

asking my permission? Let me start with the first question and teach you some vocabulary as well. In the trade, a computer that has been infested with one of these programs that allows somebody else to take it over is called a zombie. When we have a lot of zombies, we call them a botnet, where 'bot' is short for robot. We call the owner of a botnet the bot master or bot herder. (We have this theory that if you cannot solve a problem, you can give it a cute name.)

When the aspiring bot master wants to build a botnet, he looks for any website that appears inadequately administered and insecure. He then craftily attacks the website so its owner never notices. He will creep in, attach a little piece of code to a page that will cause a machine opening that page to download something, creep out again, and then sit and wait for machines to get infested as they touch this webpage. This method is called "drive-by infestation," or "drive-by downloads." As each machine gets infested it sends a message to the bot master, and when he has tens of thousands of machines he puts his botnet to work.

Let us return to the Estonia attack for a minute. One of the interesting things is that the attack was immediate. The attackers did not have a chance to build their own botnet. But in this world you do not have to build your own botnet; you just go and rent one. Building and renting botnets is now a specialty business. What this means is people are invading your machine, taking its unused processing capacity, and selling it on the black market. Some botnets are huge. The Dutch government recently broke up a botnet that had one and a half million machines on it.

Let me come back to my second question. Why was it that a web-

page could download a piece of code onto your machine without asking your permission? Well, as the web evolved – and this was not Tim Berners-Lee's original vision when he invented the web, by any means – the designers wanted to be able to load new features onto your computer that did not require any effort on your part. They wanted a world where they could download code onto your machine to "enhance" the experience of using their website. They pushed this design despite the fact that security folks were standing on the sidelines saying, "Don't do this." It was a conscious, fully informed decision to sell you a machine that was open to these sorts of attacks by people who had other priorities.

The goal of the Academy study is to look at the security of the Internet. It is tempting to think of this as a purely technical problem – just beat the geeks with sticks until they get it right – and that may be correct in some cases. But when systems designers knowingly install flaws into a system because they see the benefits as outweighing the costs, it becomes a social, legal, and policy problem. To really understand security and the Internet, you must assemble a multidisciplinary team because you have to put your arms around some really big issues. And, in fact, we have struggled because the problem is so big and multidimensional. It involves looking at technical problems, matters of trust, perceptions of risk, and issues of incentives.

The Academy, with its multidisciplinary membership, is a great place to undertake a study like this. So stay tuned, and when you leave home, turn off your computer.

Panel II: Challenges for Education, Humanities and Culture

Universal Basic and Secondary Education

Joel E. Cohen

Abby Rockefeller Mauzé Professor of Populations, Rockefeller University and Columbia University

In 1997, I had a conversation with Leslie Berlowitz about the idea of providing all children in the world with the equivalent of 10 to 12 years of schooling of high quality. Leslie's vision and the collaboration of David Bloom, an Academy Fellow at the Harvard School of Public Health, led to the creation of the Universal Basic and Secondary Education (UBASE) project. We brought together people from diverse continents, cultures, and fields of learning and action to consider what it would take to educate all the world's children well for 10 to 12 years, and what kind of a world could result from universal basic and secondary education.

Why is educating all the world's children well important? Education, if wisely oriented, can benefit individuals and societies demographically, economically, environmentally, and culturally (including politically). Here I sketch some economic and demographic aspects of the promise of educating all the world's children well.

In 1900, there were 1.6 billion people in the world. In 2001, by World Bank estimates, about 2.7 billion people, nearly 53 percent of the developing world's 5.2 billion people, were living on the equivalent of \$2.15 a day or less (in 1993 U.S. dollars at purchasing power parity). That is poverty. Essentially nobody in the developed countries lived on income that low. More people live in pov-

erty today than were alive in 1900.

By the year 2050, the United Nations Population Division anticipates adding to today's population about 2.6 billion people if men and women continue to have fewer children as suggested by the decline in fertility over the last 40 years. Virtually all of those additional 2.6 billion people will live in the cities of the presently poor countries. If couples have, on average, half a child more than forecast over the next 45 years, we will have by the year 2050 about 1.5 billion more people than anticipated. If couples have, on average, half a child less, we will have by 2050 about 1.4 billion fewer people than anticipated. A difference of one child per woman's lifetime between now and 2050 entails a difference in the Earth's population of nearly 3 billion people, which was the total population of the Earth in 1960.

In diverse cultures around the world, women who complete secondary education have, on average, at least 1.5 children fewer than women who complete only primary education, who in turn have fewer children than women who do not complete primary education; and the higher the level of the mother's education, the better the health and survival of her children. The average number of children per woman's lifetime associated with each level of a mother's education varies widely from culture to culture, and in many places the average difference associated with completing secondary education is far larger than a reduction of 1.5 children. Of course, causality runs both ways between education and numbers of children, since girls who get pregnant leave or cannot enter school in many cultures.

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In many societies, fewer girls than boys enroll and remain in primary school. The educational gap between boys and girls is a problem for many reasons, ethical as well as practical. But, according to Deon Filmer at the World Bank, the gap in primary school participation between the top and the bottom quintiles in the income distribution is much greater than the gap between boys and girls, and the gap in school participation is even greater for children with disabilities than for girls or the poor. The challenges facing universal education include reaching girls, the poor, and the disabled.

The UBASE project aimed to find out how much it would cost to educate all children. Could countries afford to put all children in school for 10 to 12 years or to give them an equivalent education? That question is difficult

to answer for at least four reasons (in addition to the paucity of accurate, internationally comparable data).

First, the average cost of educating a child who is not currently in school probably differs from the average cost of educating a child who currently is. The child not in school now may be disabled, may live in a remote rural location, or may have some other handicap. Moreover, supplying a high-quality education to a poor child may, on average, require more in-school resources than are currently expended on the better-off students currently enrolled.

Second, the average cost of enrolling an unenrolled child may be higher than the average cost per currently enrolled student because it may be necessary to compensate families who keep their children at home for the time children spend working for income or handling chores so other household members can work for pay.

For these two reasons, a linear extrapolation from the costs per child already in school to the cost per child not yet in school is speculative.

Third, we do not know how much it would cost to improve the quality of schooling so that parents will want to send their kids to school, rather than send them out to work or keep them home for chores.

Fourth, we do not know by what means people will be educated 20 years from now. Will they be taught in schools? Will they be taught with cell phones, or with MIT's \$100 computer, or with the UK's Nivo, or with India's Simputer? Or in some other completely different way?

Despite these difficulties, as part of our project Paul Glewwe and Meng Zhao (for primary school-

ing) and Melissa Binder (for secondary schooling) estimated that all children could be given the equivalent of a decent primary and secondary education for an additional cost, on top of what developing countries are already spending to educate their children, of probably not more than \$70 billion per year. In 2000, for the low- and middle-income countries (about 5.1 billion people), the incremental cost of \$70 billion per year would amount to about 1.2 percent of their gross national income (GNI). The GNI of the high-income countries (with about 1 billion people in 2000) was about \$25.5 trillion of the world's \$31.5 trillion, and an incremental cost of \$70 billion per year would amount to less than 0.3 percent of their GNI. The world, collectively, can afford to educate all its children well, but the poor countries will need some help from the rich countries. The amounts of money needed could be well above the current level of foreign aid but are feasible if the will is present (as the Marshall Plan demonstrated).

Cost is one of several obstacles to universal basic and secondary education. Like cost, none of these additional concerns is insurmountable if all are recognized and dealt with. Competing demands: Education competes for scarce national resources with roads, medical care, and defense. Returns on investment in education are difficult to measure. Lack of information: Internationally comparable, useful data on the quality of primary and secondary schooling are lacking. Political obstacles: Benefits of schooling accrue too slowly to benefit political incumbents. Violence disrupts schools. Cultural barriers: Discrimination inhibits schooling for girls and for linguistic, religious, and ethnic minorities. Historical con-

text: The history of education in a country affects the success of externally imposed educational solutions.

In January 2007, MIT Press published the UBASE project's first book, entitled *Educating All Children: A Global Agenda*, which I edited with David Bloom and the Academy's program officer Martin Malin, now at Harvard. In it, and in an article for the International Monetary Fund's journal *Finance & Development*, we identified a number of changes that need to be implemented simultaneously:

- a commitment to extending secondary education of high quality to all children;
- open national, regional, and international discussions on the goals of universal primary and secondary education – that is, what do people want education to achieve?
- a commitment to improving the effectiveness and economic efficiency of education in achieving those goals; this improvement should be driven by reliable data on what children learn; careful experiments with alternative pedagogical techniques and technologies; and comparative studies of the countries that perform best, region by region, with given funding and material resources;
- international recognition of the diversity of educational systems in different countries, and adaptation of aid policies and educational assessment requirements to local contexts;
- more money and higher priority for education – especially an increase in the absolute and relative amount of funding from rich countries for education in poor countries.

Universal high-quality primary and secondary education, wheth-

er through schools or other technologies yet to be developed, is achievable. The sooner and the greater our efforts to achieve universal high-quality primary and secondary education now, the greater the demographic, economic, environmental, and cultural impacts by 2050. Educating all children well – quality counts crucially – is a worthwhile, affordable, and achievable strategy to develop people who can cope with problems, foreseen and unforeseen.*

**I thank David E. Bloom for very helpful comments on a prior draft.*

Initiative for Humanities and Culture

Patricia Meyer Spacks

Edgar F. Shannon Professor of English Emerita, University of Virginia

The Academy's Humanities Initiative aspires to make the importance, the meaning, and the history of the humanities more widely comprehensible. At the moment, the Initiative is concentrating on two projects: one involves the collection and organization of data; the other focuses on compiling a collection of essays by academic leaders that will assess the current condition of the humanities.

Humanists, as you may know, often see themselves as being in a state of crisis. This is one of the crisis periods. Widespread perception has it that the place of the humanities in higher education and in popular opinion is diminishing, but do the facts support the perception? Both our projects will help to answer this question. In the short time that I have, however, I would

like to concentrate on the project that involves the collection of data.

The Humanities Indicators Project, as we call it, is an ambitious effort to move toward creating an annual compilation of relevant data for the humanities. At present, rational discussion is impeded by the fact that no one really knows much about what is going on in the assortment of academic fields designated as the humanities. Unlike scientists and engineers, humanists have never had available to them a single dependable source of data about their field. The *Science and Engineering Indicators*, issued biennially by the National Science Foundation, provide information about education and employment over a wide disciplinary range. In the humanities, professional organizations have tried to assemble facts about developments within their disciplines, but the data among fields are generally not compatible since different organizations employ different means of gathering data and different ways of codifying them. You would have a hard time finding out how many undergraduates now major in the humanities, and if you did find out, you could not compare your figure with the number of majors ten years ago, much less twenty years ago.

The American Academy has set out to facilitate the inauguration of a comprehensive system for accumulating and organizing basic information about education and employment in the humanistic disciplines. How many people major? How many take courses? How many get advanced degrees in these fields? What do people with Ph.D.s in the humanities do for a living? How much teaching in humanistic areas is done by part-time faculty? These are the sorts of questions we have in mind. The enterprise involves

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figuring out how best to make use of existing data, as well as how to gather new information. It has required the collaboration of men and women from many disciplines: statisticians, social scientists, and humanists – the kind of collaboration that the Academy facilitates. It has also involved many organizations, including the National Science Foundation and the learned societies under the umbrella of the American Council of Learned Societies. And thanks to foundation support and to the leadership of Norman Bradburn of the National Opinion Research Center at the University of Chicago, it is finally happening.

The effort to organize data has proved enormously complicated, but the initial project is now moving toward completion. Professor Bradburn and his assistants are putting together a prototype compilation. It remains to be seen whether the resources will be available to continue updating the available information. This initial version is showing good news and bad news for the humanities. Let me offer a few examples. On the positive side,

there turns out to be high job satisfaction among humanities graduates, who believe, by and large, that their education has equipped them well for the work they do. In liberal arts colleges, humanities faculty continue to constitute the most significant portion of all faculty. They also have an impressive presence on two-year college campuses, although most of those teachers do not have Ph.D.s. The humanities has nearly achieved gender parity in its faculty, although in 2004 women still represented less than 40 percent of tenured faculty.

The news about parity, though, is less good than it seems. Although in 2004, 60 percent of doctoral recipients in the humanities were women, the percentage of tenure-track faculty who are women has dropped steadily since 1993. This disconcerting fact means not only that future prospects for tenured women are declining; it also reflects the truth that a large proportion of the increasing group of part-time and adjunct faculty is female.

Most of the bad news apparent so far is fairly predictable. Humanities faculty are the lowest earners in academe, with a median salary over \$30,000 lower than the median for faculty in the health sciences. Although job satisfaction among humanities professors is high, they complain about their salaries. The number of undergraduate degrees awarded in the humanities is now close to the 1970s high, but since the total number of bachelors' degrees has increased, the humanities' share has diminished, standing far below that of business, for example, which awarded 22 percent of all bachelors' degrees in 2004. Nonetheless, B.A.s in the humanities remained the third most commonly awarded undergraduate degree.