines remained,[42] as did the greater exposure to teacher-led instruction in these classes.[43] Clear instructional disadvantages for low-track classes also remained after we accounted for school differences. Students in low-track classes across all school types spent greater amounts of their science class time reading.[44] Similarly, low-ability groups spent more time working alone in mathematics and less time doing whole-class activities.[45]

The combined effect of being in a low-track class in a low-SES, high-minority, inner-city school is that lessons tend to be considerably more passive than those in higher tracks at any school. The contrasts shown in Table 6.6 between the most extreme cases—low-track classes in high-poverty, minority, inner-city schools and high-ability classes in high-wealth, white, suburban schools—are particularly striking.

Do Expectations About Homework Differ Among Schools and Class Types?

Finally, we examined how expectations about homework—the instructional time students spend outside of school—differ among schools and classes of different types. We first considered the percentage of teachers who assign homework as a part of their science and mathematics lessons. Then we compared the amount of time teachers in different settings expect students to spend doing homework.

Among elementary schools, neither the concentration of low-income students nor the location of schools made any difference in whether teachers assigned homework or how much time they expected students to spend on it. However, while about a third of the elementary teachers at mixed-race and all-white schools included homework as a part of their science and mathematics lessons, 54 percent of those in

[42]For location and time on routines, $F = 13.77$, $P < 0.01$; for racial composition and routines, $F = 8.48$, $P < 0.02$.

[43]$F = 6.78$, $P < 0.01$.

[44]For SES and reading, $F = 18.96$, $P < 0.01$; for racial composition and reading, $F = 12.07$, $P < 0.01$; for school location and reading, $F = 18.17$, $P < 0.01$.

[45]For racial composition and working alone, $F = 3.94$, $P < 0.05$; for SES and whole-class activity, $F = 9.25$, $P < 0.01$; for SES and working alone, $F = 8.27$, $P < 0.01$; for SES and class activities, $F = 10.74$, $P < 0.01$.

Table 6.6

PERCENTAGES OF TIME SPENT ON VARIOUS INSTRUCTIONAL ACTIVITIES IN HIGH- AND LOW-ABILITY CLASSES IN SECONDARY SCHOOLS OF DIFFERENT TYPES

	Class and School Types	
Instructional Activity	Low-Ability Classes in Low-SES, Minority, Urban Schools	High-Ability Classes in High-SES, White, Suburban Schools
All classes		
Routine	17	9
Science classes		
Lecture	28	51
Hands-on	20	26
Reading	21	1
Test or quiz	10	4
Mathematics classes		
Class—lecture, test, etc.	48	63
Small groups	7	8
Individual	26	20

schools with predominantly minority enrollments assigned homework.[46] We also found large differences in the time teachers expect students to spend on their homework. While teachers in schools with predominantly white populations expected students to spend about 8 minutes on an average day, teachers in high-minority elementary schools expected students to spend twice that much—16 minutes per day.[47] Within elementary schools, the track level of classes made no difference in whether or not teachers assigned homework, but the class ability level did relate to the amount of homework assigned. Teachers in high-track classes assigned students an average of 14 minutes per day, slightly more than the 13 minutes assigned to low-track classes. Teachers assigned average-track classes somewhat less homework, an average of about 10 minutes.[48]

At the secondary level, school type made no difference in the percentage of teachers assigning homework (63 percent across the sampled teachers) or in the amount of time students were expected to spend on homework (an average of 27 minutes per day). Teachers of

[46]$F = 2.85$, $P < 0.05$.

[47]$F = 9.13$, $P < 0.01$.

[48]$F = 8.95$, $P < 0.01$.

classes at all levels were equally inclined to assign homework, but teachers of high-ability classes assigned considerably more homework than other teachers. High-ability classes were assigned an average of 33 minutes of homework per day; average-ability classes, 26 minutes; and low-ability classes, 24 minutes.[49]

The fact that students in low-track classes were expected to spend less time on their homework than other students points to a fundamental irony found in earlier studies of track-level differences in homework (Oakes, 1985). That is, those students who probably need to spend the most time engaged in learning activities to overcome their current deficiencies in science and mathematics are the ones of whom less out-of-school learning time is expected. In contrast, the students who achieve most easily in these subjects are expected to spend the most time learning at home. Thus, teachers have unequal expectations about homework that are likely to further distance high- and low-track students' learning.

SUMMARY

This section has examined two central dimensions of classroom learning opportunities: the curriculum goals that teachers emphasize and the instructional strategies they use to achieve them. Once again, we find patterns that suggest that disadvantaged, minority, inner-city students have more-limited learning opportunities than their more-advantaged, white peers. In the elementary years, differences in curricular goals and instruction are small, but not unimportant. In high-minority elementary schools, there are some small exceptions to the patterns, including higher teacher expectations concerning the amount of homework assigned to students. We must caution, however, that at the elementary level, our measures of opportunity are few and gross in nature, and more work needs to be done on measuring what goes on at this level. It is also possible that the increased investment in instructional time and homework may be having perverse, unintended effects: The additional time may not in fact impart the types of knowledge that encourage participation at a later stage in students' academic careers. The evidence from recent achievement assessments appears to bear this out. Finally, there may be processes at work in middle schools or in the early high school years that undo gains made at the elementary level. Our data show that the differences in curricular and instructional opportunities—as in the areas investigated in earlier sections of this report—grow considerably wider in secondary schools.

Again, we find evidence of a double disadvantage for low-income and minority students, particularly in secondary schools. Teachers in schools serving large proportions of these students place somewhat less emphasis on such essential curriculum goals as developing inquiry and problem-solving skills. Moreover, teachers in low-ability classes (where disproportionate percentages of minority students in mixed schools are found) place less emphasis on nearly the entire range of curricular goals.

Schools with large concentrations of low-income and minority students offer fewer classroom conditions that are likely to promote active engagement in mathematics and science learning—such as opportunities for hands-on activities and time working with the teacher. These differences are also compounded by differences in the experiences of students classified as high-, average-, and low-ability. The latter group are disadvantaged in their access to engaging classroom experiences and in their teachers' expectations for out-of-school learning. Because low-income and minority students are disproportionately assigned to low-ability classes, these track-related differences further disadvantage these groups. Thus, our evidence suggests that unequal access to science and mathematics curriculum goals is further exacerbated by discrepancies in instructional conditions in schools and classrooms. Together, the data reveal striking differences in classroom opportunities.

[49] $F = 80.09$, $P < 0.01$.

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Workshop on Rethinking the Learning Community

AGENDA

09:00-10:15	Welcome: Stephen Moseley, President, AED Introductory Remarks: Frank Method Video and Jigsaw Activity introduced by Beau Fly Jones
10:15-11:10	Topic: Designs for Cognitive Instruction: Beau Fly Jones
11:10-11:30	Break
11:30-11:50	Panel Discussion
11:50-12:30	General Discussion: Mildred Morton, Facilitator
12:30-01:15	Lunch
01:15-02:15	Topic: Rethinking the Learning Community: John Abbott Panel Discussion
02:15-03:15	General Discussion
03:15-03:30	Break
03:30-05:00	Mapping Activities What is important? What are the implications for A.I.D.? Next steps?