“learning technology: the opportunity and responsibility”

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INTRODUCTION

I would like to speak to you today about two of the most complex and enduring forms of human endeavor. Each sustains our well-being. Each possesses vast potential. I'm talking about education and technology.

Considered together, they give rise to a crucial question: Why have so many sectors of human activity been willing to transform themselves by harnessing technology, while our K-12 system allows itself to be frozen in time?

If we care about the educational experience of our young people—and I know that each of us cares passionately—we need to answer this question. We owe this to ourselves as champions of education and to our children: It is a debt *they* cannot collect. The responsibility is entirely—and urgently—ours.

The program that brings us together today is a celebration. But we created the Milken Family Foundation National Educator Awards to take that celebration another step—to use major recognition to elevate the profession and to further activate the people who bring that profession to life.

It is a goal that brings to mind Oliver Wendell Holmes's observation that "The reward of the general is not a bigger tent, but command." The reward for great leadership, in other words, is more leadership. And the reward for excellence in education is more responsibility.

The 1,170 outstanding educators who have received this Award, as well as the many others they represent, demonstrate the potential for American education to act responsibly by taking the initiative to anticipate and respond to students' needs. But what no initiative can give us is time. And time is running out.

Why? First, because youngsters are not young for long. The light of opportunity for educating them rigorously and effectively shines all too briefly. And second, because of the nature of technology—particularly, information and communications technology. It is evolving and supplanting itself at a speed unprecedented in human history. And its implications for education are enormous.

Those of you who have attended past Conferences know that these opening presentations have analyzed a wide range of subjects affecting young people and their education. Technology has been a thread running through the last four of these discussions, underscoring the extent to which it has impacted society.

Four years ago, for instance, we analyzed technology as a stimulus to developing human capital. We discussed how, in such critical human endeavors as medicine, business and communications—though sadly, not in education—technology had brought us to the brink of fundamental and sweeping change.

Today, we are in the throes of that change.

In just four years, information and communications technology has moved stealth-like into virtually every aspect of our lives, driving the way we create wealth; conduct commerce; cure, protect and entertain ourselves; and communicate with and influence others. In short, it is transforming the way we live, work, learn and view the world, and it is doing so at a pace that collapses both time and distance.

To illustrate, consider that in just these past four years, the Internet has become part of the daily lives of 50 million Americans—*50 million.*[1] It took radio 38 years to attain that reach.[2] And the revolution is only beginning, especially the education of our young people, and by this I mean not only the acquisition of academic skills that hopefully occurs in the classroom, but also the development of character, morals, tastes, and capacities that generally occurs outside it.

And we cannot stop the revolution. Sure, we can shut off the computer, unplug the TV, power down the cell phone. But let's face it: there is really no escaping it. Not only because the genie is out of the bottle, but also because we do not want to escape it; technology satisfies what one observer calls "the voracious human appetite for freedom and connection."[3] Clearly, people thrive on what this kind of technology provides. We need to be connected to people and ideas, and we want to feel that we are making these connections freely.

But, to repeat, the presence of technology in our lives—permanent as it is pervasive—remains wrapped in a question when it comes to education: Why have we been so reluctant to harness technology to improve K-12 education?

As we weigh our responsibilities and choices, it is important to look at the history of information and communications innovations. Even when the pace of change was slower and people had more time to adapt and seek ways to make it work *for* them, technology had its consequences—some foreseeable, some imaginable, some very difficult, indeed, to manage.

It is also instructive to gauge the *extent* of this technology's impact on various sectors, for in many cases it has been nothing short of transformative. It can have that kind of impact on education, too. And because education is so sorely in need of it, we have a responsibility to carefully and thoughtfully make the most of technology's potential in our classrooms.

For it is our experience and belief that technology—properly managed and applied—provides the opportunity to restore rigor to children's learning, to rebuild public confidence in American education, and to help ensure that the equality of opportunity in which we pride ourselves as a nation has meaning. To pass up this opportunity amounts to a collective failure of responsibility to our youth.

A HISTORICAL VIEW

First, a look at history. If necessity is the mother of invention, unintended consequences are its rowdy offspring.

This has been true since the Chinese pounded linen into pulp to make paper in the first century—and unwittingly provided a mass means for disseminating and storing knowledge. It was true, too, *a thousand years later* when a Benedictine monk created a mechanical clock to regulate the hours of prayer and paved the way for the regulation of industrial production. True, as well, *four centuries after that*, when a German goldsmith named Gutenberg invented movable type and inadvertently transformed the Word of God into the words of God,[4] and launched the world's main vehicle of communication and discovery.

And, still *another four centuries later*, it was true again, with the early 19th-century creation of the battery, which cleared the path for electricity. It would be decades, of course, before electricity began to transform lives by means of Edison's incandescent light. Crucial inventions such as the motor and the transformer first had to pave the way. And once they did electricity would make possible the first telecommunications breakthrough—the telegraph—which erased geographic boundaries, transformed financial markets, and came to wrap the continent in an information grid.[5]

The 1890s, like our own decade, was a turning point. It was a time of rapid technical innovation and unprecedented economic integration leading to a global boom. In 1900, the Paris Exhibition ushered in the new century by heralding a future in which work and leisure would be transformed—just as the Exhibition's Palace of Electricity was transformed at night by this amazing source of new light.[6]

But for most people, the reality of daily life was still limited. Lamp-lit nights meant that work was still largely confined to the day, horses congested city streets and news mostly traveled no faster than a train.

My sense of this comes not just from studying history, but more importantly from experiencing it through my mother's father, Louis Zax. My grandfather was a

master at anything he put his hand—or his mind—to. Whether it was teaching himself to play the violin, building a house or studying the fast changing world around him, he applied to it acute intelligence and unerring common sense. In understanding the past, I was blessed to have the best guide a person could hope for.

Louis Zax was born in Chicago in 1898, the son of immigrants who had come to the United States in the mid-1870s. He was 12 when his father died, and to support his mother and four siblings, he quit school. The profound disappointment of having to end his schooling, combined with his determination to succeed, made education one of his life's passions. With few of today's conveniences, people of that era did a lot of waiting. Patience was not just a virtue, it was a necessity that helped develop in my grandfather a subtle understanding of the world around him, a reflective turn of mind and the habit of putting his thoughts on paper. What then would my grandfather have written when he was twenty?

> **Michigan City, Indiana, November 19, 1918:** *This morning, following doctor's orders, Eva and I traveled by automobile to the cabin. We are escaping the influenza epidemic which already has claimed millions of lives around the world.*
>
> *Chicago health authorities have imposed strict quarantine measures, but for many people, it's too late. With so many dying, there's a shortage of caskets. Scientists have failed to make progress in finding a way to immunize us as they did with typhoid and tetanus. We have no choice but to isolate ourselves in this cabin and who knows for how long.*
>
> *It's a far cry from the excitement of our wedding just four months ago, which let loose a flurry of congratulatory telegrams. Till then, the only telegrams I'd ever received concerned business. We even had a long-distance congratulations call on the telephone we lease for our office.*
>
> *Peaceful as it is up here, I will miss the radio. Without my crystal radio set, I feel even more cut off from the outside world—no daily news, reports from Europe or music. Radio has such endless possibilities to inform, but still unrealized, for now, is all the early talk about using it to school people at home.*

The 1918 pandemic that my grandfather mentions was the most devastating in modern history, killing nearly *40 million* people—including almost 700,000 Americans.[7] Medical science was just not its equal, though in 1901 it *might* have saved President McKinley's life if the doctors operating to remove the assassin's bullets from his abdomen had used the new x-ray machine delivered by a concerned Thomas Edison. But they were too set in their ways even to try. The President died from infection eight days later.

By 1918, the technological advances my grandfather was observing were still coming at a manageable pace and in forms that seemed familiar and welcome. Though the car was already in a design recognizable today, it had not yet begun to transform society. Same with the telephone: Though popular, its use was mainly commercial.

But the impact of radio was more immediate, stirring hopes that in addition to informing and entertaining, it would also educate. My grandfather once described it as a "people's university," in which one teacher could instruct hundreds of students at a time. He appreciated what this could mean for the eight out of ten Americans who, like him, hadn't been able to complete their education—though he did go on to earn his diploma at night school. By the early 1920s, a handful of broadcasting companies had established systems immune to competition, and the promise of radio as a medium devoted to the public interest disappeared.[8] Of course, over the years, radio *would* change America, but not in the ways first envisioned.

In November 1948, I was born, and that next winter my grandfather, then 50 and retired, came to visit from Chicago:

> **Los Angeles, California, February 12, 1949:** *I arrived at Ferne's earlier this week, traveling, as usual, by train. Things are pretty lively here. When Ferne got home from the hospital with the new baby, Bernie surprised her with one of those new television sets. What a marvel! Information from the newspapers, personalities from radio, the thrills of the cinema, the music of the phonograph—all packed into one little box sitting in the living room.*
>
> *I hear they're even talking about using this television gadget for education. It'd be great, all right. But my guess is it'll never happen. Advertising and human nature being what they are, I'll bet entertainment will prevail.*

In 1946, 6,000 American homes had TV sets,[9] and broadcasters had sound and good intentions. But as Edward R. Murrow warned as early as the mid-'50s, television "can teach, it can illustrate, it can even inspire, but only to the extent that humans are determined to use it to those ends."[10]

By the time I graduated from elementary school in 1960, 90 percent of American households had televisions.[11] Commercial broadcasting had long since hit its stride and American television was indeed changing American life. In those years, television contributed to such crucial developments as the civil rights movement, serving as its mobilizer and messenger,[12] and chronicled and amplified the protests over Vietnam. It also allowed Baby Boomers like me to witness such memorable events as Larsen's perfect game in the '56 World Series.

But it also gave rise to unbridled consumerism and a menu of entertainment—for adults *and* children—that ranged from the basically inane to the completely unacceptable. And since television hides nothing, it was children who paid most dearly for the exposure. What the printed word accomplished over the course of centuries by establishing the notion that children have rights and deserve protection, TV would obliterate in a decade.[13] For then as now, television exposes children to adult experiences and knowledge that, of course, only increases its authority and luster—especially in the minds of the young.

Nor, as my grandfather predicted, did television do much for education. Instructional television introduced in schools in the 1950s and '60s failed to deliver, primarily because the implementation was top-down, and gave teachers little say in how it would be integrated into classroom instruction.

As prescient as my grandfather was about television, he could not have foreseen the impact of another innovation at the time: the transistor. In the 1940s, few Americans knew that the government was hurriedly developing computational devices for use in flight simulators and digital machines for air defense, or the innovations it would generate—from magnetic core memory, to video displays, to computer networks—would give rise to the digital age.

By 1994, my grandfather, retired for a second time, was living in Los Angeles in a condominium whose appliances had more computing power than NASA did the day Neil Armstrong stepped on the moon. He was well into his nineties, still playing golf, dabbling in the financial markets, and reflecting on the wonders of the world around him:

> **Los Angeles, California, April 25, 1994:** *At 96, I can say that in some areas I actually have been ahead of my time. Since the '40s, for crying out loud, I have been using a movie camera to film my golf swing—not that different from what I do now, using my miniature video camera and watching myself in slow motion the minute I'm done filming. Why didn't I market my idea a long time ago?*
>
> *That's a little like asking why I once traveled by train from Chicago to New York just to get a supplier's signature, when today a fax machine would do the job.*
>
> *Of course, my great-grandchildren can't imagine a world without all this technology. Why, they even use calculators in math class now. Thinking back, it seems I hardly even used the adding machine in our Chicago offices. I did the computations in my head, learning not just the concept of mathematics, but also the craft.*
>
> *It also amazes me how the kids get all their information on computer. Yet for all the speed and ease, I sometimes wonder if they're not more focused on finding the information than on understanding it.*
>
> *In fact, Lowell addressed this in his talk the other day at the Foundation's National Education Conference when he was explaining how information technology was changing the way we do and think about almost everything. These kinds of changes can create daunting challenges, but after watching them unfold for the better part of 96 years, I am convinced there is greater risk in not adapting to change.*

Six months after that 1994 Conference, my grandfather passed away. His passing not only removed a vast source of insight, humor and kindness from our lives; it ended an era for us. But, two months later a new era began when our fourth son was born. Our son will always be a living connection to my grandfather and provide a vital new bridge to the future.

My grandfather was born in a day when life was lived and ideas were considered at a manageable pace. Our youngest son has been born into an era of information frenzy; an era when as my friend Rabbi David Wolpe has put it "even the daily newspaper arrives with the faint odor of obsolescence."[14] The pace of change is overwhelming—creating enormous pressures and demands on individuals and institutions. But these challenges *can* be met, if we are informed and prepared to confront them. And when we are, the opportunities for using technology for positive purposes are immense.

HARNESSING TECHNOLOGY FOR POSITIVE PURPOSES

The imaginative use of information and communications technology by sectors as diverse as business and medicine can serve as an example to the education profession.

Let's begin by considering its impact on business and the economy.

The Internet: From having 18 million users worldwide in early 1994, the Internet has exploded to more than 100 million users worldwide today[15]—and Internet traffic is doubling every hundred days.[16] The Internet has penetrated 25 percent of the market in just seven years—faster than the telephone, which took 35 years; television, which took 26 years; and the personal computer, which took 16.[17]

Computer Use: Just a decade ago, only one out of four Americans used a computer in his or her work.[18] Today, one out of two does.[19] This is reflected in the astounding jump in business computer purchases, from nearly $23 billion in 1988 to nearly $300 billion today.[20] That increase has fueled the growth of companies that only a decade ago were not known to most Americans. Yet today, Microsoft, Intel, Compaq, Dell and Cisco are all household names and have seen their aggregate market value increase from $10 billion to over $550 billion in just ten years.[21]

Telecommuting: It is estimated that at least seven million people are now working productively in virtual environments, both at home and on the road.[22] They are logging on rather than driving in, changing forever the way businesses think of the traditional office. As Peter Drucker has put it, "What is the point of spending huge sums to bring a 200-pound body downtown when all you want of it is its eight-and-a-half pound brain?"[23]

Allocation of Resources: Convinced that information technology yields high returns, businesses are changing the way they allocate resources—from just seven percent of total capital equipment spending on information technology in 1970 to almost 50 percent today.[24]

This transformation did not happen overnight. Like education, business faced massive challenges during the last quarter century, and it had been slow to embrace systemic reform. Yet industry leaders came to understand that to survive in the competitive world market, they had a responsibility to change—top to bottom—the way they did business. In undertaking the responsibility to reform itself, business seized upon the powerful tool of information and communications technology to propel necessary changes.

All this is having more than just a ripple effect on the U.S. economy; it is causing a tidal wave of growth that since the 1990-91 recession is running four times the pace of the overall economy.[25] In the last four years, information technology—which makes up only ten percent of total gross domestic product—accounted for a staggering 37 percent[26] of economic growth. Not since the automobile has a single industry so dramatically driven the U.S. economy: Where 25 years ago, information processing contributed 65 percent less than automobile production to industrial output, today it provides 30 percent more[27] and it practically drives the cars themselves with at least five or six microprocessors and microcontrollers that operate everything from the engine to the cassette deck.

Information technology innovations are also helping to drive down inflation. IT equipment prices have dropped by an average of 8 percent over the past three years, helping drive down the overall U.S. inflation rate below 2 percent.[28] Following Intel founder Gordon Moore's prediction in 1965 that microprocessor density will double every eighteen months,[29] microprocessor prices, for example, have fallen from $1,533 in 1985[30] to just $3.42 last year.[31] To put this in perspective, if "Moore's Law" were applied to the automobile beginning in 1985, today's cars would travel at a top speed of more than 20,000 miles per hour, get nearly 850,000 miles on a tank of gas, and cost $42.

Along with lowering inflation, information and communications technology is helping to reduce other business costs in industries as diverse as banking, bookselling and aerospace.

The cost of processing a check, for example, has dropped from $1.07 at a branch facility to one penny over the Internet.[32] Amazon.com has gained an edge over such established giants as Barnes & Noble, partly because of lower execution costs, quick inventory turnover and low overhead for management.[33] And at

Boeing, using the Internet to handle thousands of spare parts orders each day has not only reduced the costs of faxing, phone calls and data entry by 25 percent, it has, in the words of one senior manager, "free[d] us to concentrate on the real problems"—namely, the issues customers are concerned about.[34]

One company that was early to catch on to all of this potential was Wal-Mart. By using information and communications technology for better inventory control, Wal-Mart was able to lower costs and keep shelves adequately stocked.[35] Simply stated, this has made for happy customers, responsive suppliers and such market dominance that, where ten years ago it was roughly equivalent to rival K-Mart, today it has a stock market value of more than $128 billion—more than 13 times the value of K-Mart.[36]

Information and communications technology is also helping to open up new international trade opportunities, to drive consolidations, to spur regional growth and to create jobs, for properly skilled workers, that is.

Even Federal Reserve Board Chairman Alan Greenspan—whose pronouncements are generally shielded by multiple qualifiers—reported in recent testimony before Congress that, "The dramatic improvements in computing power and communications and information technology appear to have been a major force" behind the current trend in high economic productivity.[37] And many economists believe that we are in only the initial phase of technology's positive effects on economic growth, inflation and employment.[38]

The implications for education are vast. Businesses today demand that workers have not only superior math and reading skills, but also the ability to solve problems, to communicate effectively, to work cooperatively and to understand and use technology—all skills that should be acquired in school. When it comes to jobs, we can look to technology again. Looking ahead, technology-related occupations like computer administrators and specialists, computer engineers and systems analysts are the only ones projected to increase by more than 100 percent by the year 2006.[39]

Today's shortage of nearly 346,000 qualified IT workers,[40] has caused the IT worker's average wage to rocket to $52,000—almost double the national average.[41] The combination of rapid growth in demand for these workers, the lowest unemployment rate in 28 years, and the mismatch between the skills people have and those they need, assures that this trend will only continue.

As in business, technology has become central to the progress of medical research and health care.

As one of the Foundation's two major giving areas, medicine is a field in which we have been active for 20 years and in which we have witnessed dramatic advances thanks to technology.

Our most extensive interaction with medical research is our work at the Association for the Cure of Cancer of the Prostate—or CaP CURE—which my brother Michael founded in 1993 when he was diagnosed with advanced prostate cancer. As the largest private source of funding for this research globally, CaP CURE is changing the face of prostate cancer research worldwide. And technology has made possible much of the ground breaking work that CaP CURE supports.

Scientists supported by CaP CURE at the University of Washington, for example, use technology to map the genetic differences between cancerous and healthy cells—allowing them to sequence more base pairs of DNA in a day than a scientist used to do manually in a year.[42] Sophisticated database systems are helping to track and accelerate clinical trials around the country by allowing scientists to instantly access, compare and analyze the most current findings in prostate cancer research and therapies. And CaP CURE scientists are converting declassified nuclear weapon technology in order to more precisely refine and measure dosages of radiation prescribed for patients.

Our strategy has been to provide accomplished and promising researchers with the means to benefit from these advances, so that they might find inventive ways to treat, cure and, in time, prevent the most common cancer in America after skin cancer.[43] This disease is a legacy we are determined not leave the next generation.

But for all the advances in medicine, business and so many other sectors, they represent only the early stages of this revolution. Other engines will continue to drive it, for example: the increasing affordability of computers; the continuing increase in bandwidth; the advances in encryption technology; and crucial new systems that permit children Internet access only to parent- or teacher-approved sites. Each one of these will allow us to access information ever more quickly, securely and conveniently.

But there's still another revolutionary engine—this one more potent than all the others combined. It is alive. It is well. It is our children. Yes, today's Millennial Generation will be nearly as numerous and likely more thunderous than the original Boom. Its oldest members are now 16 and its youngest will be born the year of the millennium. Together they will number the nearly 75 million born during the eighteen-year Baby Boom.[44]

We know that generations are the primary agents of social change. We also know that the Baby Boom's impact on the way American society has worked, played and thought about itself since mid-century has been without precedent. And the Millennial Generation is going to shatter all these "old" ways, because more significant than its size is its culture.

The members of this generation are already so bathed in technology that it is part of their natural landscape. In fact, what is *unnatural* to them is its absence. In their eyes, institutions and people that ignore its use are less relevant and credible. As one observer noted, "For the first time in history, [young people] are more comfortable, knowledgeable and literate than their parents about an innovation central to society."[45] This makes them, indeed, a potent force for social change.

CHALLENGES WE FACE IN K-12 EDUCATION

I see this vividly in my youngest son—a card-carrying member of the Millennial Generation. The ways technology is making its mark on him literally drives its impact home because it is there, not in the classroom, that one sees it most dramatically. At age three, he is as comfortable at a computer as he is on his tricycle.

But, when my son enters the classroom, he will be inducted into a K-12 system in which teachers lecture, explain and ask factual questions and he will listen, do individual seatwork and take quizzes. In short, he will be engaged in almost the same process of learning as when I was a boy—or, for that matter, when my grandfather was a boy. Therein lies the problem. Since 1880—yes, 1880—practically nothing has changed in American classroom practice.

This is confirmed by the landmark studies of practices in nearly 3,500 classrooms by John Goodlad, Larry Cuban and other researchers, which establish that for this entire period the following characteristics tend to prevail in middle and secondary classrooms and are common at all grade levels:

- The predominant organization pattern is whole group;
- The teacher retains sole authority over instructional materials, class organization and teaching methods;
- Significant teacher time is demanded by classroom management—maintaining order, monitoring student work and conducting quizzes;

- Despite a whole class setting, students essentially work and achieve alone, with virtually no opportunity for small group collaborative work;

- Little time is spent on commending and correcting students, or on guidance for improved performance; and

- Students have limited exposure to technology, field trips or outside presenters and little hands-on contact with subject matter beyond the printed page.[46]

Compounding the problem of stagnation is that of misperception. Goodlad found that even teachers who thought they were individualizing instruction, encouraging inductive reasoning and involving students in group processes, were not doing so.[47] Their perceptions—and good intentions—were not reality in the demanding day-to-day workings of the classroom.

If the methods of teaching and learning have not changed, is it any wonder that student performance hasn't changed either? Consider a most durable measure of student performance, NAEP—the National Assessment of Educational Progress—that assesses both relative performances over time as well as absolute levels of performance. NAEP's long-term trend assessments of student performance in science, math and reading reveal that student achievement has shown little change over the last quarter-century.[48] The largest gain in this period being 5.2 percent among nine-year-old students in math, and the largest decline, 3.6 percent, among 17-year-old students in science.[49]

We are also falling embarrassingly short of our target of international superiority in math and science by the year 2000, a goal set by President Bush and the state governors in 1989.[50] Last year we spoke about the Third International Math and Science Study (TIMSS), which compares academic performance in 21 countries at the fourth-, eighth- and twelfth-grade levels. You will recall that while our fourth-grade students performed above average in math and science, they make less progress between fourth and eighth grades in either science or math than do their counterparts. So much so, that by the eighth grade, American students revert to a mediocre standing.[51]

TIMSS' recently released twelfth-grade results show that this downward spiral continues, with the result that our high school seniors rank near the bottom in both math and science.[52] In math, the United States trailed countries such as the Netherlands, Sweden, France, Australia and Canada—and its results were not significantly different from the Russian Federation and Lithuania.[53] Similar results were seen in science. And our best and brightest students, those enrolled in advanced placement physics and calculus, also lag behind their counterparts in

other countries.[54] It is sobering to think that the longer our students are in school, the poorer their relative progress—with the result that nearly one-third of all entering college freshmen require some type of remedial education.[55]

Perhaps the most serious problem indicated by these results is our failure to close the "opportunity divide." In writing on the common school, Thomas Jefferson described educational opportunity as a civic essential, an economic imperative and a moral obligation. Yet two centuries later, educational opportunity is an empty promise for young people on the far side of more than one educational divide. Canyon-size gaps persist in academic achievement, income, and technological fluency.

The NAEP data underscore the academic achievement divide between whites on the one hand and Hispanics and African-Americans, on the other. For 17-year-old students, it has remained relatively unchanged for the last decade.[56]

Aligned with the achievement divide is the income divide which has widened dramatically between those with college degrees on the one hand and those with and without high school degrees on the other.[57] As referred to above, the new skills demanded by business are all fruits of the kind of rigorous education that is generally not available.

And paralleling these divides is the newest one—the digital divide. To illustrate this, let's consider two California high schools located just miles apart. Redondo Beach High School is in a predominantly white suburban beachside community; Birmingham High School is located in an ethnically mixed urban enclave. And both, according to the Digest of Educational Statistics, would be counted as part of the 78 percent of American schools reported to have Internet access[58]—and therefore, both would be thought to be providing 21st-century skills for their students.

Yet the two schools could not be more different. State-of-the-art technology is not just accessible to students at Redondo Beach High School; it pervades the curriculum and supports a strong educational program. Students get hands-on experience to master their academic program and to develop crucial technical skills, such as learning HTML programming. Here we can be confident that students are being prepared both for college and the workplace. As Berkeley-bound senior Mark Miller puts it: "I have the background necessary to pursue anything I want."

Across town, at Johnny Cruz's school, one phone line provides Internet access for more than two thousand students and a single e-mail account is maintained for the entire guidance department. An introductory computer course sets the upper limits for students' technological training and 5_ inch floppy disks remain the technical standard. Yet Johnny remains determined to pursue a career in computer engineering and his dream, as he puts it, of a "good salary and a family."

The experience of Mark and Johnny drives home the gravity of the digital divide—particularly to me, since Johnny's school is my alma mater. The Foundation is now at work there on several different fronts.[i] But the point is Birmingham's situation is not the exception, but the rule.

This is not readily apparent from the statistics. Even 63 percent of poor schools today have Internet access.[59] And President Clinton himself proclaimed two weeks ago that, "(T)he digital divide has begun to narrow."[60] But the digital divide has done no such thing. I know this not only from what I have observed in schools across the country but because school Internet access is simply not the measure of opportunity.

Equal opportunity is about having in the classrooms up-to-date computers, Internet connections, powerful content, teachers who are technologically fluent, and technical support. This is all the more important for students like Johnny Cruz, who face a "double divide" since they also lack access to technology at home. Indeed, only 14 percent of students from poor households have access to computers, compared to 82 percent from more advantaged homes.[61] And when considered by race, the disparity is just as sharp.[62]

Low test scores and the lack of progress in narrowing the opportunity divides are all clear warning signs of a system not working. The public is responding to the alarm by demanding alternatives.

Charter schools, for example, have increased from a single facility in 1992 to 786[63] today operating in 33 states and the District of Columbia.[64] With ever-growing political and popular support, they will continue to multiply. There's been a similar explosion in home schooling—from fewer than 100,000 students in

[i] As a measure of the Milken Family Foundation's conviction that learning technology can propel achievement and motivation, this year we invited a proposal from the school to give it a jump start into the information age. The Foundation has also been at work to help address the achievement gap. Since 1996 we have provided support for the implementation of the International Baccalaureate program at Birmingham, making it the first of the 50 high schools in the Los Angeles Unified School District to offer the program. And for the last two years, the Foundation has also supported Birmingham in the implementation of AVID (Advancement Via Individual Determination), a program that helps average performing students develop the motivation, discipline and skill to gain entry and succeed in four year colleges.

1983,[65] to an estimated one-and-a-quarter million last year.[66] Private scholarship programs to pay private school tuition for poor students are expanding rapidly. And publicly funded voucher programs are also growing in support. A dramatic 62 percent of all African-Americans[67] and 86 percent of those of parenting-age (26 to 35) support these programs.[68] The warning signs could not be more clear: The annual national poll undertaken by the Milken Exchange on Education Technology finds that approximately one-half of parents of public school children would send their children to private schools if they could afford it.[69]

None of this is escaping politicians' notice. Democrats joined Republicans in Congress this month to pass a bill to provide tax-free savings accounts for private school tuition—further evidence that frustration over the state of public education is not restricted to any one party or ideology. [70]

Over the years, we have heard heated, heartfelt, and even eloquent debate on educational reform and we have seen well-intentioned efforts on the part of the federal and state governments and the nation's 14,883 public school districts.[71] Yet, these efforts have neither changed classroom practice nor lifted American education above mediocrity.

Our $313 billion K-12 system[72] has become more like a petrified forest than the vigorous, adaptable learning environment that education should and can be. If America's unique system of universal public education is to survive, our 87,000 public schools[73] cannot stand still. And to do so, educators must be encouraged to think systemically about their mission and to meet fully the challenges of the children they serve.

The elements of this kind of comprehensive change—each of which we have analyzed at length in presentations at earlier Conferences—include:

- **Early childhood education and care**, because every child must come to school prepared to learn;
- **Children and family services**, because health and social services are essential to children being ready to learn;
- **Decentralization with consequences**, because schools must be given the flexibility and resources to succeed and be held responsible for results;
- **Standards, assessment and accountability**, because the effectiveness of instructional changes depends on this triad;

- **Teacher training and professional competency**, because any effort to provide a rigorous education must work to improve the quality of teaching; and
- **Education technology**, because it can be a catalyst to the other reform elements and a direct stimulus to change in classroom practice.

Indeed, if these systemic reforms are going to dramatically improve student performance, they must transform what is actually going on in America's 1.8 million classrooms.[74] This will require mobilizing an education vanguard that not only understands technology's potential for teaching and learning, but is determined finally to succeed.

LEARNING TECHNOLOGY

While there is a vanguard of educators around the country—many of whom are here today—working to change classroom practice, these educators can hardly accomplish this alone.

Educators and students need tools that reflect the time in which we live as well as the era into which we are moving. That means they need technology. But make no mistake: Technology is no more the cure-all for all the needs of education than the x-ray was for those of medicine. Technology is a bridge, not a destination. Let's take a look at how information and communication technology is helping to transform teaching and learning practices in the classrooms of three Milken Educators: Lorenzo Gonzales of Cuba, New Mexico; Janet Steele of Spokane, Washington; and Robert Foor-Hogue of Sykesville, Maryland.

[The nine-minute video presentation that followed provided a vivid demonstration of technology at work in three American classrooms. Brief written summaries follow. Complete videos are also available by contacting the Milken Family Foundation at (310) 998-2800 or visiting the Milken Family Foundation Web site: www.mff.org.]

Lorenzo Gonzales uses technology to build vital communication spans between his eleventh-grade biology students and the scientific world. Mr. Gonzales's rural New Mexico school is 90 miles and a world away from Albuquerque and the University of New Mexico. Students in this predominately low-income, Hispanic and Native American high school have had few educational opportunities beyond what has been available in Cuba. In Mr. Gonzales's class we meet Jennifer, a talented science student full of curiosity and ambition to pursue answers to real-world scientific questions. All she and her other

ambitious classmates need are the right opportunities. Six computer workstations with access to the Internet open the door to those opportunities.

Telecommunications brings educational partners into Mr. Gonzales's classroom instantly expanding the amount of individual attention a student is able to receive. Without classroom technology and telecommunications, Mr. Gonzales would not have the time or resources to allow 25 students to pursue the kind of scientific inquiry that Jennifer is doing with nitrogen fixation.

Just do the math—with 25 students meeting 50 minutes a day, five days a week, a teacher could spend 250 minutes on whole class instruction, or he or she could spend ten minutes a week with students individually. The solitary teacher has little choice. Lectures, explanations and quizzes may help structure class time, but they don't generally nourish curiosity and academic productivity. In fact they become of little importance when students have significant intellectual support supplementing what their teacher can provide. Mr. Gonzales is using technology to provide that support.

E-mail connects Jennifer with a unique mentor, Professor Johnson from the University of New Mexico; and Internet access provides a depth and breadth of learning resources that a remote town like Cuba would never have thought possible.

In Janet Steele's classroom in Spokane, Washington, she has unleashed the learning potential of her second- and third-grade students by making them researchers, problem solvers, instructors and authors.

Technology is putting a wealth of text and graphical data within their reach, helping Ms. Steele to supply a framework in which her students can make sense of the information they collect. What her students produce is useful far beyond the walls of their classroom. Their publication on the class Web page is both the incentive and the payoff for all their hard work.

In 1980 when Robert Foor-Hogue began teaching high school science in Sykesville, Maryland, students had little interest in science, and enrollment was low. But it only takes one look into his classroom to understand the 600 percent increase in science class participation. In the classroom a 5,000-gallon aquarium and high-tech equipment are helping them make measurable contributions to the ecology of the local environment. And a wooded wetland and a damaged trout stream on the school campus provide students with a living model for study.

Students need to be actively engaged in the learning process and to create their own understanding of important ideas. In the classroom laboratory created by Mr. Foor-Hogue, everyone has the opportunity to participate in hands-on, multi-disciplinary, real-life science. His biology students use principles from engineering, chemistry, ecology and social science to enrich and expand their work. Students learn science because they do science exactly as professionals do—in technology-rich laboratories that allow them to ask questions, design research studies, collect and analyze data, and report their findings to a larger community. And as students learn more, they challenge teachers in new ways to become better learners themselves and thus, better teachers.

As a catalyst to change in classroom practice, learning technology is helping these educators promote active and participatory student learning. The key to success is liberated educators whose understanding and creative use of computers, probeware, networks and the Internet are enabling them to achieve undreamed-of levels of excellence for themselves and for their students.

There is little question that the successful use of technology does not just happen. We believe, and have stated repeatedly in past presentations, that certain conditions are necessary if information and communications technology is to dramatically improve student performance. They include:

- **Clear performance goals** that ensure a focus on student achievement;

- **Professional competency** rooted in content expertise and instructional know-how sufficient for educators to use technology to advance their own and their students' learning;

- **An integrated learning environment** that aligns powerful technology tools and content to support research-based practices and produce high student achievement;

- **Technology capacity** of computers, connectivity and other equipment and services that are kept operational, user-friendly and up-to-date;

- **Accountability** mechanisms that evaluate process and results, and yield information to help guide practice and policy;

- **Leadership and community support** that fosters a shared vision and leads to collaboration among educators, parents, business and policy leaders, and other citizens; and

- **A learning organization** that engages individuals in the continuous improvement of every classroom and school.

Some argue there are other issues we should address before making a commitment to these essential conditions. These issues range from evidence of technology's effectiveness in improving academic performance to the cost of implementing the sort of technology program we have been discussing.

Let's take a look first at cost:

Implementing the vision is costly. Experts at the Milken Exchange on Education Technology, McKinsey & Company, and elsewhere agree that a comprehensive technology system for all public schools—one that includes professional training, infrastructure, software, technical support and five multimedia computers in every classroom—will cost at least $50 billion.[75] That means that our public schools will need about $14 billion annually to phase in the system over five years, and, from the start, to maintain and update the system and keep professionals current.[76]

It is estimated that $5 billion is spent annually on technology in public schools, less than a quarter of which comes from the federal government.[77] The recent slashing of the E-rate subsidy for schools and libraries[78] underscores that federal funding for technology, in its present form, is as tenuous as it is insufficient.

It is time to reconceive the federal role by establishing a reliable multi-billion dollar funding stream for learning technology, similar to those we have for the disadvantaged and for special education. Money is available, it's just a matter of priorities. For example, consider the new $217 billion highway bill, which increases transportation spending by an astonishing 40 percent over the next six years.[79] This should be a time not only for investing in the transportation of people and goods on old-fashioned roads but also in the *acceleration of learning* on information highways.

While $14 billion annually is a lot of money, let's put it into perspective. On an annual basis, today, we spend on average roughly $6,200 for every pupil in our public schools.[80] Of this, $113 on average, less than 2 percent, is currently being allocated for technology and telecommunications.[81] To achieve the goal we outlined, we're talking about an increase of $197 per pupil—for a total technology allocation of $310 per pupil. When you compare the amounts other industries spend annually per employee for computer technology only, we find that an expenditure of even $310 in K-12 education would still be by far the lowest.[82]

Or, to look at cost from another vantage: If we were to apply our projected $14 billion annual technology expenditure to reducing class size across K-12,

classes would be reduced by fewer than three students per class, or on average only from 24 to 21 students.[83] Research tells us that class reduction on this scale neither changes classroom dynamics nor increases achievement.[84] To spend the projected additional dollars on class size reduction, a move that would not only involve the cost of building more classrooms, but also demand 363,000 additional teachers when we're already on the verge of a teacher shortage,[85] is ultimately not cost effective. And the public agrees: The recent Milken Exchange poll found that, if the federal government had a $14 billion budget surplus to spend on public education, voters would rather spend the money to equip every classroom with technology than to repair school buildings, improve security and even reduce class size.[86]

Our work at the Foundation and the Milken Institute also confirms the future economic benefit of this investment. In one study, in which we consider the increase in labor market productivity of children whose K-12 education has been supported by technology, the return was four times the cost, a ratio comparable to the GI Bill,[87] considered the most successful social infrastructure program of all time.

Let's now consider technology's effectiveness in improving academic performance. The Milken Exchange has made research on learning technology a strategic focus. We are working with others to build a national research agenda that identifies key questions and creates a coherent flow of research to help inform practice. We are also developing models to assess the effectiveness of significant technology projects such as California's Digital High School initiative,[88] which the Milken Exchange was recently selected to evaluate.

This research agenda builds on what is known about the positive effects of learning with technology. For instance, James Kulik's analysis of 550 individual research studies from 1981 to 1991 demonstrated that students not only learn more when they are engaged in tutorial and drill-and-practice computer applications, but they also learn more quickly and like their classes more.[89] Another analysis of 219 research studies from 1990 to 1997 found that students who had access to educational technology perform significantly better on reading, mathematics, and writing tests than those without access to technology.[90] The benefits could be seen in both regular and special education classrooms, and in all grades from pre-kindergarten through college.

Dramatic gains can also be seen among students using more advanced innovations. In the early 1990s researchers at the University of Toronto created the Computer Supported Intentional Learning Environment—or CSILE—in which students acquire skills and knowledge through an incremental process of posing problems, debating and finding solutions over a computer network. Recent evaluations with

control classrooms showed that CSILE helped students attain deeper understanding and think more critically and creatively.[91] They also made significant gains over control students on standardized reading, language, and vocabulary tests.[92]

This research, along with what we have seen in hundreds of classrooms across the country, underscores the fact that basic skills, collaboration, inquiry and higher-order thinking are being enhanced by the use of technology. The Milken Exchange is surveying more than 2,000 exemplary technology-using educators throughout the country to help us further measure technology's benefits to teaching and learning.

While the Milken Exchange poll finds that the public is looking to our schools to ensure that children are technologically fluent, it also reveals that many policymakers are waiting for more research before making the commitment to implement learning technology.[93] I understand their concerns, but waiting, too, has risks.

Not that long ago, business also lacked hard "evidence" about the effectiveness of technology. The May 26, 1986, cover of Fortune magazine decried, "The Puny Payoff from Office Computers … Business has spent billions, but white-collar productivity has not budged."[94] While the Fortune article found many examples of companies successfully managing technology to realize significant productivity gains, others had still failed to learn—and to train workers—how to use computers most beneficially.[95] In some businesses, computers were doing the wrong tasks or even sitting idle. No wonder the national payoffs were puny.

The leaders of successful firms understood that technology, as part of an entire rethinking of the way they did business, would provide their companies with a competitive edge. Just as businesses did a decade ago, education has to rethink its ways of doing things. And as it does so, it should consider the irony that education, the original knowledge industry, is the last to invest in technology to increase its access to knowledge.

This is unacceptable. That is why each of the Milken Family Foundation major initiatives in education is directed toward the goal of responsibly addressing the issues that are stalling the implementation of learning technology into America's classrooms.

The **Milken Exchange on Education Technology** is the nerve center of an emerging national network of educators, public officials and business leaders who are advancing the responsible use of education technology. In the last year, the Milken Exchange has moved forward in each of its five areas of strategic importance, including increasing public awareness, advancing public policy, ensuring wise investments of resources through better planning, supporting new

designs for teaching and learning, and accelerating classroom practice through sound research.

The **Milken Family Foundation National Education Conference** brings together the worlds of business, government and education to discuss the development of human capital, which is also the commitment to ensure opportunity for every child. We are advancing these goals by developing a better understanding of learning technology and our respective roles in its creative, responsible development.

The **Milken Family Foundation National Educator Awards program** has structured its state conferences, its communications with state and national networks, and its professional development opportunities all to reflect the increasing importance of learning technology.

The **Milken Educator Virtual Workspace** is a Web-based collaborative teaching and learning environment where Milken Educators from across the United States can engage in professional development activities online. The next generation workspace, MEVW2, which we are unveiling at this Conference, will further promote collaboration and communication by means of chat functions, bulletin boards, listservs, and project management tools. MEVW2 also emphasizes group and individual accountability and encourages the dissemination of Milken Educators' work to the larger community of teachers and learners.

And, the **Milken Community High School,** whose 650-student facility, opened last month by the Stephen S. Wise schools, is giving the Foundation the opportunity to help build from the ground up a high school fully integrated with technology. The guiding vision of the board, the faculty and the Foundation is of a school that has all the conditions for students and educators to reap the benefits of a rigorous education—from a love of learning to a love of teaching. The impact of these conditions will be greatly enhanced by what we believe is every educator's professional right: a laptop computer, professional training, powerful software, Internet access and technical support.

We believe that such a learning environment will have the power itself to transform individual lives. But its power as a model resides with all of us. To assure that learning technology is constructively developed and deployed for the *real* good of children requires each of us, supported by the others, to take specific steps.

Our federal officials, our governors and legislators, must provide the resources—for funding is the bedrock. But the effort needs more. It needs a vision as bold as the Rural Electrification of the 1930s or the GI Bill of the 1940s. And it needs leadership to promote both equity and excellence; to create provisions that guarantee a return on technology investments; to act strategically, through initiatives that build upon one another; and to ensure that reform reaches right down to the classroom; namely, to the content of curriculum and the modes of learning.

Our state chiefs must include robust provisions for learning technology in the budgets they submit to governors and legislatures; secure the leadership of their professional, business and policy partners in these efforts; and invest in developing professional leadership from distinguished educators, trained and equipped to guide and show the impact of learning technology in the classroom.

Business leaders must make available their top technical staff to advise education in the planning and implementation process, and they must call for policymakers to make learning technology a top state priority.

And exemplary educators must assume the vital role of learning technology pioneers. Their creativity and leadership and the credibility those talents have won them—equip them to ignite the imagination of their colleagues and students, to provide the framework for technology's responsible use, and to report fully from the classroom front.

CONCLUSION

Another Oliver Wendell Holmes—the Justice's father—made an apt observation: "I find the great thing in this world is not so much where we stand," he wrote, "as in what direction we are moving…. We must sail sometimes with the wind and sometimes against it, but we *must sail*, and not drift, nor lie at anchor."

This is my message today: American education is in urgent need of direction and movement and the force of the winds of change must not deter us. Weighing more alternatives, drifting, lying at anchor—these are no longer options. We must set sail *now*. As theologian Harvey Cox has put it: Not to decide *is* to decide. To determine the future of American education this way is simply not responsible.

In the case of reforming education, using the full potential of learning technology *can* mean navigating unfamiliar waters at an unnerving clip. It *can* mean decisions—big ones—at a pace we are not used to. Change of the scale and

urgency we have described this morning always involves risk. But resisting change means greater risk still. The fate of President McKinley was not an aberration. It was the result of the human instinct to stick with what we know—whether it works or not.

The routes to the rigorous education all children need and deserve are changing, expanding and exploding with new possibilities—for those *with* learning technology. Meanwhile, those *without* it are deprived not just of something interesting or cool or useful. They are deprived of what has the potential, when properly managed and applied, to be the most powerful technology for learning ever invented.

We owe it to our children to be open to change. Children are our first and greatest responsibility, and they count on us to get them to the place where education is the ennobling experience that touches on just about everything we value as individuals, citizens and productive human beings; that provides the fullest opportunities for fulfilling ourselves; building character and opening the routes to all that we have yet to learn.

Johnny Cruz did not say he *wants* to be a computer programmer or an engineer. He said he *plans to* have one of those careers, along with—as he put it so movingly—a good salary and a family. In other words, this is a young man with direction of his own. One way or another, *he* is going to make it. But he will do so *in spite* of an education system that has failed, in many ways, to properly equip and prepare him for the challenges he has set for himself. But what about the hundreds of thousands, or even millions, of young people who do not have Johnny's drive and initiative? They will be left behind altogether.

We have it in us to ensure that the potential for success for all young people is *because* of —not *in spite* of—their education. That it is, *because* of its rigor and relevance to their real lives. *Because* of the preparedness and imagination of their teachers. *Because* of the infinitely rich experience of learning with tools like technology. All of this is within our children's reach. And if we act responsibly we can put it right in their hands.

appendix a

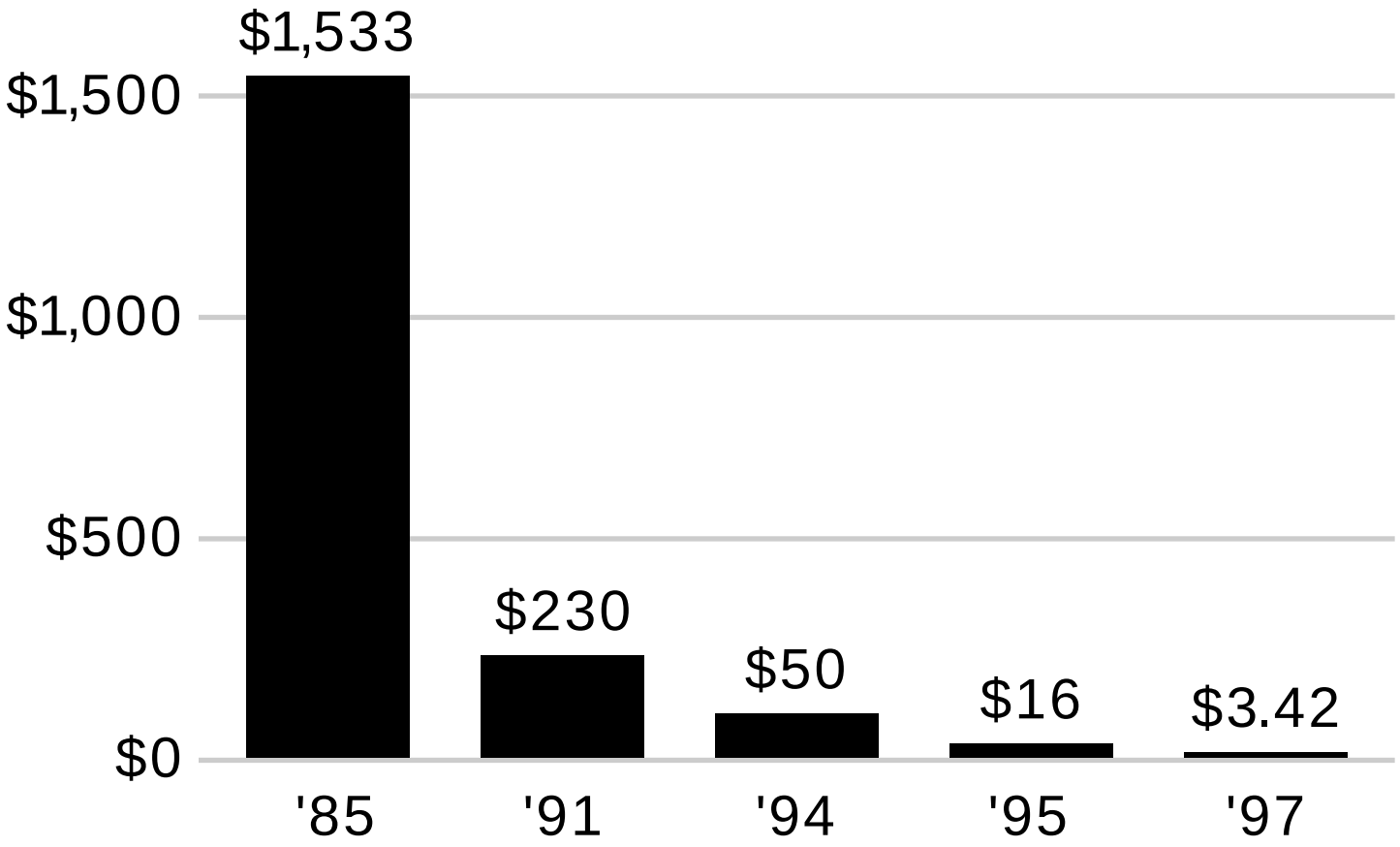
speed of change

	invented	years to 25% market penetration
household electricity	1873	46
telephone	1876	35
television	1926	26
personal computer	1975	16
cellular phone	1983	13
internet	1991	7

appendix b

microprocessor prices plummet

price per million of instructions per second (mip)



appendix c

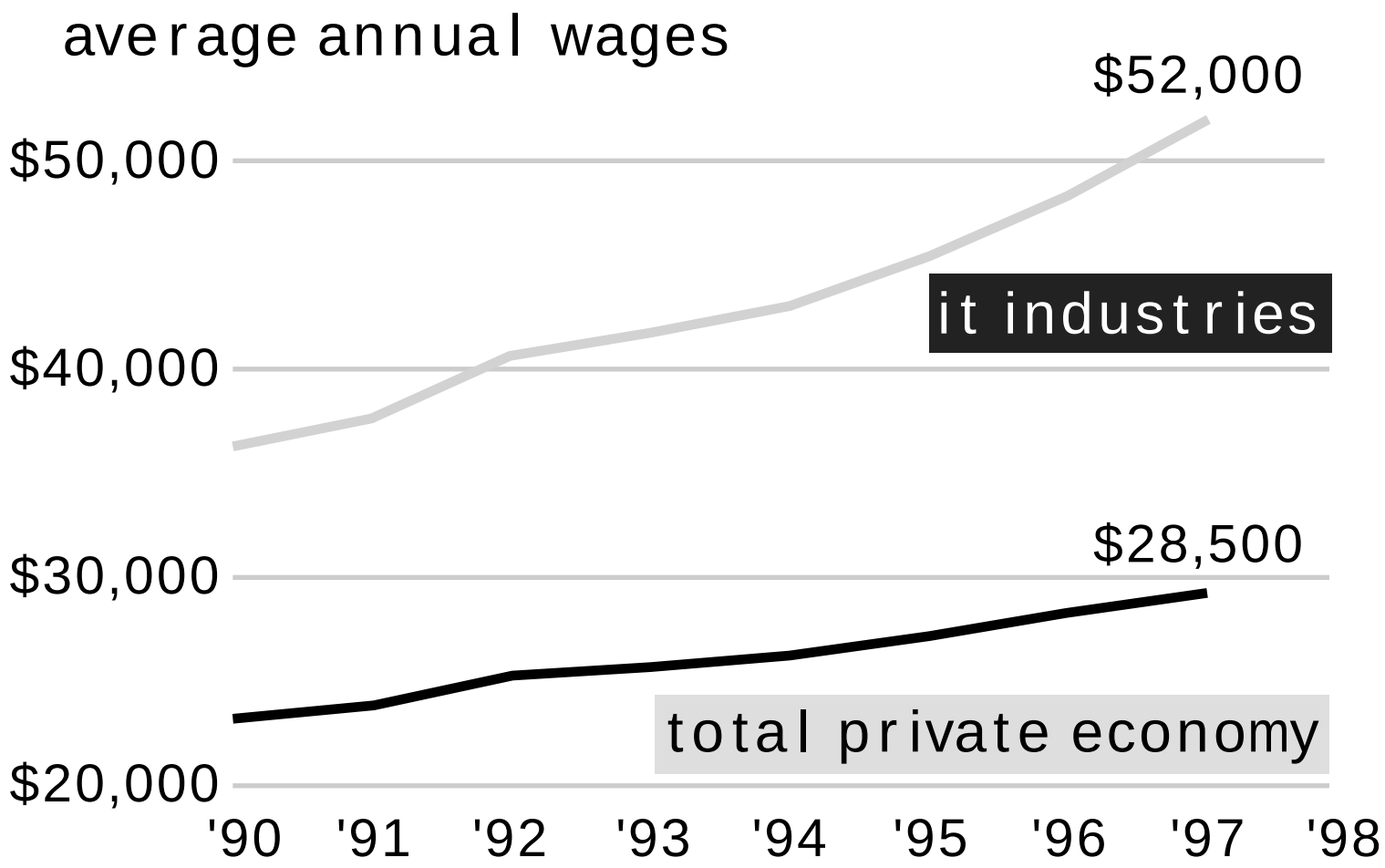
fastest growing occupations

1996 – 2006

	percent growth	average annual salaries
computer administrators and specialists	118	$46,100
computer engineers	109	$69,200
systems analysts	103	$58,300
home-care aides	85	$16,000
physical therapy assistants	79	$21,300
home health aides	76	$15,600
desktop publishing specialists	74	$43,100
medical assistants	74	$16,900

appendix d

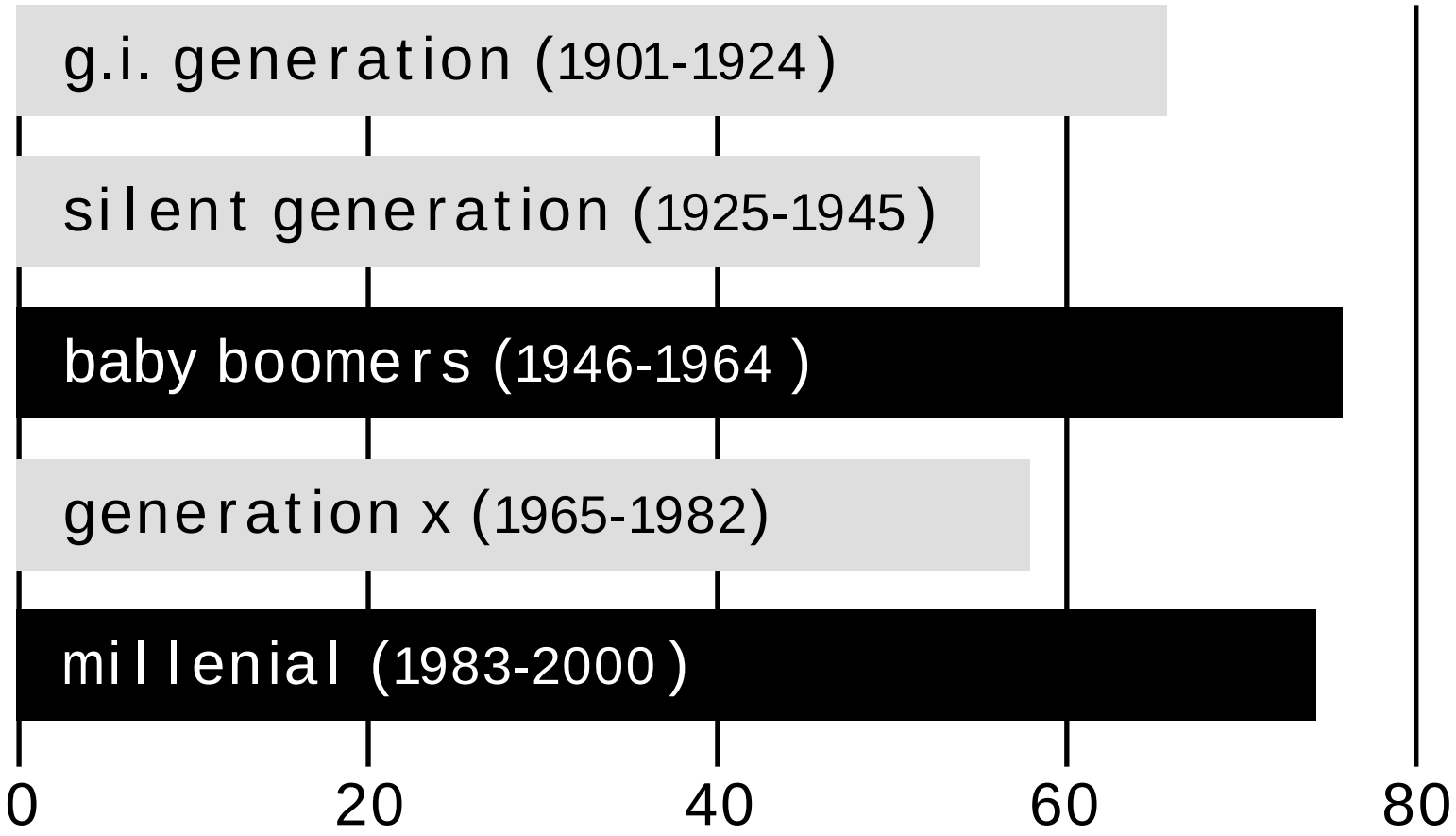
i.t. industries pay more



appendix e

generations

births in millions



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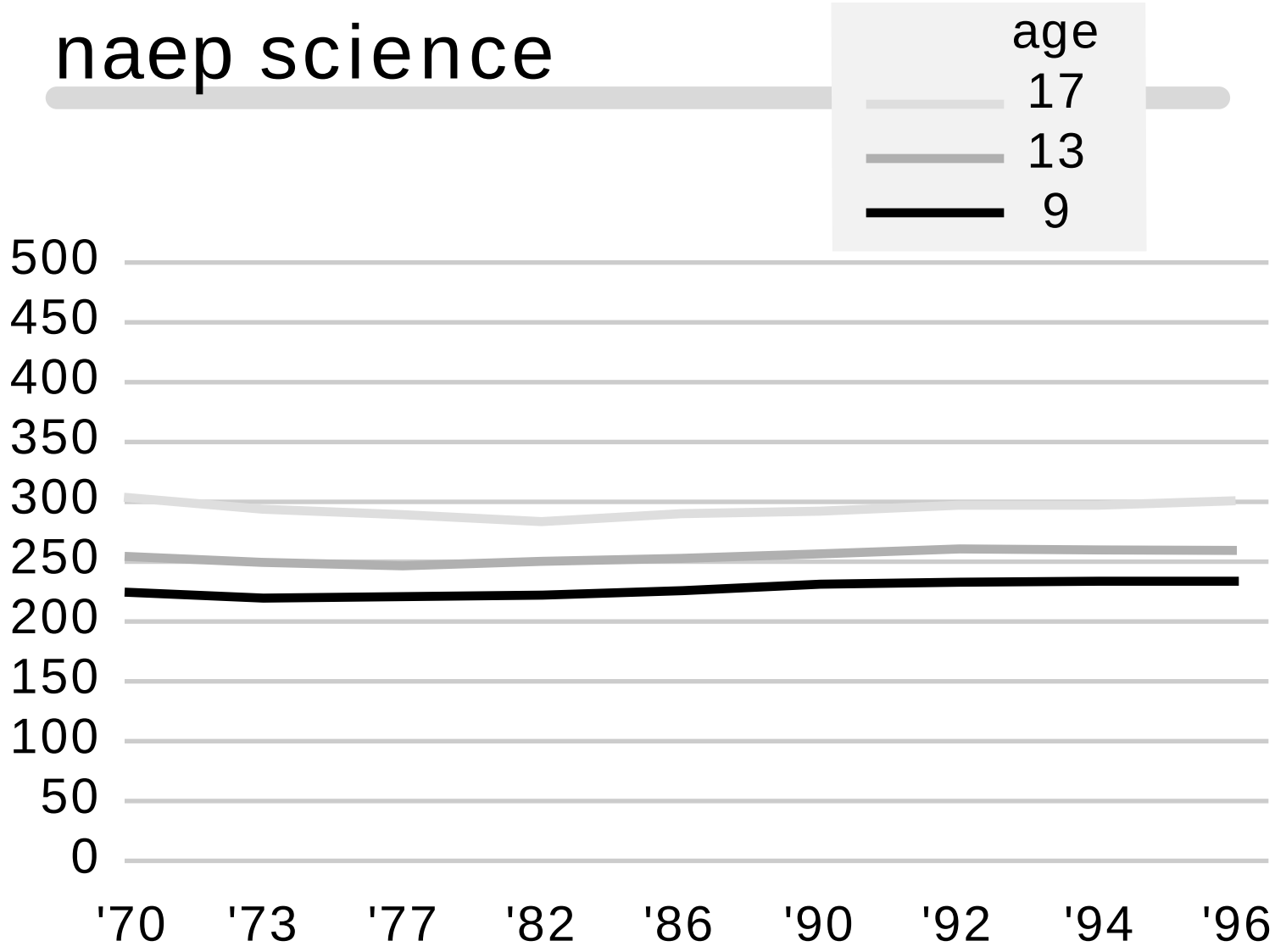
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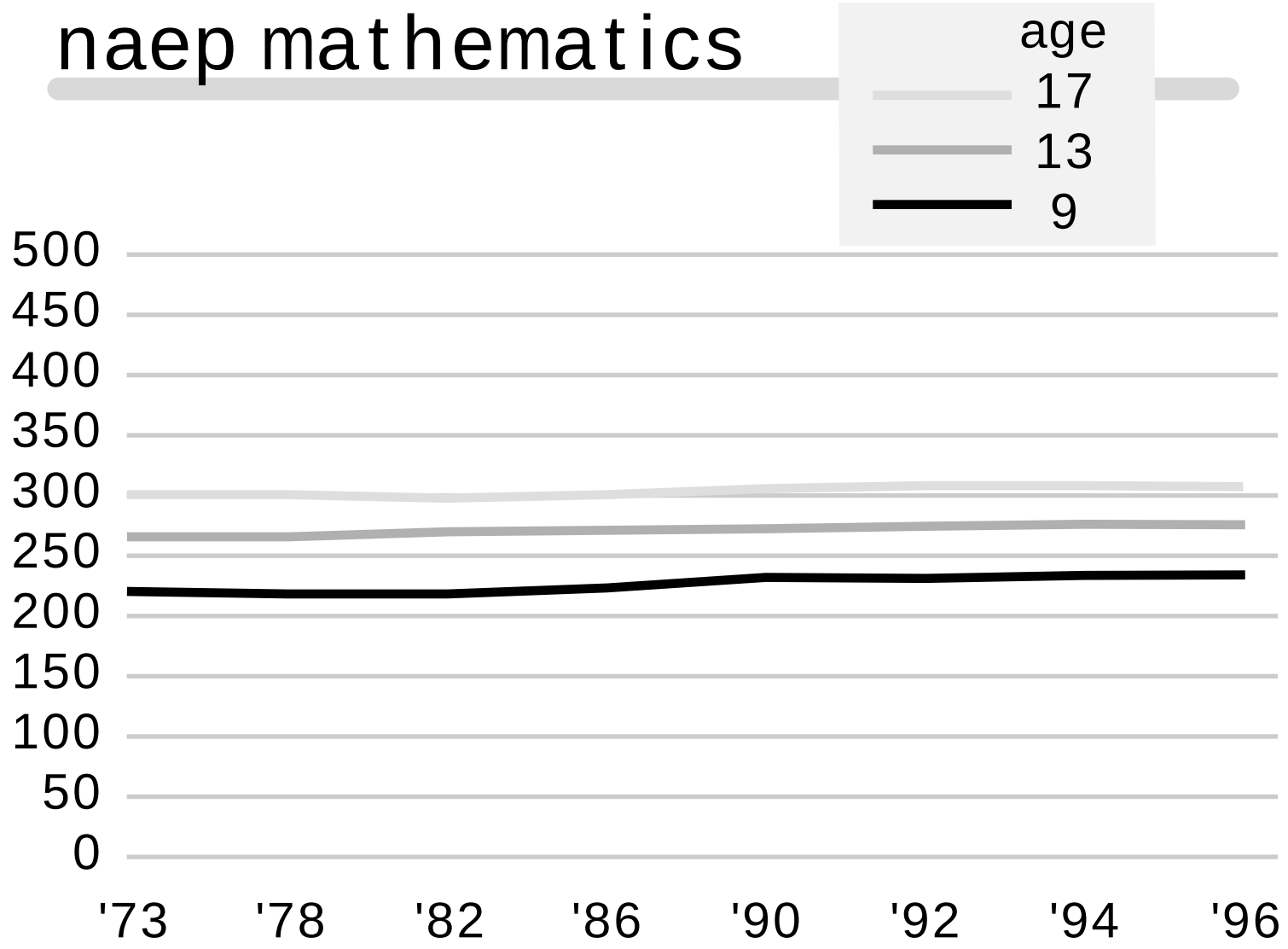
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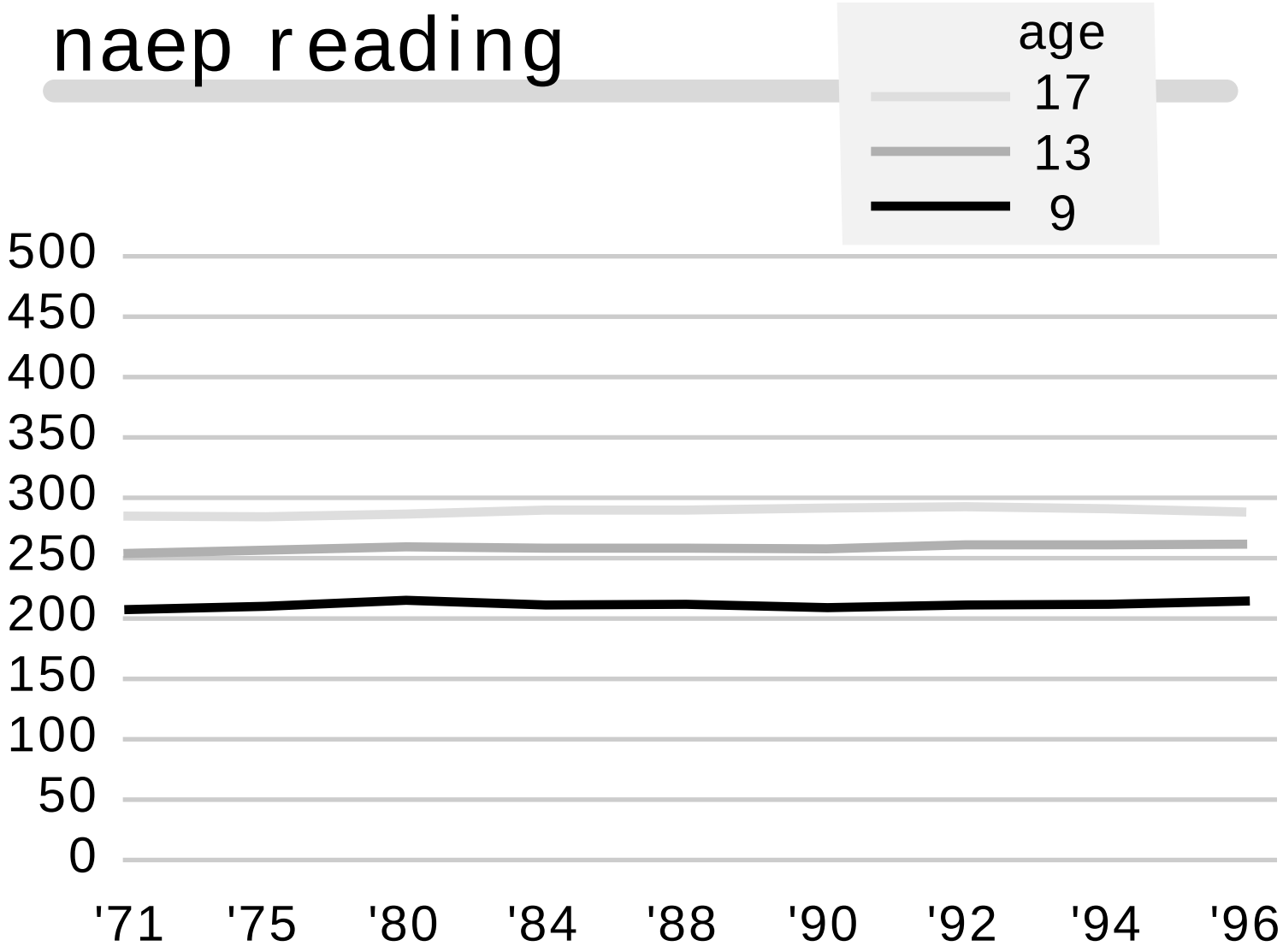
appendix h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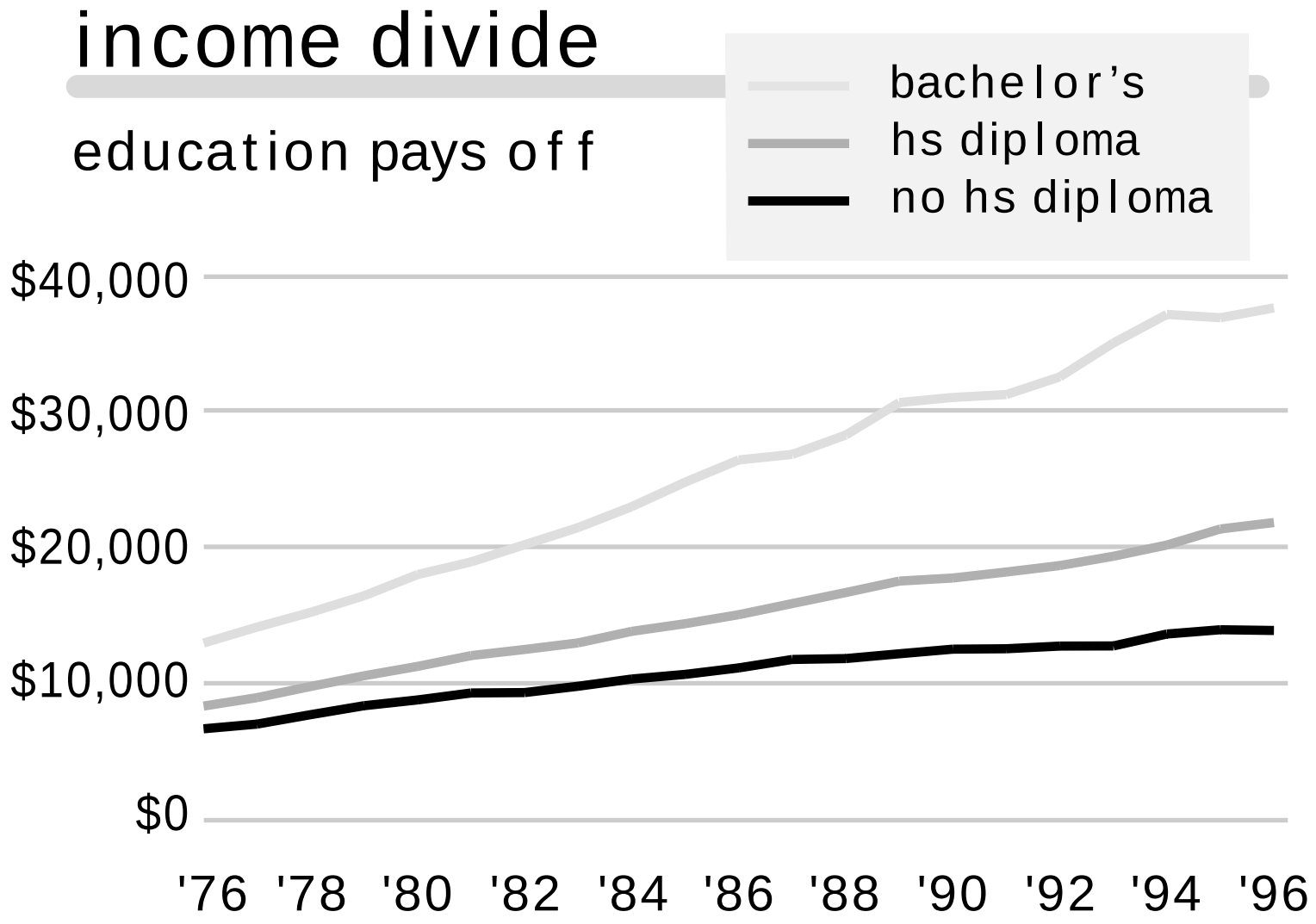
appendix i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annual investment in computer equipment per employee

telecommunications	$7,970
real estate	$6,110
insurance	$5,360
chemicals	$4,740
wholesale trade	$2,670
movies	$2,540
air travel	$2,150
security & commodity brokers	$1,490
legal	$1,410
k-12: recommended	$310
k-12: current	$113

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