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THE DIGITAL OPPORTUNITY INVESTMENT TRUST AND AMERICA'S GLOBAL LEADERSHIP

By Dr. Eamon Kelly[*±]

Introduction

The digital age has drastically reshaped the world that we live in—making communication faster, information more accessible, and our knowledge more expansive than ever before. With even more information at our fingertips, it has become increasingly difficult to keep up with the pace of information output. Knowledge is now the principal source of wealth creation and new jobs in the United States. Ensuring that the United States and its populace keep up with the fast pace of knowledge dissemination and continuously evolving technology is crucial to maintaining a vibrant economy as well as remaining secure at home. With a similar purpose and governance structure, the Digital Opportunity Investment Trust (DO IT) proposes to do for education and training what National Science Foundation (NSF) has done – and continues to do – for science. This paper will explore some of the parallels between the NSF and DO IT, as well as explain why DO IT is not only a desirable investment, but also a necessary investment for America.

The 21st century is clearly the century of the human mind harnessing the power and promise of science and technology. In information technology, we shall have the equivalent of infinite bandwidth, infinite processing power, and an infinite array of new technologies that can change our daily lives. Despite these new communication capabilities, the United States is falling far behind our competitors in educational performance. We are failing to invest in the crucial research and development needed to advance education and training. Our nation's poor performance in education is not to be taken lightly—especially considering the competitive nature of today's world. It has even impacted America's capacity to fight the "war on terror." We are unable to fill some of the most crucial positions in US intelligence and homeland security agencies because of a lack of trained and qualified personnel. There exists an urgent need to change the emphasis currently placed on education, and change the way Americans are educated, to ensure our economic competitiveness and our security at home and abroad.

Alarming Trends in America's Human Capital

Before specifically discussing the Digital Opportunity Investment Trust and its role in advancing the competitiveness and economic growth of the United States, it is important to understand how well Americans are currently learning and performing, especially when compared to the nation's major economic competitors. Looking at the performance of the U.S. human capital base highlights three serious problems that could greatly undermine America's prosperity and security

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[*] Eamon Kelly is Former Chair of the Board of the National Science Foundation, President Emeritus of Tulane University, and Professor of International Development at Tulane University.

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in the long run. First, the U.S. public education system is failing to produce students that are internationally competitive—especially in the areas of math and science. Second, due to the lack of highly skilled Americans in science and technology, the U.S. has an alarming and unsustainable reliance on foreign human capital. Third, the shortage of a highly skilled workforce (especially in information technology and languages) has led to a shortage of intelligence and technology specialists—compromising our national security. Taken together, these shortfalls in our education system and our workforce underscore the need for an initiative such as DO IT, which focuses on education and workforce training, to remedy the underinvestment in America's expansive human capital potential.

Public Education

How well are Americans currently learning in classrooms across the nation? Is the power of information technology being used to advance teaching methods and students' skills? The grim answer is that American school children are falling behind school children in other industrialized countries with regard to educational performance and attainment. In December 2004, the Program for International Student Assessment (PISA) found that U.S. students ranked 24th in math literacy and 26th in problem-solving among 41 participating nations and that U.S. students "did not measure up to the international average in mathematics literacy and problem-solving skills."[1] Other studies, such as the Trends in Mathematics and Science Study (TIMMS), released December 14, 2004, have found similar results—ranking U.S. student performance significantly behind other industrialized countries in both math and science skills.[2] In 2004, the United States, which used to lead the world in high school completion rates, ranked 10th among other OECD countries in the percentage of adults, ages 25 to 34, with a high school degree.[3]

While 99% of America's schools have become connected to the Internet during the past decade, it is becoming increasingly apparent that it is not enough to simply place computers and the Internet in public schools and assume that our students are learning the skills they need. Providing the hardware without the training and appropriate software often means that the "great promise of internet technology [is] frequently unrealized."[4] Indeed, much of the problem may lie in teacher training: The National Education Technology Plan, published by the Department of Education, finds that "today's students, of almost any age, are far ahead of their teachers in computer literacy."[5] In order to use the full promise of technology in U.S. classrooms, teachers must acquire much needed skills in information technology.

There is also a significant inequity occurring in educational attainment within the United States—the level of education achieved varies greatly according to race, income level, and age. According to the Census Bureau, older age groups in America have significantly lower levels of educational attainment than younger generations. While 25% of white students who enter kindergarten receive a bachelor's degree, only 12% of African-American and just 10% of Latino students obtain a higher education. Income further determines educational attainment in the US: 48% of men and women from high-income families graduate from college, compared with just 7% from low-income families.[6]

These educational performance issues and inequities within the U.S. education system are alarming. Fortunately, however, the advancement of technology may provide hope on the horizon. The next few years will see dramatic improvements in bandwidth capacity, computational power, and graphics capability. We are learning about even more powerful and less expensive techniques that can enhance students' educational experiences and increase

educational accessibility across racial, income, and age lines. One-on-one tutoring or customized learning plans have been too costly to implement in the past—but we now have the tools to make this optimal, individualized learning available to a great deal more of our school children. DO IT can harness these capabilities to address the shortfalls of America's education system.

America's Workforce

Education and skills development are not only a priority for younger generations in K-12 schooling and universities, but also for those Americans already in the workforce. It is important to recognize that learning does not stop upon graduation from high school or university; education is a lifelong process. The demographic composition of America is changing. By 2025, 20% of Americans will be age 65 or older. By focusing on lifelong learning, we can ensure that this significant proportion of our population remains productive members of our workforce. Workforce training is currently costly and unrealistic for employers and employees alike. One estimate finds that 50% of all employees' skills become outdated within three to five years of being hired.[7] The National Council of Education Statistics found that over 40% of the adult labor force performs at the two lowest levels of literacy.[8] A Hudson Institute study finds that 60% of all future jobs will require skills that only 30% of today's workers possess. The lack of a skilled workforce means corporations are facing escalating costs for remedial skills training and technology training.

This gap in the supply of high-tech US workers led Congress to double the number of visas for foreign high-tech workers to fulfill demand for computer programmers and engineers in 2000.[9] In 1999, "one-third of all [science and engineering] PhD-holders working in industry" and 16% of PhD-holders in the federal government workforce were born abroad.[10] Since 9/11, however, the number of foreign workers allowed into the United States has been greatly reduced.

While the U.S. has a diminishing turnout of engineers, scientists and mathematicians, some of our largest economic competitors (China, India, Singapore, Great Britain) are taking initiatives to encourage the development of advanced information technologies and the necessary skills for their workforce. The fact that "global competition for [science and engineering] talent is intensifying" has made over-dependence on foreign talent a grave concern.[11] This leaves an alarming gap in many highly-skilled jobs across the country—from professors at universities to computer programmers. With highly-skilled jobs unfilled by Americans and an inadequate number of skilled foreign workers entering the United States, crucial positions and crucial skills are not being met. All of these findings do not bode well for America's future in science and information technology.

Human Capital and National Security

The shortage of highly-skilled Americans does not just slow economic growth and U.S. competitiveness abroad; it also threatens our national security. In January 2005, there were 7,693 unfilled jobs (at government service pay grades 9-15) at the Department of Homeland Security, the FBI, the CIA, and the Department of Defense (for civilian employees within the Army, Navy, Air Force and Marines).[12] Most of these higher-level jobs necessitate technological proficiency and data analysis skills. In November 2004, the President announced a targeted 50% increase in the CIA's clandestine services. With only 5% of the U.S. labor force scoring at the highest level of literacy proficiency, where will the government find the applicants with the necessary skills and languages to fill these crucial positions?[13] Investing in advanced-learning technologies will

produce a larger pool of qualified applicants to serve in our military and intelligence agencies. DO IT will cultivate a more technology-literate pool of applicants that can satisfy the highly-skilled positions in our armed forces and security agencies which are currently difficult to fill.

Investing in the Future: The Role of Human Capital and R&D

Without building new models and tools for teaching and learning, we are stuck in classrooms that haven't changed much since the turn of the century and we continue to use methodologies that do not fully integrate and utilize the technology that permeates every other sector of our lives. Former U.S. Secretary of Education Rod Paige notes, "Education is the only business still debating the usefulness of technology. Schools remain unchanged for the most part, despite numerous reforms and increased investments in computers and networks."[14] By failing to invest in research and development of educational content and new methods of teaching using technological advances, the United States is overlooking its most crucial asset—human capital. Study after study has found that investment in human capital stimulates economic growth; by increasing the skills-level of our workforce, productivity and GNP are sure to increase as a result. Indeed, according to Nobel Prize laureate Gary Becker, "human capital is estimated to be three to four times the value of stocks, bonds, housing, and other assets."[15] Thus, improvements in the productivity and skills of Americans will have a profound impact in years to come.

Currently, the government is spending $500 billion on public K-12 education, yet investing less than one-tenth of one percent of that amount on research and development (R&D).[16] Research and development efforts for education are essential—not only to ensure that federal money is well spent, but also to determine the best educational techniques and develop improved methods of teaching.

Many countries increase investment in research and development as a means to "spur job growth" and in turn succeed in attracting the best and the brightest researchers and innovators. Comparing money spent on R&D to GDP, the United States still ranks behind its main competitors, at fifth among OECD states.[17] Between 1993 and 1997, the number of researchers in America increased by 11.8%, compared with the OECD's 23% growth in researchers.

As the federal government is under-funding research and development for education, profit-seeking private firms are also slow to invest in the development of new educational techniques and software because they are not able to capture all of the benefits from such an investment. Investment in educational technology has higher social rates of return than private rates. What we are witnessing is a market failure in R&D for educational technology.

There are some examples of private investment for the public good. Google, in conjunction with several university libraries, recently announced its initiative to put millions of books online to provide "universal access to the world's printed treasures."[18] There is a need for more private ventures in educational technology. Unfortunately, though, we can't always rely on the goodwill of private investors to fill this gap. As Thomas Kalil points out, while there is a high social rate of return for the creation and production of adult literacy software, "the amount of money that is available for commercial software to address this market is a tiny fraction of the budget for the latest PlayStation2 or Xbox game."[19]

DO IT – Addressing Our Educational Needs with Advanced Technology

Having illustrated the need for increased investment in human capital and educational research and development in the United States, we now turn to how DO IT can begin to meet these critical needs. DO IT can help to develop the necessary educational programs that can address these shortfalls in our public education system and workforce through smart and efficient investment and coordination. DO IT will focus on the primary need in educational technology – development of educational content and software that makes use of the wide array of technologies at our fingertips.

The NSF has accomplished its achievements in science by nurturing the people, ideas, and tools needed to generate new scientific knowledge and new technologies. Similarly, DO IT will bring together a community of researchers and developers for education, workforce training, and lifelong learning. DO IT will foster collaboration among cognitive scientists, computer scientists, and educators with classroom experience in order to produce the most effective teaching prototypes. Thorough research and design of software and educational content, together with testing through pilot programs and experimental groups, will ensure that DO IT funding results in state-of-the-art teaching and learning techniques that embrace the potential of information technology.

Some basic tools could include: **interactive digital aids** for reading, writing, math or languages. For instance, animated math software with entertaining 3D graphics and in-depth, problem-solving narration can ask students questions during the lesson to keep them involved and allow them to learn at their own pace.[20] More advanced educational technology could include **virtual reality** and **simulations** that would make it easier for learners to grasp complex ideas or processes and gain more hands-on knowledge. Learning through virtual reality and simulations would be more engaging and experiential than the traditional modes of learning that constitute today's education system. New communication tools could connect students to experts from around the world and reach rural or urban, remedial or advanced learners alike. **Intelligent tutoring systems** that assess a learner's strengths and weaknesses as well as measure a student's progress in a certain subject area will allow students to ask more questions and receive more answers than they are able to do in a typical U.S. classroom—a classroom with one teacher and 30 or more other students.

These are just some of the many technological tools that can also help to guarantee that lifelong learning and workforce training become the rule rather than the exception. A long-term strategy, such as DO IT, will improve the quantity and quality of educated, skilled workers in America.[21] Working Americans must be able to continuously learn new skills in order to remain competitive in their jobs, and firms will rely on highly-skilled workers to remain competitive in the globalized marketplace. Workforce training will be made less expensive for employers, and more accessible for employees. Learning through some of the methods mentioned above will enable people to learn at their own speed, in their own time, and at a place of their choice—yet still give them the interactive and individualized instruction that is often lacking in a classroom setting.

Digitizing our Public Institutions

Another part of DO IT's mandate will be the digitization of America's public institutions that have been left behind in the continuously-evolving and unaffordable realm of information technology. Museums, libraries, universities, arts and cultural centers, and public-broadcasting

stations have largely been unable to provide their services to the general public in the form of digital media. Hundreds of years of our country's history and culture could be made accessible to people in their homes, schools, or workplace through digitization. Digitizing many of the fragile or hard-to-access records contained in museums and libraries all over the country could enhance the tools available to learners of all ages and disciplines. The greatest barrier most public institutions face is the cost of digitization. Often, user fees or subscriptions restrict the number of users who can access the information.

DO IT will work to increase the pace of digitization and work to coordinate digitization efforts on a national level to enrich the digital environment that Americans are exposed to. Most Americans cannot make trips to our richest museums and institutions in person and, therefore, never benefit from what our public institutions have to offer. DO IT will work to bring the DNA of America to all Americans.

Investing in Education: Following a Precedent

An investment such as DO IT is by no means without precedent. The United States has a history of farsighted investment in education that has ensured that Americans continue to be among the most educated and productive workers and innovators in the world. The Northwest Ordinance of 1787 set aside public land to support public schools in every state. The Land-Grant Colleges Act of 1862, enacted during the Civil War, established 105 land-grant colleges that have led to the preeminent system of higher education in the world. In 1944, the GI Bill expanded educational opportunities for more than 20 million American men and women who fought in World War II, making the United States "the best educated nation in the world," according to historian Stephen Ambrose.[22] In 1958, the National Defense Education Act responded to the launch of Sputnik by declaring an educational emergency and investing heavily in educational development. In the time period following such impressive investments in education and R&D, "the United States was the world's most productive economy by virtually any measure. U.S. output per worker was higher by margins of 30 to 50% over the other leading industrial nations…"[23] Many attribute this era of U.S. economic growth and global leadership to the surge in federal investment in education and R&D during the post-war era. These investments are positively correlated with the increase in the level of educational achievement in the United States: "Between 1950 and 1973 the average number of years of American post-secondary education again doubled, further widening the gap" between the United States and Europe.[24] The emphasis placed on education and training from 1950 to 1970 helped to make America's workforce the most educated, productive and innovative in the world.

DO IT, similarly, would be a digital gift to the nation that uses interest from government revenue earned from the licensing of a public asset—electromagnetic spectrum—for the much needed innovation and development of teaching methods and educational technology that will keep the United States ahead of the rest of the world.

Historical Parallels: The Right Time is Now

In 1950, Congress had to make a decision on whether or not to provide funding to start the National Science Foundation. With the beginning of the Korean War, Congress questioned whether or not funding science research and development was an appropriate way to spend federal money. Testimony from the Defense Department and the U.S. Atomic Energy Agency highlighted the relevance of NSF's mission to national security. At the signing of the bill

enacting the NSF, President Truman said "The fact that the world has not found postwar security in no way lessens the need for the National Science Foundation. On the contrary, it underscores the need."[25] The United States finds itself in a similar position today. As the war against terror continues, many may question whether now is the appropriate time to spend government revenue for educational advancement. It is apparent, however, that current insecurities in the world underscore the need for DO IT.

The complex and evasive nature of the enemy that America faces today is of a different nature than any enemy the nation has faced before. It is an enemy that requires even greater understanding of information technology and more skills in science or languages. As noted above, many jobs in U.S. intelligence and security agencies are currently unfilled due to the shortage of highly-skilled applicants. In 1957, the launch of Sputnik by the Soviet Union woke up the U.S. government to the need to further invest in education, science, and technology despite budget constraints. The statistics mentioned above paint a picture of an under-skilled American workforce, and of American students that have fallen behind our competitors in educational performance and attainment. That disconcerting picture should serve as an urgent call to action.

DO IT Governance and Accountability

The proposed governance structure of DO IT is modeled after entities such as the NSF and the NIH. The model ensures that the management structure provides ultimate accountability to the Congress while also enjoying the independence from political interference needed to guarantee the highest-quality product. DO IT will be overseen by a Board of Directors whose members serve with the advice and consent of the Senate. The DO IT governance will be much like the National Science Board—the governing board of the NSF. Similarly, the DO IT Board would be responsible for setting direction and budget guidelines and for providing oversight of the organization. The DO IT Board would be available to Congress whenever needed, just like the National Science Board. The only difference is that the director of DO IT would be selected by, and serve at the discretion of, the governing board.

DO IT will not only fill the current investment gap in R&D for education, but will maximize the private sector's role and capabilities through a competitive grant process. The strong record of the NSF in producing high-quality advances in science, such as nanotechnology or genetic mapping, proves that the competitive grant process fosters the highest quality of research and work in the field. Applications are reviewed by a panel of scientists and leaders in the field—ensuring that the funding goes to the best candidate through an objective and transparent process. By not having excessive earmarks or undue political interference, the NSF's competitive grant process ensures that the government's investments are productive.

The NSF has enjoyed a very smooth and cooperative working relationship with Congress. The NSF has shown exemplary compliance and transparency in its dealings with Congress. With a similar governance structure, DO IT would have a comparable rapport with Congress, and the same sound financial management as the NSF.

Conclusion

DO IT will set in motion an investment that will address the widening gap between America and its competitors. DO IT will not only advance each American's capacity to filter and utilize the wide array of available data, but will produce a more secure and skilled nation in today's insecure

world. The United States can't afford not to enact DO IT if we want to remain competitive and secure. America is falling behind in education and training in the information age, yet continues to under-fund educational research and development. The power that technology can play in revolutionizing education must not be underestimated. In order to succeed in the digital era, we need to understand how technology can reshape how teachers teach and how students learn. The end result will be a strong human capital base that will lead to a more productive and competitive workforce.

Because of the foresight of Congress in 1950, the US has remained a leader in the fields of science and technology due largely to the role of the NSF. DO IT will ensure that we maximize the use of America's invaluable human assets, which can enhance our collective well being. DO IT can make our economy more vibrant, our nation more secure, and our citizens more competitive and productive. Moreover, the success of the NSF governance structure shows that DO IT can be effectively governed and structured so as to be thoroughly accountable to Congress and to the public trust.

America needs DO IT.

Endnotes

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[5] Id.
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