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ABSTRACT

This report examines findings of the National Assessment of Educational Progress, which describes the educational attainments of today's youth, in combination with economic trends and future projections to reveal the shortcomings of students nationwide. The report begins with a description of three major economic trends within the United States: the displacement of goods by services, factors related to the growth in productivity, and the increase in foreign competition. Future employment projections are then presented that provide evidence of changing labor-force skills. National assessment results for 17-year-old students with both high- and low-level skills in reading, writing, mathematics, and science follow. Implications of these conclusions are then discussed: the 10 percent of students who are unable to perform basic skills represent hundreds of thousands of people and the percentage of students who achieve higher order skills is declining. The final two sections of the report explore problems confronting educators (changing definitions and diverse needs of students, educational responsibilities and relevance, curriculum and skills, institutional instructional technology, teacher shortages and training, accreditation issues, and joint education-industry responsibility and finance) and some actions currently proposed. Sample exercises from the National Assessment are appended. (YLB)

THE INFORMATION SOCIETY:
ARE HIGH SCHOOL GRADUATES READY?

Education Commission of the States
1860 Lincoln Street, Suite 300
Denver, Colorado 80295

September 1982

Credits and Acknowledgments

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PREFACE

A draft of this report appeared in March 1982, and its reception has been extremely gratifying. Since that time, the suggestions of numerous reviewers have been considered carefully and incorporated into this final copy whenever appropriate. The substantive portion of revision relates to labor force projections, although the underlying conclusions of the report remain unchanged.

With increasing national attention given to the growth of high technology industries, it is possible to overestimate their present influence on the economy and the rapidity with which their penetration will occur, particularly during the current recession. Although high technology industry is currently the fastest growing sector of the economy, it does not yet dominate the labor force. Advances in communications and information processing, however, are restructuring both traditional and emerging industries. This restructuring is inevitable but because of limiting factors -- including the speed of education systems to adjust -- sporadic upswings may accompany economic growth. It is our conviction that improving the education of our nation's youth, the future workers of tomorrow, will facilitate a smooth transition from an industrial to an information society.

EXECUTIVE SUMMARY

The United States has entered the age of rapid information transmission. Breakthroughs in electronics and communication technology are responsible for this transformation and permit unprecedented industrial restructuring. Structural changes in the labor force characterize an expanding economy, however, and need not threaten economic stability. Thus by examining the skills needed in tomorrow's labor force we can better prepare workers for the changing conditions they will encounter.

Other factors significantly related to economic growth are advances in new knowledge and increased education levels of the work force. Occupational growth throughout the 1980s is projected to expand most rapidly in the higher-skilled, technical occupations. Tomorrow's workers will likely need improved skills in the selection and communication of information. Many of today's skills considered to be of a "higher" level are the potential basic skills of tomorrow. Attention given only to the minimum competencies as currently defined shows a lack of foresight and leaves many

students without adequate preparation for future learning and employability.

The National Assessment of Educational Progress (NAEP) surveys the knowledge, skills and attitudes of the nation's 17-year-old students. Survey results indicate that today's minimum skills are demonstrated successfully by a majority of students. Higher order skills, however, are achieved only by a minority of 17-year-olds, and this proportion declined over the past decade. If this trend continues, as many as two million students may graduate in 1990 without the skills necessary for employment in tomorrow's market-place.

Many efforts are already underway to promote higher standards of educational achievement. Future actions must include long-range planning in the following areas:

- An increased awareness of the contribution of human resources to economic productivity
- An understanding of the diverse needs of tomorrow's students and of workers displaced by technological changes
- Improved education/industry partnerships to maintain relevant goals in education
- Re-evaluation processes of essential employment skills
- Improved curricula that incorporate future requirements and the instruction of higher order skills

INTRODUCTION

Recent advances in electronics and communications have exponentially expanded our technical knowledge. The age of rapid information transmission or, The Information Society, may radically alter traditional approaches to economic expansion. Tomorrow's jobs will require new skills as technological devices are applied to traditional production methods.

This report upholds the view that investments in human resources can contribute positively to economic growth. Although technological advances respond to existing manufacturing and communication challenges, education and retraining dilemmas accompany them. The preparation of today's youth, as the future workers of our country, concerns many educators and legislators. Skills such as analysis and synthesis become increasingly important when information multiplies. The education students receive today will have long-lasting impacts on future economic conditions.

Inattention to the education of tomorrow's workers has serious social and economic consequences. For example, high unemployment is devastating to the economic security of any industrialized nation. Critical problems are associated with rising unemployment: decaying cities lose their populations; income tax revenues are lost; welfare costs and violent crimes increase; health and housing problems increase; and an increased proportion of workers become discouraged.

High unemployment in one sector of the labor force and a demand for workers in another frequently accompany breakthroughs in technical knowledge. Today's rising unemployment rate of blue collar workers -- 32 percent since December 1980 -- provides evidence of this phenomenon. At the same time, severe labor shortages exist in higher-skilled, technical occupations (Employment and Earnings, January 1981 and July 1982).

Although the unemployment rate is expected to decrease by 1990, scores of workers will not be able to return to the jobs they previously held. Between 1949-1965, 8,000 types of jobs disappeared from America's labor market, largely due to automation. At the same time, more than 6,000 new job types appeared (Dede, 1981). In a technically oriented society, unemployment is largely the consequence of a lack of education and skills rather than a shortage of job opportunities.

Industries can assume some of the responsibility for retraining experienced workers to move laterally within their firms. They will not, however, assume full responsibility for all unemployment problems, particularly for workers whose basic educational backgrounds are insufficient (Dede, 1981).

What types of skills will be required by tomorrow's labor entrants? A typical job description in 1990 will likely include many tasks such as these:

- Operate various computer and peripheral equipment.
- Prepare input for and execute utility programs.
- Maintain files of technical information and verify the correctness of file input.
- Monitor work flow of production systems.
- Participate in the enhancement of system and development efforts.
- Interface with other departments about possible enhancements and determine computer program errors.
- Provide technical liaison and assistance to users.
- Evaluate and maintain new software/hardware.
- Provide training in the above tasks for less experienced personnel.

This list is by no means exhaustive and not intended to represent the job level of every future employee. Tasks such as these, however, will become more widespread across all industries. Obviously the more technical the job, the more on-the-job training that will be required. But students who lack the minimum skills can expect to encounter stiff competition for employment and advancement in the labor force.

The "basics" of tomorrow are the skills considered to be of a higher level today. These skills include:

- Evaluation and analysis skills
- Critical thinking
- Problem-solving strategies (including mathematical problem-solving)
- Organization and reference skills
- Synthesis
- Application
- Creativity
- Decision-making given incomplete information
- Communication skills through a variety of modes

What do we know about the achievement of these skills by today's students? The National Assessment of Educational Progress has surveyed the knowledge, skills and attitudes of over one million students since its inception in 1969. The

National Assessment project is mandated by Congress and administered through the Education Commission of the States. Information collected by National Assessment is the only source of national survey data that describes the educational attainments of today's youth. Examining National Assessment results in combination with economic trends and future projections reveals the shortcomings of students nationwide.[1]

The remaining sections of this report describe more fully these findings, beginning with an overview of economic trends and future employment projections. The National Assessment results that follow present survey findings for 17-year-old students in the areas of reading, writing, mathematics and science. The final sections of the report explore questions raised by the data, including the problems confronting educators and some actions currently proposed. This report is a resource document intended to stimulate research and communication among the groups concerned with technology's impact on education.

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[1] While results in this report are presented at the national level for 17-year-olds in school, National Assessment also provides analyses in ten learning areas for 9- and 13-year-olds, geographic regions of the country, several racial groups (where sample sizes permit), and achievement by sex, level of parental education, and size and type of community. A publications list is available from the NAEP Distribution Center, (303) 830-3745.

HOW IS THE ECONOMY CHANGING?

Although it is impossible to predict with certainty the composition of tomorrow's labor force, examining previous economic trends reveals its dynamic structure. The increasing contribution of human capital -- the knowledge, skills and education of the labor force -- to economic growth has been examined by a number of economists. Their work provides evidence of the importance of education for economic progress. This section describes three major economic trends apparent within the United States: (1) The displacement of goods by services, (2) factors related to the growth in productivity and (3) the increase in foreign competition.

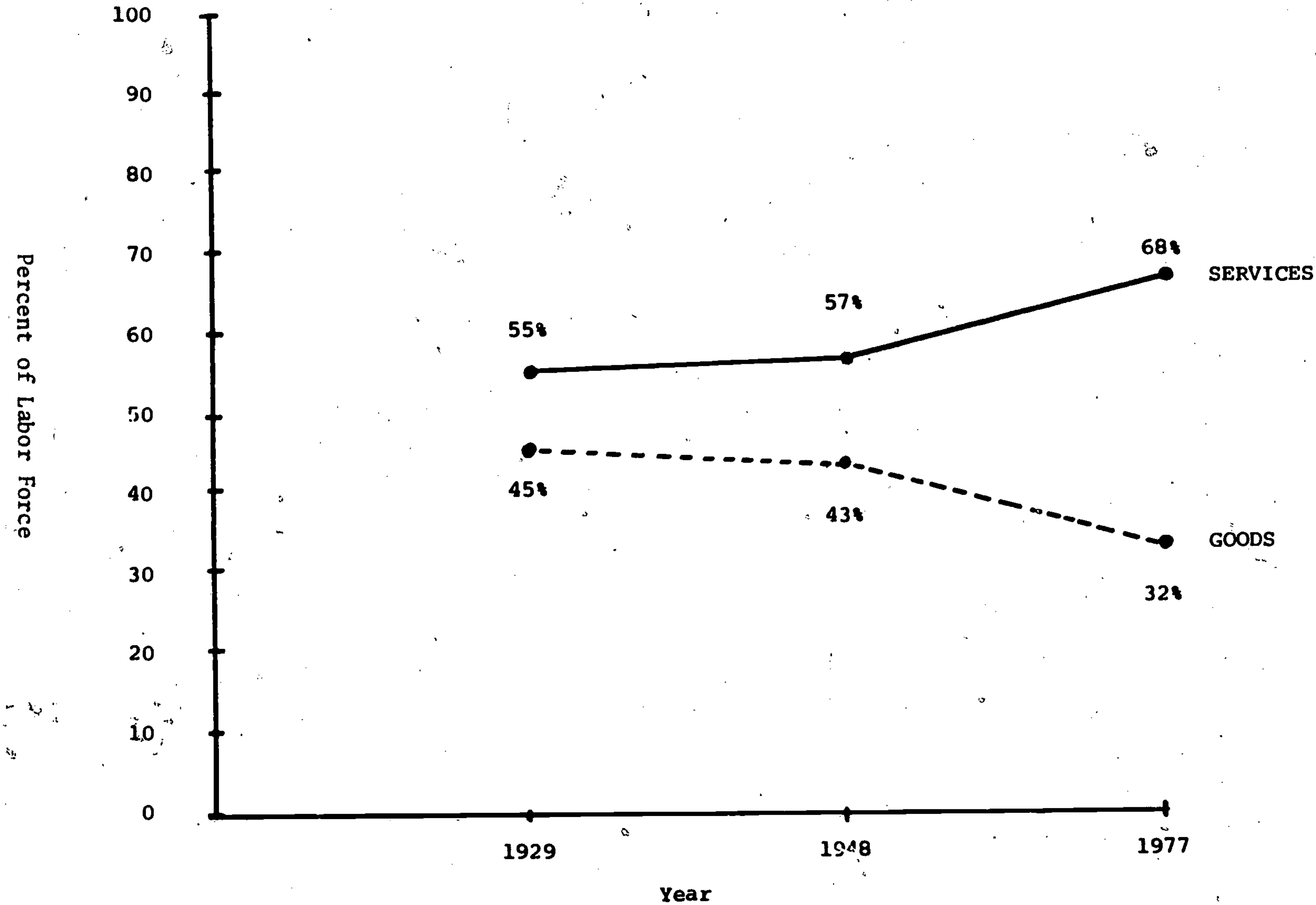
Displacement of Goods by Services

Ginzberg and Vojta (1981) provide insight into the economic transitions of the past 30 years. Four factors are responsible for the dramatic restructuring of the labor force since World War II: 1) the displacement of goods by services; 2) the increasing importance of human capital; 3) the growth of the nonprofit sector; and 4) the internationalization of the business system. The common thread in the emergence of these factors has been the increased knowledge and upgrading of labor force skills. Because discussion of each factor is beyond the scope of this paper, only the first -- the displacement of goods by services -- will be highlighted. A closer inspection of this transition provides the backdrop for the remaining three factors.

The service sector of the economy, as defined by national accounting convention, is comprised of all output that is not derived from the goods-producing sectors (agriculture, mining, manufacturing and construction).

Today it is apparent that the service sector has replaced goods production as the major economic activity of the labor force. The labor force of 1948 totalled 48.1 million workers, of which 20.9 million were in goods production and 27.2 million were in services. By 1977 the labor force increased by more than 30 million workers, totalling 79.5 million people. Of these, 25.1 million were in goods production and "54.4 million -- more than the total payroll of the 1948 economy -- in services" (Ginzberg and Vojta, p. 49). The domination of services over goods is also evidenced by the percent of the Gross National Product accounted for by each sector, with services generating three times as much revenue. Exhibit 1 shows the trend described above as percentages of the labor force.

Exhibit 1. Displacement of Goods by Services in the American Labor Force, 1929 - 1977



Source: Ginzberg and Vojta, 1981.

The different skill levels evident within the two sectors reflect the importance of this restructuring and its profound impacts. A new type of labor has emerged, with over half the increase in employment between 1959 and 1978 in the areas of higher-level professional, technical, managerial-administrative, sales and crafts occupations. In addition, the fastest growing service sectors employ more than twice as many persons with high-level skills as employed in manufacturing. The gap between the service and goods-producing sectors will continue to grow, as described in later sections of the report.

Growth in Productivity

In another study of economic growth, Edward F. Denison of the Brookings Institution examined factors related to productivity in the United States.[2] Up until 1973, productivity, measured by national income per person employed,

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[2] The numbers cited are from Edward F. Denison, Accounting for Slower Economic Growth, The Brookings Institution, 1979, and are from data "for the nonresidential business sector of the economy, nearly four-fifths of the total, because output can be measured best for that sector, but data for the whole economy tell the same story" (Denison, 1982).

continued to rise. From 1929 to 1948 productivity rose 27 percent, even though this period included the Great Depression and World War II. Then again, from 1948 to 1973, growth in productivity increased by a startling 83 percent. In the period 1973 to 1981, however, productivity decreased 1.7 percent.

Denison studied the factors responsible for economic growth up to 1973 and found that new knowledge was the factor most related to productivity gains. The next largest source of growth was the increase in the amount of education that employed persons had received. Although its influence cannot be measured, this second factor directly affects advances in knowledge.

As a result of these findings, Denison asserts that the the federal government's attempts to stimulate productivity almost exclusively through tax incentives will not suffice.

> Lagging investment is only one cause of lagging productivity, and any increase in investment that can reasonably be envisaged can go only a small way toward restoring the old growth rate. A much broader approach is needed. It should include attention to the quantity and quality of education of all types and at all levels .... The education we provide tomorrow will affect productivity far into the future ... (p. 4).

Increase in Foreign Competition

Another development affecting the U.S. economy is the recent increase in foreign competition. Our position as a technological leader and a competitor for world markets will be severely threatened if we are unable to keep pace with other countries. Unless our industries are able to modernize, increased production and future profits will suffer. Many foreign producers have already upgraded their facilities with robots or other types of computer-controlled production (Miller, 1981).

Hideaki Kumano, a director at the Ministry of International Trade and Industry (MITI), in Japan, states that his country's goal is to produce "knowledge intensive" industries. In order to accomplish this, Japan's research and development spending has increased 500 percent since 1971, with the thrust on industrial and consumer applications. In the United States, 50 percent of research and development funds are targeted for military and space research (Newsweek, 1982).

Part of Japan's success has rested on its investment in intelligence and human minds. Developments in software are limited only by human factors and the Japanese have long held a permanent and collective quest for knowledge. In consortium with industrial investors, the Japanese government will inject about $70 billion into the computer industry during 1975 to 1985. Half of this figure is targeted for computer training and teaching (or about $3 billion per year) (Servan-Schreiber, 1980).

It is charged that the United States is at least ten years behind in its industrial revitalization attempts (Servan-Schreiber, 1980). Our economic development and industrial growth have depended on energy-consuming products of which the automobile industry is a now-famous example. At the time when OPEC was formed and mapping out its strategic embargos, the United States was preoccupied with Watergate and other domestic affairs. This oversight has had disastrous effects on our economy. Now that oil is no longer cheap nor considered inexhaustible, the industrial base of the world must be restructured around another type of raw material. Servan-Schreiber designates the microchip as the material to fulfill this purpose.

> The chip will eventually replace the barrel of oil as the basis for a new kind of information society .... In the 1980s, everything will depend on moving away from energy-intensive industries, such as steel, toward energy-efficient industries based on combining scientific computers and data processing .... These new technologies must be applied to accelerated programs in education and medicine .... No industrialized country will survive the upheaval unless it makes use of this technological revolution to create the jobs of the future (pp. 137-142).

Although Japanese industries were virtually wiped out following World War II and their oil-dependence has been greater than that of the United States, in spite of OPEC they have consistently increased their productivity and gained the world's markets because of their foresight in adhering to the above ideology. Other countries are beginning to follow Japan's example, notably Germany and France, who are contributing their own advancements to the exploding computer markets. The United States cannot ignore these global events any longer because its economic survival depends on successfully competing for world markets.

WHAT CAN WE EXPECT IN TOMORROW'S LABOR FORCE?

How will the composition of tomorrow's labor force differ from today's? Consider this description from Business Week (August 3, 1981):

> The rapidly developing drive toward the workerless factory -- and the automated but still populated office -- will affect American jobs and jobholders on a scale unprecedented in modern times. Scholars of automation ... expect a radical restructuring of work skills and the creation of new ones at an ever-increasing rate .... Ultimately, the nation's education system will have to prepare future workers for functioning in an electronic society (p. 62).

Our country is entering a phase of innovative industrial practices and increased human productivity. The demand for new products reflects the accomplishments of the age of electronics. The Bureau of Labor Statistics predicts that the computer industry will lead all other industries in terms of output increase throughout the next decade. Not only computers, but optical equipment, radio and communication equipment, and scientific and controlling instruments are projected to be among the most rapidly growing industries throughout the 1980s (Personick, 1981).

The type and quality of skills will be crucial factors in determining the degree of one's employability. As some economists have noted,

> Many existing skills, such as traditional information handling, typing, automobile maintenance and mechanical engineering, will be a glut on the market, while numeracy, quick-wittedness, and fluency will be at a premium (Stout, 1980).

Only a few decades ago, a skill acquired at the beginning of one's career was expected to maintain its economic relevance until retirement. Now, some experts predict that the life expectancy of a skill is ten years or less.

The following projection data provide further evidence of changing labor force skills. Four areas best describe these data:

- White-/Blue-Collar Opportunities
- Robotics
- High Technology Manufacturing
- Jobs Accounting for Most New Openings

White-/Blue-Collar Opportunities

According to the Bureau of Labor Statistics' low-trend projections (generally the most conservative), the labor force of 1990 will consist of approximately 120 million workers. Labor projections indicate that the percentage of white-collar workers will continue to increase while the percentage of blue-collar workers declines. New job openings in white-collar fields are predicted to reach 12.1 million by 1990, bringing the total in these occupations up to 61 million. This is almost 51 percent of the projected 1990 labor force. On the other hand, the number of blue-collar job openings is expected to reach only 5.9 million by 1990, for a total of over 37 million. Thus, workers employed in blue-collar occupations will account for approximately 31 percent of total employment. Even within this shrinking percentage, only the skilled crafts are expected to maintain their proportion of the blue-collar ranks (Carey, 1982).

Robotics

Although robots are not yet widely incorporated within American industries, their sophistication and application continue to increase.

General Electric's Annual Report for 1981 provides a description of the factory of the future:

> The 'factory of the future' will use computer graphics for design and planning. On the factory floor, programmable controls will team with numerical controls, lasers, and industrial robots to build parts, and solid-state inspection cameras linked to computers will assure quality.
>
> Computers will link work stations, stockrooms, marketing activities, and transportation to get higher-quality products.
>
> Computer-aided engineering enables engineers to simulate product performance before prototypes are built, streamlines product development, and slashes costs.
>
> A voice-data entry system lets workers talk directly to a computer as they monitor the quality of parts.
>
> Assembly-line data are fed into a computer to aid inspectors in spotting deficiencies.

A study conducted by the Carnegie-Mellon University on the impact of robotics on the work force concluded that their eventual widespread acceptance will trigger additional changes in the composition of the work force. While there will be a large number of new job openings, the primary adjustment will come from skill shifts and dislocations.

The authors assert that today approximately 15 percent of the work force consists of production workers in manufacturing. Throughout the next 50 years this percentage is expected to dwindle to only 3 percent.

Current robots and new ones not yet conceived could perform about seven million existing factory jobs. While industrial productivity rises due to automated efficiency, many millions of workers will be displaced. Workers are less likely to be replaced by automation in service occupations, due to personal contact, than in goods-producing employment (Tomorrow's Jobs, 1981).

High Technology Manufacturing

High technology industry in the United States is currently a multi-billion dollar enterprise and includes such fields as information processing, electronics, machinery, aerospace, energy, mining, instruments and biotechnology. Spurring along the research and manufacturing of high technology products is intense national and international competition, in spite of the current economic growth obstacles.

There is no sign that computer growth has yet reached its limit. The technologies of tomorrow are potentially richer than any previous technology due to their scope, safety, speed, diversity, lower energy needs and reduction in size and costs (Stout, 1980). The "growth" industries of the future will be formed by the outgrowth of the new technologies, creating an increasingly sophisticated American industry.

The fastest growing occupations through 1990, as targeted by the Bureau of Labor Statistics, include workers such as data processing machine mechanics (148%), computer systems analysts (108%), computer operators (88%), computer programmers (74%), and aero-astronautic engineers (70%) (Personick, 1981). The California Department of Economic and Business Development predicts that "... for every job directly created by high technology industries, two will be created indirectly" (<u>High Technology and High School</u>, 1982). Between 1982 and 1990, it is projected that some 40 percent of California's new jobs will depend on growth in high technology industries.

While it is apparent that the growth in demand for high technology manufacturing is accelerating, our ability to supply the necessary resources is limited by a number of factors (Stout, 1980). These inhibiting factors may reduce the rate by which industrial change can occur, slowing down the applications of new technological knowledge. Some limiting factors include:

- the current economic recession
- changing trade union organization
- software limitations
- fear of unemployment
- institutional attitudes and practices
- reallocation of labor and other resources
- the ability of education and training systems to respond to the demand for multi-skill training

Jobs Accounting for Most New Openings

Because of the factors limiting technological growth, the fastest growing occupations are not expected to account for the majority of jobs throughout the 1980s. In the following table, the Bureau of Labor Statistics presents the occupations that will account for 50 percent of all new jobs generated during the 1980s.

Exhibit 2

THE FOLLOWING OCCUPATIONS WILL ACCOUNT FOR 50 PERCENT OF ALL NEW JOBS GENERATED DURING THE 1980'S

OCCUPATION	GROWTH IN EMPLOYMENT 1/ 1980-90 (IN THOUSANDS)
SECRETARIES	700
NURSES' AIDES AND ORDERLIES	508
JANITORS AND SEXTONS	501
SALES CLERKS	479
CASHIERS	452
NURSES, PROFESSIONAL	437
TRUCK DRIVERS	415
FOOD SERVICE WORKERS, FAST FOOD RESTAURANTS	400
GENERAL CLERKS, OFFICE	377
WAITERS AND WAITRESSES	360
ELEMENTARY SCHOOL TEACHERS	251
KITCHEN HELPERS	231
ACCOUNTANTS AND AUDITORS	221
HELPERS, TRADES	212
AUTOMOTIVE MECHANICS	206
BLUE-COLLAR WORKER SUPERVISORS	206
TYPISTS	187
LICENSED PRACTICAL NURSES	185
CARPENTERS	173
BOOKKEEPERS, HAND	167
GUARDS AND DOORKEEPERS	153
STOCK CLERKS, STOCKROOM AND WAREHOUSE	142
COMPUTER SYSTEMS ANALYSTS	139
STORE MANAGERS	139
PHYSICIANS, MEDICAL AND OSTEOPATHIC	135
MAINTENANCE REPAIRERS, GENERAL UTILITY	134
COMPUTER OPERATORS	132
CHILD CARE WORKERS, EXCEPT PRIVATE HOUSEHOLD	125
WELDERS AND FLAMECUTTERS	123
STOCK CLERKS, SALES FLOOR	120
ELECTRICAL ENGINEERS	115
COMPUTER PROGRAMMERS	112
ELECTRICIANS	109
BANK TELLERS	108
ELECTRICAL AND ELECTRONIC TECHNICIANS	107
LAWYERS	107
SALES AGENTS AND REPRESENTATIVES, REAL ESTATE	102

1/ LOW ALTERNATIVE ONLY

SOURCE: BUREAU OF LABOR STATISTICS

The occupations presented in the table cover a range of industries and do not fall exclusively within the high technology sector. Because of the enormous advantages offered by high technology products, however, it is not unreasonable to suggest that they will radically alter the skills necessary for the performance of these jobs. Many of the occupations listed in the table (secretaries, cashiers, hand bookkeepers and stock clerks, for example) have already felt the impact of word processors, computerized cash registers and inventory control equipment. As the cost of microcomputers continues to plummet while their diverse applications increase, a majority of future jobs will depend on workers with flexible skills who can adapt to the technology.

* * *

Futurists advance two scenarios of the new technology's impact on future job skills. The first, "The machine will do it all," implies that many future tasks will be simplified as machines perform the majority of complex operations. For example, as research advances the application of voice-sensitive computers, training in the use of traditional keyboards may become unnecessary. Thus the number of jobs requiring low-level skills may actually increase.

The alternative view suggests that because computers are capable of performing more efficiently and productively than their human counterparts, the availability of low-level tasks will decline. Consequently, displaced workers will require retraining to upgrade their skills. Past evidence indicates that the majority of recent job openings have occurred in higher-level, technical occcupations.

The paramount conclusion evidenced by the changes in traditional occupations, as well as by the new jobs generated in high technology industries, is that the skills required for future employment will be different from those of today. Our nation's future economic productivity and security depend on how quickly and how well we can prepare tomorrow's workers for this inevitable development.

ARE STUDENTS READY? RESULTS FROM NATIONAL ASSESSMENT

The "basics" of tomorrow will be different from those of today. Although literacy alone is not an assurance of employment, education levels are positively correlated with work force participation. For example, in 1979 greater proportions of high school graduates than school dropouts were labor force participants: 86 percent compared with 67 percent (The Condition of Education, 1981).

Because education is so vital for employment, identification of the minimum skills required for self-sufficiency in our society has become a prominent education issue. The previous decade witnessed the birth of the "back to basics" movement in our nation's schools. Agreement upon what is considered basic is not universal, however. To one group of educators, the basic skills are defined as "life" or "survival" skills, such as reading a parking ticket or filling out an income tax form. Another group of educators claim it is the schools' fundamental responsibility to acquaint our nation's youth with a diversity of knowledge in the arts, humanities and sciences, for instance, so that they will be prepared as adults to challenge any opportunity they so choose. The issues of minimum competency and functional literacy have provoked heated debates over education philosophies, levels of funding and school curricula. In 1981, 36 states had implemented Minimum Competency Testing Programs covering the basic skills of reading, writing and mathematics (Pipho, 1981).

Further confounding the issue is the fact that definitions of what is considered basic do not remain constant over time. Levels of literacy have risen in the United States throughout the past century. For example, previous definitions included a demonstrated ability to sign one's name (colonial measure) and a self-proclaimed ability to read and write (Graham, 1981).

The data base of National Assessment is particularly well-suited to describe the educational attainments of students for a broad range of literacy definitions. Not only do the assessments cover the full range of contents taught by our nation's schools, but learning areas are periodically reassessed so that improvements or declines in achievement may be measured. A single assessment includes both easy and difficult items, thus results yield information for minimum skills or for those skills considered to be of a higher level (Mead, et al., 1979; Brown, 1980). Keeping the description of tomorrow's labor force in mind, what does National Assessment data reveal about the preparation of high school students as future workers?

A comprehensive examination of the lower- and higher-level skills measured by National Assessment is presented in <u>Contributions of the National Assessment to Understanding the Problems of Literacy and Equity</u> by Rexford Brown. Following is a summary of the results from this and other National Assessment reports for both high- and low-level skills for reading, writing, mathematics and science.

Reading

Low Level

* In a 1976 study, National Assessment found that 87 percent of the nation's 17-year-olds could perform reading tasks designated as functional by the Right-to-Read program.

* In the 1971, 1975 and 1980 reading assessments, the average proportion of 17-year-olds correctly answering questions requiring literal comprehension was 72 percent. Literal comprehension involves locating or remembering the exact meaning of a word, sentence or paragraph from a reading passage. There was no change in literal comprehension throughout the 1970s at the national level.

High Level

* Although 17-year-olds' lower-level reading skills do not appear to be declining, the higher-level literacy skills <u>are</u>. Between 1971 and 1980 the average performance level for inferential reading skills dropped from 64 percent to 62 percent. Inferential comprehension requires "gleaning from a passage some idea that is not explicitly stated." Readers must use

"the explicit information along with their personal experiences and thinking abilities to make predictions, form generalizations, reach conclusions, make comparisons, form judgments and create new ideas.[3]

* In a special report entitled Reading, Thinking and Writing (1981), results are presented for students' written responses to selected reading and literature items. The selections chosen allowed assessment of relatively complex interpretive and analytic skills. Students were requested to provide evaluative judgments and extended discussions of the text material. For two of the analytic tasks, the results indicate that only 5 to 10 percent of the students showed strong analytic skills. Another 35 to 50 percent showed some uneven evidence of looking at a text analytically, though they might not do so with any detail. About 10 to 15 percent showed no evidence of being able to do the analytic tasks at all (p. 16).

* To measure change in students' analytic skills since 1971, one item was administered to over 2500 students in both 1971 and 1980. Students were requested to substantiate their claims about the mood of the passage

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3 Three National Assessments of Reading, 1981.

by turning back to the text for evidence. A drastic 10 percent decline was noted for 17-year-olds' ability to provide adequate analyses. In 1971, 51 percent of the students wrote adequate analyses, while in 1980, only 41 percent were able to do so (Reading, Thinking and Writing, p. 23).

* A sample inferential comprehension exercise is shown in the Appendix. For this exercise, students were asked to identify the main purpose of an editorial entitled "Competition is Healthy," a persuasive article regarding the need for advertising professional fees and services. A successful response to this question required the reader to identify the writer's intent, which is to encourage people to see this need. The average percent correct for 17-year-olds on this item was 31 percent.

Writing

Low Level

* If lower-level skills require minimal ability to write complete sentences and paragraphs with few mechanical errors, then about 75 percent of teenagers appeared to be able to do so in 1980. From 10 to 25 percent of the students have very serious problems with written English, and this proportion has neither increased nor decreased throughout the past decade.
* Results for elementary rhetorical skills (e.g., narrative) and coherence are high. Over 90 percent of the students wrote at least marginally acceptable narratives and 86 percent of their narratives displayed coherence in 1980.
* Only 47 percent of the 17-year-olds in 1979 wrote a letter judged to be successful at straightening out a billing error. This percentage has not changed from 1974.

High Level

* Persuasive writing typically involves logic, analysis and other complex skills. In the 1974 assessment of writing, only 21 percent of the 17-year-olds were judged to be competent or better (rating of 3 or 4 on a

4-point scale) on a persuasive writing task. The 1979 writing assessment provided evidence that these skills are declining, with only 15 percent of the students receiving competent or better ratings. This is a statistically significant decline of 6 percentage points. The persuasive exercise for which these results were obtained is presented in the Appendix.

* The primary trait scoring system is used by National Assessment for essay evaluation. Rating written responses for primary traits involves examining the responses in terms of their effectiveness and whether they accomplish their intended purpose. Writing tasks are designed to measure several different types of writing including explanatory, expressive and persuasive writing abilities. The percentages judged as competent or better show a large variation across the different tasks, ranging from 15 to 75 percent. This suggests that a good many students are unable to write for different purposes and audiences. They do not possess flexible writing skills that can be varied as situations dictate (Brown, 1980).

Mathematics

Low Level

* In a 1975 report, NAEP established that well over 90 percent of the 17-year-olds could perform simple addition and 85 to 90 percent could perform simple subtraction. Between 80 percent and 90 percent could multiply and divide. Computations using decimals, fractions and integers were more difficult, but percentages were still high.
* Lower level mathematics skills are neither advancing nor losing ground.

High Level

* One of the mathematics' objectives is the assessment of mathematical understanding. Understanding implies a higher level cognitive process than recalling facts or using skills and requires translation between symbols and words (Changes in Mathematical Achievement, 1979). The second national assessment of mathematics conducted in 1977-78 indicated a 4 percent decline in mathematical understanding. The average percent correct for these items was 62 percent in 1973 and 58 percent in 1978. Students appear to lack an understanding of the

concepts underlying mathematics and have difficulty translating and interpreting mathematical knowledge.

* Mathematical application involves the use of mathematical knowledge, skills and understanding to solve problems. It requires judgment -- the ability to determine which facts, algorithms or understandings are relevant -- as well as the ability to apply the needed processes. In 1973 the average performance on mathematics applications items for 17-year-olds was only 33 percent. This percent also declined by 4 percentage points when items were reassessed in 1978, to 29 percent. Most respondents demonstrated a lack of even the most basic problem-solving skills. Students did not think through problems but rather applied a single arithmetic operation to the numbers in the problems. Clearly, problem solving is the one area that demands urgent attention (Carpenter, 1980).

* Multistep math problems require more than one operation for their solution. A sample multistep exercise is shown in the Appendix. For this problem, students were asked to calculate the installment payment of a loan. Although the calculations are relatively simple, four computations are required to obtain the correct

response. Success on this item averaged 33 percent. This percentage is about the same as the mean percentage over 30 multistep word problems, which was 35 percent. Thus in the 1978 mathematics assessment, approximately 65 percent of the 17-year-olds did not correctly solve the multistep word problems.

Science

The 1977 national assessment of science revealed that only 46 percent of the 17-year-olds responded correctly to all science exercises. This was a two-percent decline from the average percent correct for items given in both 1977 and 1973. Additionally, for items administered in both 1973 and 1969, a three-percent decline was noted. The trend revealed by these percentages is that national science performance for 17-year-old students is steadily declining. Another way of looking at these data is that in 1977 over half of the national 17-year-old population did not respond correctly, on the average, to National Assessment science exercises. Thus, a majority of our country's 17-year-olds do not perform acceptably on exercises considered to measure scientific literacy.[4]

To examine the science exercises in terms of lower- and higher-level skills, it is useful to employ Bloom's cognitive ability classifications.[5] The four categories from lowest to highest are: knowledge, comprehension, appli-

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[4] See Science Objectives for the Third Assessment, National Assessment of Educational Progress, 1979, ISBN 0-89398-293-8, for a complete review of National Assessment objective and exercise development.

[5] Benjamin Bloom, ed., Taxonomy of Educational Objectives, The Classification of Educational Goals; Handbook 1, The Cognitive Domain, 1956.

cation, and (combined) analysis, synthesis and evaluation. The results of lower- and higher-level science skills are described below.

Low Level

* A slight decline for lower-level science skills is indicated from the assessment results. The majority of biology exercises are classified in the two lowest categories, knowledge and comprehension. In 1977, the average percent correct for all biology exercises was 52 percent. Seventeen-year-olds' performance on biology items declined by one percent between the first and second science assessments. An additional one-point decline was measured between the second and third assessments.

High Level

* The physical science exercises constitute a larger number of the higher-order classifications. The 17-year-old average percent correct in 1977 was 44 percent, although it should be noted that enrollment in these courses has declined throughout the past decade. Performance in physical science declined by three

percent between the first and second assessments of science. Results from the third assessment showed an additional two percent decline. The decline found for the higher-level science skills is at least twice that of the lower-level decline. Thus there are grounds for suspecting that the science results reflect the same decline in higher-level skills as shown by the other assessments.

* A sample science exercise from the analysis, synthesis and evaluation classification is shown in the Appendix. In this exercise students were asked to examine a table and select a statement supported by the data shown in the table. The average percent correct was 57 percent for 17-year-olds in the 1976-77 science assessment.

CONCLUSIONS AND IMPLICATIONS

To summarize the National Assessment findings, it appears that a majority of 17-year-olds across the nation have command of very basic reading, writing, computing and thinking skills. However, although percentages may be as high as 90 percent for some basic tasks, the remaining 10 percent who are unable to perform them represents hundreds of thousands of people.

In addition to a mere mastery of the basics of today, schools must teach students the understanding and application of higher level skills, the basics of tomorrow. The data from all four learning areas -- which are developed independently -- indicate that students have acquired very few skills for examining ideas. Many are capable of preliminary interpretations, but few are taught to move on to extended comprehensive and evaluative skills. The results of these national assessments provide evidence that schools currently are not fulfilling this goal. In every learning area presented here the pattern is clear: the percentage of students achieving higher order skills is declining.

Furthermore, percentages of students unable to successfully demonstrate com tence range from 38 to 85 percent, depending on the type of skill.

Achievement scores on the Scholastic Aptitude Test (SAT) support National Assessment results: both the mean mathematics and verbal scores on the SATs declined over the 18-year period from 1963 to 1980. The number of students scoring above 700 (possible 800) on the SAT mathematics test declined by 15 percent during 1967 to 1975, while the students scoring below 300 increased 38 percent (Hurd, 1982). Moreover, it has recently been advanced by several noted educators (Gilbert Austin, Roger Farr and Ralph Tyler) that the decline in SAT scores reflects a deterioration of complex, higher order skills (Madaus, 1981).

The National Science Board's Commission on Precollege Education in Mathematics, Science and Technology has defined three tasks that our education system must address:

1. Generate a sufficiently large pool of well prepared and motivated students to pursue professional careers in science and engineering;

2. Provide a range of high quality educational opportunities that are sufficiently broad and flexible to prepare a wide spectrum of students for careers in technically oriented occupations and professions; and

3. Raise the general science and technology literacy level of all students to prepare them better to live in the society of today and tomorrow, regardless of what careers they elect to pursue (National Science Board, 1982).

Available evidence indicates that we are modestly fulfilling the first task (Hurd, 1982; National Science Board, 1982), although it will be necessary to increase the <u>percentage</u> of high school students drawn into this pool as the number of high school graduates continues to decline throughout the 1980s.

It is with tasks two and three that shortcomings of the U.S. education system are particularly noticeable. Because the majority of students are from these two latter groups, education goals must address their needs as the future workers and citizens of our country. To attend primarily to the minimum competencies as they are currently defined shows a lack of foresight and leaves many students without adequate preparation for future learning and employability.

The United States stands virtually alone among the industrialized nations in expecting so little from its youth. In addition, our education system poses unique problems by its inherent commitments to diversity and local and state control. "The emphasis is more on what a student wants to know than on what is important for advancing the nation's welfare" (Hurd, 1982).

The National Center for Education Statistics predicts the number of high school graduates in 1990 to be 2,444,000.

Thus, if the decline of higher order skills is not reversed by then, as many as two million students may graduate without the skills required for employment in tomorrow's technically oriented labor force. In addition, the underdeveloped pool will expand each year as successive graduating classes enter the work place. Consequently the gap between the number of qualified workers needed and the number being produced is widening. Clearly we are not cultivating the raw materials, our future workers, vital not only for economic progress, but ultimately for economic survival.

In the United States, a difficult transition lies ahead as educational and industrial leaders shift their thinking to future economic demands. The explosion of technological applications necessitates progressive strategies for both the interim and future problems it poses.

The remainder of this paper focuses on two areas:

1. Specific elements of the problem facing our country's education system;

2. Some current actions proposed by educators, legislators and corporations to strengthen the relationship between education and technology.

WHAT ARE THE PROBLEMS CONFRONTING EDUCATORS?

1. <u>**Changing definitions and diverse needs of students.**</u> Technology used for educational purposes holds the potential to reshape instructional delivery systems. As equipment costs come down, a decentralization of learning may occur from traditional schools into homes, communities and industries. The increased use of educational devices will result in a large portion of society having access to instruction. The pool of education consumers can be expanded to include younger children, those seeking professional training, the aged, adults interested in noncredit courses -- virtually anyone desiring to further their education (Dede, 1981).

Future students of our technologically oriented society will emerge from many diverse sectors, with each having a variety of different needs. Secondary and postsecondary students planning to enter technical careers will demand more rigorous and up-to-date training within their respective fields. With technological devices pervading everyday lifestyles, students who are not planning a technical career will need an understanding of the basic principles underlying their operations. Additionally, retraining of workers displaced by automation must be assumed by public or private institutions and industries.

A concern voiced by the Council of Chief State School Officers is that a new disadvantaged class may emerge: those who do not have access to technology in their schooling. Technological equipment will be adopted first in advantaged school districts, creating a "have and have not" situation. The Education Products Information Exchange predicts a gap in computer literacy between the rich and poor districts, just as there is in traditional literacy (Heard, 1982).

2. **Education responsibilities and relevance**. Critics of education institutions are abundant, and schools are blamed for everything from high unemployment rates to the increase in violent crimes in the United States. Fortunately, there exists a large number of concerned citizens, teachers and educators who are responsive to the shortcomings of the structural design of the systems. For example, prior to the establishment of minimum competency programs, graduation requirements in some states were based on attendance measured in Carnegie units and not on the actual skills achieved by students. Minimum competency testing programs

have attempted to respond to this imbalance and establish a new validity for the high school diploma.

Current criticisms focus on the decline of higher level skills and the lack of relevance of education to the real world of work. Minimum competency programs have since gained disfavor, arousing fears that the minimums are becoming the norms. American schooling no longer lacks the basics but rather the "complexities that make for mature learning, mature citizenship or adult success" (Casteen, 1982).

Underlying this shortcoming in the schools is a public attitude that technical topics are best left to the specialists and that there is no need to educate the majority of students beyond the basic level. It is not widely recognized that a higher level of functional skills will contribute to the economic growth and prosperity of our country.

One of the alleged shortcomings in the management of education is the lack of data on individual accomplishments upon completion of schooling. Because acquiring follow-up data on students is costly, there are no means by which to measure the success of program goals. If education is to become more relevant to the world of work, it is essential to establish information feedback systems on the successes of students who have completed the required curriculum. Quality control focuses on the inputs into the system -- teachers and textbooks, for example -- and not on the outcomes. Thus, no attempt is made to incorporate long-term information into the management system's program planning. The Consortium on Education for Employment describes this failure in more detail in its report, <u>Quality Assurance in the Preparation of Youth for Work</u> (1981). The Consortium states:

> ... neither education systems, nor employment and training programs are structured to assure employers that individuals coming from systems are prepared to function effectively in the work force (p. iii).

Their recommendation emphasizes more client-centered management, focusing on the accomplishments of individuals and program goals. The basic unit of measurement for these accomplishments should relate to employment competencies.

Program planning conducted in the absence of this information encourages remedial training following graduation. This approach is counterproductive as resources are funneled into corrective programs rather than into the elimination of basic inadequacies. The future education of our nation's youth and work force for a technical society must incorporate information from many sectors: business, industry and graduates (employees), as well as educators.

3. **Curriculum and skills**. In a time when it is essential for students to gain an understanding of the concepts and applications of science and mathematics, enrollments in these courses are declining (National Science Foundation). How can participation in these classes be encouraged and, just as important, how can nonmajors obtain a working knowledge of these fields? If present science curriculum materials favor those with an aptitude or interest in scientific endeavors (also reported by NSF), what instructional materials can be provided for students not planning careers in science?

It is not enough merely to require more coursework in science and mathematics. Curricular materials must draw upon new knowledge in learning research and match abstraction levels to the majority of students.

> In U.S. secondary schools and in colleges, students enter a course in physics or chemistry and are immediately introduced for the first time to the highest levels of abstraction, without any intuitive basis or prior empirical knowledge. Thus many find these subjects hopelessly difficult and fail or drop out (Klein, 1981).

Skills that transcend traditional course delineations, such as problem solving, creativity and analysis, must also be taught. Other countries (Venezuela, Canada, United Kingdom, Australia and others) are currently focusing efforts upon the systematic teaching of "thinking" skills to their students and citzens. In fact, Venezuela has recently created a new position which carries the title of "Minister of State for the Development of Human Intelligence" (Martin, 1981). The methods employed are based on those developed by Edward de Bono, a recognized world authority on teaching thinking as a skill. Dr. de Bono charges that the greatest fallacy of education is that thinking skills are automatically bestowed on those with high IQ's, thus, there is no need for teaching them correctly (de Bono, 1980).

4. **Instructional technology**. Advancements in technology have the potential to supply:

- greater efficiency in learning
- relief of teacher shortages through computer-aided instruction
- administrative efficiency
- decentralization of learning environments into homes, communities and private industries
- higher-level instruction opportunities for disadvantaged and isolated students

Much remains to be discovered about technology's capacity for improving the learning process due, in part, to the lack of available software (Dede, 1981). Innovative attempts are being made, however, and one software producer claims that its computerized learning program "increases learning in language arts by three times" over traditional classroom teaching (Lindsay, 1981). Even if great advances are made in software throughout the forthcoming decade, many schools simply cannot afford additional expenditures, not to mention the hardware costs associated with such programs. The dilemma that confronts education is this: How can schools become increasingly responsive to demands for instructional technology when, at the same time, they are faced with cutbacks in funds? As noted by Dede, competition for tax dollars is increasing from health, energy and transportation sectors (among others), and citizens are unwilling to put more money into education (the current level stands at a little less than eight percent of the Gross National Product).

Dr. Stanley Pogrow has identified the seven most prominent barriers impeding the large-scale use of computers in schools:

- Inadequate capital resources for schools to purchase computers
- No incentives for teachers to use computers
- Lack of computer literacy among existing teachers and administrators

- Shortages of graduates with technical majors entering education

- Political resistance by teacher unions

- Lack of incentives or profit opportunities for industry to develop educational software

- Inadequate protection against software piracy

5. **Teacher shortages/training**. Education institutions are experiencing increased competition from industries for individuals with scientific or technical training. Faculty salaries have traditionally been lower than those offered by industries. Future teachers with technical skills must be provided with more incentives to remain in the teaching professions. For example, the executive director of the Scientific Manpower Commission notes that good postsecondary schools have been able to attract top-level faculty because of the opportunity to do research at the forefront of things. This is no longer true -- research now can be better done in industry (Iker, 1982).

In addition, those who remain in teaching must have access to mechanisms for further enhancing their expertise and staying on top of the state-of-the-art. To equip students for a technological society, teachers must be familiar with the new skills. Some teachers will be reluctant to upgrade their computer literacy for various reasons: they may fear revealing inadequacies in fields where they were masters, or they may believe educational technology threatens their jobs. The current incentives for teachers to use the new technology are weak. Compensation for earned professional education credits and time in-service does not promote computerized efficiency (Heard, 1982).

In the future, teachers' skills must include a familiarity with new delivery systems, which they will convey to students through more individualized instruction. If meeting social needs validates educational programs, then instruction must simulate future learning conditions.

6. **Accreditation issues.** As long-distance learning becomes possible via telecommunications that transcend state and regional boundaries, accrediting associations and states must resolve several issues. Specifically, they must modify accreditation standards and revise their application.

In a sense, long distance learning via telecommunications is an extension of the problems involved in off-campus and out-of-state operations. Considerable progress has been made in these operations both in the home institution and in the place where programs occur. The Grover Andrews study on Assessment and Nontraditional Learning has been one part of the picture, and, more recently, policy statements by regional accrediting associations are carrying this further. It should, however, be emphasized that telecommunications add a new dimension and will require special attention.

7. **Joint responsibilities and finance.** Education revenues are insufficient for fulfilling the demands made by changing populations of students, training programs and up-to-date equipment purchases. Thus industries will be sought to fill the gaps. State governments can provide more tax incentives to industries for equipment donations and staff sharing. Additional industrial functions might be:

- increased number of on-the-job training programs
- educational environments within industries
- information exchanges with local school districts to assess which skills are required
- job incentives for students who meet certain industrial requirements
- summer internship programs for secondary students
- participation in determining local districts' curriculum
- benefits for employees with technical expertise to teach in schools and universities
- research and training fellowships

Industries cannot afford to pass up these opportunities and others because their future existence depends upon it.

Unions may also play a vital role in responding to the needs for training. As white-collar unions increase their membership, the masters of the new "trades" must be called upon to establish expanded apprenticeship programs. Because a union's bargaining power partially lies in its ability to produce individuals qualified in their crafts, it will be beneficial for both unions and displaced workers to band together and create solid apprenticeship programs.

WHAT'S BEING DONE?

Although this list is not exhaustive, some recent actions to remedy discrepancies between technology and education are presented below.

* Governor Edmund Brown Jr. initiated a comprehensive modernization of California's education and job training for the 1980s. The goals of the $25.7 million "Investment in People" program include:

  --the promotion of mathematics, science and computer studies in California's elementary and secondary schools;

  --the support of employee-based, high technology job training in California's community colleges;

  --an increase of output by engineers and computer scientists from California's universities; and

  --training and job assistance for displaced workers, welfare clients and youth from high unemployment areas.

* In its second year of a three-year project, the U.S. Department of Education is exploring what is currently possible in the teaching of thinking skills. The program has four major goals: (1) to provide school

and college instructors and administrators with consultant advice on the quality of existing programs; (2) to relate research to educational practice; (3) to initiate research, setting an example and a standard of quality; and (4) to identify researchers and practitioners interested in cognitive skills training. With the conviction that students need skills to learn new information easier, the final product will outline a detailed curriculum for cognitive skills training (U.S. Department of Education, 1982).

* The Bethlehem Area School District (Pennsylvania) piloted a Philosophy for Children Program during the 1979-80 school year. To address student needs for life skills in the face of societal dilemmas and technological change, the program focuses on decision making, problem solving and logical thinking, and the simulation of creative thinking. Materials for the program were developed by Dr. Matthew Lipman of the Institute for the Advancement of Philosophy for Children (IAPC), Montclair State College, New Jersey. A program evaluation by the Educational Testing Service (ETS) concluded that significant gains were made "in the students' informal and formal reasoning skills, in

their fluency and flexibility of thought and in their daily academic and social classroom behaviors" (Shipman, 1982).

* An increasing number of education leaders, including the Council of Chief State School Officers and the National Conference of State Legislatures, have become involved in the identification of education priorities for our changing economy. Governors James B. Hunt (North Carolina) and Robert D. Ray (Iowa) have played an instrumental role in improving technological literacy. A special session of the National Governors' Association 1982 Annual Meeting was devoted to "Education for a High Technology Economy."
* In a foresighted effort, the State of Vermont included reasoning skills as part of its statewide Basic Competency Program in 1974. During the past eight years the state has developed 15 reasoning competencies, teaching strategies and assessment methods. Vermont's Basic Competencies in Reasoning include problem solving, classifying and organizing, making reasoned judgments and research skills (State of Vermont, 1982).
* Mississippi Governor William Winter suggested " ... using funds to raise teacher standards, improve

secondary school curriculum to require more math and physical sciences, enhance libraries and create 'centers of excellence' in specific educational programs" (O'Connor, 1982).

* In November 1981, the National Science Board of the National Science Foundation (NSF) established a commission to evaluate science education in secondary schools. The commission will encourage state and local governments and private organizations to address science and technological issues. Previously stated priorities of the NSF are:

  - Support research-level education through predoctoral fellowships;
  - Monitor science and engineering education and identify national needs; and
  - Intervene in selected areas where improvement in education outcomes is possible.

  NSF proposes, additionally, to tap the underused talents of minorities and women (NSF Correspondence, 1981).

* A 10-year project began in 1981 to review college preparatory curricula in the United States. The College Board sponsors the project with financial support from the Ford Foundation. Included in the

goals of Project EQuality (with both the E and Q capitalized for emphasis on quality and equality) are the redefinition of academic competencies taught in high school and the development of a core curriculum that students should master before entering college.

Six major areas are targeted for rigorous programs: reading, writing, speaking and listening, mathematics, reasoning and studying. Each area includes the acquisition of some complex skills as well as the traditional basics.

The College Board also proposes to "keep up with the accelerating change in the uses of technology that are affecting business ..." and plans to "involve representatives of business, industry, labor, government, and the military in dialogues about the basic academic competencies ..." (Annual Report, 1980-81).

* In 1981 the College Board began a three-year comprehensive education improvement project, "Options for Excellence," in Bexar County (Greater San Antonio), Texas. The identification and education of future professional leaders for the nation's academic, political and social institutions comprise the major efforts of the project. One of its goals is the

improvement of college preparatory curricula in public and private secondary schools.

* The Southern Regional Education Board (SREB) has proclaimed the "substantial improvement of academic standards above minimal expectations" as one of its goals for the 1980s. In a report entitled "The Need for Quality," SREB's Task Force on Higher Education and the Schools provides 25 recommendations for improving teacher education, curriculum, vocational state and local cooperation and presents financial implications for the recommendations. While some of the recommendations are based on the South's experience, they are generalizable to all regions of the country. The overall concerns are to challenge all students to attain higher levels of achievement and to reduce the need for remedial education at the collegiate level. The report addresses competencies required by an increasingly technological society:

> In a time when states are exploring the possibility for expanding high technology industry, it is essential that a work force be developed which is well-grounded, flexible and adaptable to new industry needs, rather than trained for skills already on their way to obsolescence (p. 21).

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* Exxon donated $15 million to 66 colleges and universities to supplement salaries for junior faculty members and to create teaching fellowships (<u>Sciquest</u>, 1/82).
* Westinghouse recently donated $1 million to Carnegie-Mellon University (Pittsburgh) for their robotics institute (<u>Sciquest</u>, 1/82).
* General Motors, General Electric and Boeing have contributed $1 million to Rensselaer Polytechnic Institute for the construction of a productivity center (<u>Sciquest</u>, 1/82).

APPENDIX: SAMPLE EXERCISES FROM NATIONAL ASSESSMENT

Competition is healthy

Last year the Supreme Court presented doctors, lawyers, dentists, and other professionals with a right that most of them did not want — the right to advertise their services to the public. Since then the professions, especially law and dentistry, have been acrimoniously divided over the question of advertising.

Older lawyers and dentists with established practices have spurned the idea of hawking their services, as though, they say, they were selling another dog food or deodorant. But young men, trying to find a market for their services, have seized the opportunity to go to the public. Established members of the profession accuse them of misleading the public and undermining professional standards.

It is easy to sympathize with someone who has built a practice the hard way and sees it threatened by an interloper who values the hard sell above professional dignity. But the fact remains that most of the professions could benefit from an injection of old-fashioned competition. In a world where fees are never publicized and the quality of work is hard to judge, the public has no way to tell whether it is getting its money's worth.

If established practitioners think the public is being misled by irresponsible advertising, there is always a step they can take. They can advertise themselves, both individually and through professional groups. They can tell the public what they think good practice is and what it should cost. They can describe the services they perform and what qualifications they have.

If some professionals abuse the privilege of advertising, there are plenty of laws on the books to bring them into line. But it is time for established practitioners to realize that the public needs to know more than a little bronze plate on the door can tell it.

What is the main purpose of the editorial?

- To explain the new law which allows advertising by professionals
- To show the problems younger lawyers, dentists, and doctors have getting started
- To encourage people to see the need for advertising professional fees and services
- To warn people about the dangers of advertising by professionals
- I don't know.

STOP DO NOT CONTINUE UNTIL TOLD TO DO SO.

MATHEMATICS EXERCISE

Jerry bought an old Ford for $900.00. He paid $200.00 down and borrowed the rest. The total finance charge was 10% of the loan. He paid off the loan and finance charge in 10 equal installments. How much was each installment?

ANSWER ________________

WRITING EXERCISE

Some high school students have proposed converting an old house into a recreation center where young people might drop in evenings for talk and relaxation. Some local residents oppose the plan on the grounds that the center would depress property values in the neighborhood and attract undesirable types. A public hearing has been called. Write a brief speech that you would make supporting or opposing the plan. Remember to take only ONE point of view. Organize your arguments carefully and be as convincing as possible. Space is provided below and on the next three pages.

IF YOU NEED MORE SPACE, CONTINUE ON THE NEXT PAGE.

SCIENCE EXERCISE

Distance from equator	Highest altitude at which trees can grow
500 miles	12,500 feet
1500 miles	11,500 feet
3000 miles	9,500 feet
4000 miles	4,000 feet

Only one of the following statements is supported by the data shown in the table above. Which one is it?

- [x] The farther you are from the equator, the lower the altitude at which trees can grow.
- [ ] The farther you are from the equator, the higher the altitude at which trees can grow.
- [ ] The farther you are from the equator, the taller the trees are.
- [ ] The farther you are from the equator, the smaller the trees are.

- [ ] I don't know.

Correct Response, Percent Correct and Level of Classification for Selected National Assessment Items

	Correct Response	Percent Correct 17-Year-Olds In-School
Reading Exercise Level: Inferential comprehension	Foil 3	30.8%
Writing Exercise Level: Persuasion	See table on following page	
Math Exercise Level: Multistep word problem	$77.00	32.8
Science Exercise Level: Process of inquiry, interpretation of data.	Foil 1	56.6

SCORING CATEGORIES FOR WRITING EXERCISE

Percentages of 17-Year-Olds at Each Primary Trait Score Level, "Rec Center" Exercise 1974, 1979†

Year	Score Point: Non-rate-able 0	Not Persuasive 1	Minimally Persuasive 2	Persuasive 3	Fully Persuasive 4	Marginal or Better 2, 3 & 4	Competent or Better 3 & 4
1974 (n = 2,308)	2.7%	19.3%	56.6%	20.4%	1.0%	78.0%	21.4%
1979 (n = 2,784)	2.1	25.2	57.5	14.5	0.6	72.7	15.2
Change 1974-79	-0.5	5.8*	0.9	-5.9*	-0.3	-5.3*	-6.2*

*Statistically significant at the .05 level.
†Percentages may not total due to rounding error.

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