SHEFFIELD LECTURE - YALE UNIVERSITY JANUARY 11, 2000 INTERNET LEARNING: IS IT REAL AND WHAT DOES IT MEAN FOR UNIVERSITIES?

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I. INTRODUCTION

My interest in learning over networks dates back to 1989. In 1989 there was no commercial Internet. It was hard to get people interested in learning over networks or to even to understand what learning over networks meant or could mean. Fortunately, in 1992 I was joined at the Sloan Foundation by an extremely able program director, Frank Mayadas. Then we were able to get a real program started.

I am glad that I have been involved in this field for many years, because if I had to build up a picture of Internet learning now, from what is available to be read in the newspapers or news magazines, I would be thoroughly confused. I would not be able to find out what was really meant by Internet education. I would not know whether this thing, whatever it might be, actually provides real learning or not. I certainly would not know whether this thing, whatever it is, is significant for the present day providers of higher education; today's universities, four-year schools and community colleges.

The sort of thing you *can* easily read about is UNext, a highly publicized for- profit company. UNext plans to use educational materials supplied by leading universities. UNext says grandly on its web site "Welcome to the Future of Learning." Columbia University, a participant, describes it as a ground-breaking distance learning enterprise. And its board of directors is heavy with Nobel prizewinners. Nevertheless, if we are looking for solid information about distance learning, surely this is not it. If we examine what UNext, has actually done, we find that to date no courses have actually been given. Therefore most of the extensive discussions of UNext are, at this time, just speculation.

A somewhat more negative view was provided by Supreme Justice Ruth Bader Ginsberg at the dedication of the Rutgers Center for Law and Justice. There Justice Ginsberg asserted that while she could see the uses of the internet as an aid in legal education, "I am troubled by ventures by Concord where a student can get a J.D. … without ever laying eyes on a fellow student or professor." Like those who predict wonderful learning outcomes, this view too is speculation. At the time of Justice Ginsberg's remarks only 26 people were enrolled in the Concord Law School, and they were starting their first semester.

Back on the super positive side, Western Governors University made headlines in 1996, and even as recently as 1998 was described in a usually very sober publication (the *Chronicle of Higher Education*) as "A New Model for Higher Education." Its enrollment projections, described in the article, at that time for the 1999 –2000 academic year were about 15,000. Its actual enrollment today is about 250.

All of these assertions both positive and negative are fired off as if there was a vacuum of real knowledge about teaching and learning in this new mode. But while these assertions were being made, and well beneath the radar screens of the newspapers and news weeklies, there has been real activity. Institutions

of higher learning that have been teaching for many years and were not, like those I have just cited, invented yesterday, were teaching real people in significant numbers. So let me describe the state of the art today based not on speculation but on the actual, and largely unreported, experience of these schools.

II. NATURE OF THE NEW TECHNOLOGY

First a few remarks on the technology itself. In the Internet we certainly have a new technology available that is relevant to learning. But this in itself is not new. There have been many technologies that have been heralded as likely to have a major effect on education, ranging from the audio visual, to educational films, to Plato (the computer instruction not the Greek Philosopher) and other computer aided instruction, as well as a vast variety of televised courses. But to date none of these have had significant impact.

In actual practice the traditional classroom has proved to be quite resilient, which is a quality that we should respect. What is happening now, may well be different, because it accepts the fundamentals of classroom teaching, more or less as we know them now, but reproduces them outside the classroom.

After all, what are the elements of higher education, as we know them here at Yale or at any other college or university?

First there is the Professor. He or she leads the class, sometimes writing, sometimes showing slides, sometimes responding to questions. This person, also, if you persist and have good timing, can also sometimes be found in his or her office for one on one discussion.

A second element is the course material. Sometimes this is available in the form of a textbook, sometimes in the form of references; sometimes you just listen and take notes.

A third element is classmates. They help both in and out of class. They provide an element of shared experience, and they are people with whom both the course content and what the professor meant can be discussed between classes. They also provide important emotional support.

Today it is possible to provide *some form* of these elements electronically, without a campus, without a classroom, and without the necessity for the learner to be at some fixed place or time when a lecture is being given.

Through the Internet we can access course material, put there by the Professor. This can be video portions of a lecture and slides stored electronically, or it can be text covering the same material. Through the Internet we can interact with the professor by electronic mail. Through the Internet we can in some sense discuss with our classmates, even though we have never seen them, the course material and things that are obscure. We can for example send a message to our classmates "I'm baffled - can anyone do the problem on page 13?"

We call systems that do this ALNs, Asynchronous Learning Networks, and this is the form of new technology that I consider significant and that I am going to discuss today.

III. BEYOND THE TECHNICAL:
WHAT WE KNOW TODAY

Certainly naming the elements of today's educational process and showing that something like those elements can be reproduced outside the classroom does not mean that this process will work. It is not obvious that this process can really educate people or that people will want to learn this way. It is a real question - Will people really learn this way?

Fortunately the question of whether ALNs, asynchronous learning networks, really work with real people, has, to a considerable extent, been answered by considerable practical experience. To date, the 47 schools

of the Sloan Consortium alone have provided more than 4,000 faculty-semesters of ALN teaching experience and more than 100,000 enrollments.[1]

All ALN projects initiated under Sloan grants are still in place whether or not we provided follow-on funding; in fact, most have been considerably expanded through use of non-Sloan money. We estimate that schools that have received Sloan grants will provide 85, 000 enrollments during this academic year and will be offering 70 full degree programs. The participants are a very wide range of institutions. They range from research universities to community colleges. For this academic year the University of Illinois will have 4,500 enrollments, Penn State will have 3,000, Stanford University 3,000, SUNY, the State University of New York will have 12,000, University College, the extension arm of the University of Maryland will have 12,000 and Northern Virginia Community College will have 6,000. All sorts of courses are being given ranging from Accounting to Mechanical Engineering to Computer Science, Criminal Justice, Sociology and Philosophy. [2]

So we can do more than speculate, there is a real experience base to work from. We can reasonably ask from this considerable experience what is it that we know today about this kind of learning?

The main thing is that we are confident that the students are not only taking courses, they are actually learning. Many comparisons of learning outcomes have been made; this is usually when the same course is taught off campus and on campus by the same professor giving the same exams. Usually the learning outcomes for the different sections are indistinguishable. The off campus and on campus groups usually score about the same. Of course they are not always the same. But enough work has been done in enough areas to see that this outcome is not the exception but rather the rule to which there are exceptions. With 100,000 enrollments there are plenty of individual horror stories as well as stories of exceptional learning results, but the clear consensus is that with the same faculty/student ratios, which is what we have by and large in the Sloan Consortium, learning quality is about the same.

We also know there are both pitfalls and advantages to this new approach that are not mere redoes of the older world.

While an ALN is an attempt to reproduce the basic elements of classroom teaching, it is certainly not the same as classroom teaching. It has both weaknesses and strengths compared to classroom teaching. An ALN lacks, for example, the instantaneous interaction with the professor that a good classroom has, a classroom where a question can be asked and answered in real time. But it also means that people who are shy about asking questions in class can not be crowded out by those who are much more vocal. They can send their questions, more freely and more thought out, through the calmer medium of electronic mail.

We have learned that if homework is constructed to be instantly electronically corrected and returned it can be an important learning tool; we have also learned that inadequate training on the fundamentals of the underlying software can lead to the disappearance of a large portion of a class, before learning about the course material itself has even begun. We have learned, as one might expect, that lab courses are a problem, but one that usually can be dealt with by various expedients. And we have learned that institutions of higher learning can adapt to these new students, register them at a distance, and deliver instruction.

We have learned that ALN courses can be given to students having the usual qualifications by the regular faculty, as they are at University of Illinois and Penn State and SUNY, or through the traditional extension arm, as they are at the University of Maryland. And the results in both cases are overall the same as they were with classroom teaching.

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[1] An enrollment is one student-semester.

[2] For more on the Sloan Consortium see www.sloan-c.org

We have learned that ALN can be done in a wide variety of styles, text based, video based and everything in between and that all these styles can work (or not work). It is still pedagogy that counts.

We do know enough today to say that a new technology has arrived on the higher education scene and that it works. Let us therefore consider some of the consequences.

IV. CONSEQUENCES

A. Consequences for Learners

For the learner it eliminates the cost of travel, lodging, and, most of all, the cost of foregone opportunities. You can be working; you can be at home with a family, and still have the ability to learn. Because of this the overall market for higher education and advanced training will certainly be made much bigger by ALNs.

B. Consequences for Professors

For those who teach ALN classes, teaching will be different. How different depends on the form of ALN employed. One cheap simple and direct way is to videotape the professor giving lectures and put the written material up with the tape in the form of slides. Assignments are posted on the website as is reading material. Other forms put what would have been the lecture material up simply as text and go on from there. One of the things we have learned is that there is no one form of ALN. Just as there are many styles of teaching, there are many styles of ALN teaching. ALN is a broad technology; it can work in many forms.

There is an enormous range of ways to convert a course to online form. If you insist that the course be full of gripping graphics you can make the process arbitrarily expensive. This gives rise to the notion that course conversion is expensive. When we started we provided $50,000 for course conversion; today we give $4,000-$12,000.

Interaction with the students is also different. Usually there is more interaction, and incautious professors who do not set rules for when they will answer e-mail find they have given themselves 24 hour/day jobs.

C. Consequences for Institutions

For institutions there are some inherent elements of economy since ALN reduces the need for buildings and related support. On the other hand there are costs of course conversion and the costs of computer and other support at the institution level. The bookkeeping of institutions of higher learning is so arcane that trying to compare these different kinds of costs ends up being strongly detail dependant and not particularly illuminating. If we compare courses with the same faculty/student ratio, which means comparing courses with comparable quality, my best judgment today is that a reasonable approximation is that costs are the same.

But if that is so what institutions are in a position to reach out to that new and larger market? Certainly it is not easiest for top tier schools with large endowments. At such schools tuition covers only a fraction of what the university spends per student. Adding more students, even at full tuition is often not economically attractive.[3] This is one of the interesting perverse results of alumni generosity, many universities are not profit making institutions to which a larger market is attractive, rather they are subsidized institutions who lose money on every student. They are therefore not in position to provide

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[3] A marginal analysis of the cost per additional student would be less negative as it would not allocate the costs of supported research, buildings etc. to the cost per additional student.

their quality education to a larger market. Stanford has conquered this difficulty by charging considerably more, not less, for off campus degrees, but so far it is the exception rather than the rule.

It is the schools that rely mainly on tuition, or the schools whose state support grows adequately with enrollments, including on line enrollments, that are able to expand most easily. There are many schools in this position today; Drexel and Pace Universities are examples of this. Whether state schools are or are not in this position depends on the details of how they are supported. SUNY, the State University of New York State, which now has about 6,000 students online, simply does not distinguish in its support; it gets the same amount for students on line as on campus.

Aside from the economics, often there is something politically attractive about reaching out to every corner of the state, and therefore such moves may well be state supported. This has been our experience so far with the University of Illinois system.

Of course even in many schools that are heavily subsidized there are parts that are profit making and these can grow through ALN. Schools of business or of Law are good examples. These are the areas that are the most likely starting points for for-profit competitors. Phoenix, is a serious and real for profit venture that gives mostly business degrees and has several thousand students on line.

What is the future of the profit-making sector within higher education? This leads into the general questions of the effect of ALN on the structure of the entire higher education industry. At this point we leave the domain of fact and definitely move into the realm of speculation. I believe it is a fact that ALN is a significant new technology that will allow new and effective modes of teaching and of organization. How this new technology will play out in this industry is, by contrast, very speculative. But I will give you my best speculations.

V. EFFECTS OF ALN ON THE HIGHER EDUCATION INDUSTRY

When looked at the industry level the whole picture has a familiar ring. A new technology has arrived on the scene. Typically lots of new providers appear rushing to take advantage of it. Often the current providers are much slower to react, due to internal organizational and personal reasons, the fear of cannibalizing their own businesses, or various forms of denial. It is typical that diesel locomotives were introduced by General Motors, not by Baldwin Locomotive the leading provider of steam locomotives. It is typical that Apple pioneered the PC, not IBM. Incidentally neither one is a leading provider of PC=s today since the criteria for success in this rapidly evolving area have changed again since the early days of the industry. More recently still, Amazon pioneered selling books on line, not Barnes and Noble.

New technologies usually succeed first in a niche where they have special advantages. For the steam engine the niche was pumping water out of the bottom of coalmines. For ALN the niche is learners whose location or life style allows no easy alternative. But having a niche to build on allows the technology to survive and grow and become more effective. In its improved form it may well penetrate a far larger market.

After a while in a new technology industry, especially if there are economies of scope or scale in what is being provided, there is a shakeout, many smaller firms disappear or are absorbed, and the industry takes on a more stable form. Entry of a new technology into an industry often brings in new providers, and new important names appear, and some names disappear or are diminished.

It is hard to forecast the impact of a new technology. Nevertheless I will describe a few plausible scenarios. These are more possibilities than predictions.

One effect of this new learning technology is likely to be more competition at a national level. Phoenix is a national educator; UNext aspires to be one, as does Penn State. For many students the choice of locality for their education has always been and still is restricted. The demands of family, or of work, do not allow

them to make an educational choice uninfluenced by nearness. ALN is likely to allow this group to choose from a much wider range of alternatives.

There is also, and this is important, for the first time, the possibility of more comparable quality. The unsubsidized schools to date have not been the high quality schools. But that too may change, because the new method of instruction allows the Professor to not be a regular employee and to be anywhere. He or she could be a world-leading specialist in the area to be taught. We do not know today to what extent this approach will be successful. This is related to the fact that we don't know today in what area people care mostly about course content or in what areas it is the credential that matters.

It is possible, though by no means necessary, that we will see a shift between subsidized and non-subsidized providers. Higher education today is almost always subsidized in the sense that it does not cover its expenses through its revenues. The subsidy may come from alumni and endowment or from the state, but there generally is a subsidy. There is a real possibility that the economics of ALN will enable unsubsidized and profit making providers to compete in a much broader way with the subsidized schools. This will be especially likely if the new providers master the ins and outs of the this new approach while the older schools struggle slowly with the question of whether they really want this new stuff at all.

A. Combinations of Institutions

There can also be new combinations of institutions. The Sloan Foundation has supported an alliance of unions and phone companies called (NACTEL) National Advisory Coalition for Telecommunications, which is arranging courses to help workers in the telephone industry to make the transition from the analogue to the digital world. Pace University is providing the courses that lead to an Associate Degree in Telecomm. The union provides marketing to its nationwide 800,000 members, and the phone companies pay the tuition as part of their collective bargaining agreement with the unions, the Communication Workers of America and the International Brotherhood of Electrical Workers. This is an interesting combination of institutions. This program is just ramping up; there are about 500 in it in this its first year. However this is a program that enables PACE University to reach out to a truly vast new audience.

And even within the traditional academic sector, some alliances seem possible and useful. Carnegie Mellon has initiated collaboration with some community colleges. CMU developed a high quality ten-course certification in software engineering, which will be taught on line by community college faculty. Carnegie Mellon envisages a close alliance with many community colleges. They will train and support community college faculty who will actually do the teaching. This could be an important model for many research institutions to interact with schools that have a teaching emphasis. But at present it is new and untried.

Alliances of many sorts are made possible by the abolition of distance, we cannot predict what will actually emerge, but the scene will change.

B. New Possibilities: Lifelong Learning

For the first time lifelong learning can be more than just a phrase but rather a real possibility for large numbers of people who want to learn but can not leave their jobs to do so.

And also give *a new* meaning to the phrase lifelong learning by teaching outside the classroom a wide range of things that were never taught there in the first place. Those of us who have had some exposure to engineering often hear that what an engineer knows goes out of date in 5 years, or 3 years if you prefer. But what does this mean? If it means anything, it means that there has been so much progress in some areas that the new knowledge has become essential. But where is that progress made and where can it be acquired? Often this is not in academia. There are industries where academia leads and industries follow,

but there are others where industry knowledge of what they are doing is far deeper, and what is taught in academia is a faint shadow. These new modes of learning open up the possibility of access to new knowledge whether its source is academia, industry, or anything else.

C. New Possibilities: Diversity

Another new possibility has to do with diversity. Diversity at universities has meant different things at different times. It has meant diversity of race, of socio-economic background, of geographic origin. But, we take for granted a remarkable homogeneity of age and experience, or lack of experience. This too can change. If ALN students are being educated along with traditional ones it becomes possible to have a diversity of ages and experience represented in the classroom. Our limited experience with this indicates that students find this very enriching.

Clearly it is also possible to have a lecture or lecture equivalent taught by someone the professor believes has something to say, wherever that person may be. This could be interaction about a particular business event, or how a scientific discovery was made, from those who were actually there.

Because of the possibility of such changes that improve quality, I believe it is wise for universities, even those who have no desire to reach out to more or different students, to understand, not ignore this new technology. And even beyond the quality issue, it is usually unwise to ignore a new technology that is having an impact in your industry. And I think that in this case understanding is more likely to come from activity rather than study. A few who have given courses on line on campus will usually understand the possibilities and limitations and usefulness, or lack of it, of this new instruction for their institution, far better than a committee set up to study the question. [4]

D. Learners

These changes brought about by new technology, which have both ups and downs in them for today's education providers are good for people who want to learn and for the country as a whole.

The ability to learn specialized skills at any time in one's life will certainly be enhanced, and this will strengthen the productivity of our entire country. From the individual's point of view it will *never* be too late to learn.

In some very limited sense learning has always been available to those who want to learn, and who will make the often-heroic effort required. History likes to dwell on people who were self educated, they learned on their own from a few books, struggled through snowstorms to the public library, or in a later epoch and on a larger scale, struggled through daytime jobs and then went year after year to night school. We don't hear about those who wanted to learn but couldn't because they chose not to take the time from caring for their families, or because there simply were no night schools where they were.

Today it is becoming possible to make learning something that can be done at a time and place of your own choosing; it can be done at home, but without the isolation of solitary learning. ALN can bring the support of classmates and of an instructor to you wherever you are. By making learning outside of the classroom less heroic, we can make it what it ought to be, an ongoing part of ordinary life.

VI. ABOUT THE AUTHOR

Ralph E. Gomory has been President of the Alfred P. Sloan Foundation since June 1989. Dr. Gomory received his B.A. from Williams College in 1950, studied at Cambridge University and received his Ph.D. in mathematics from Princeton University in 1954. He served in the U.S. Navy from 1954 to 1957.

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[4] Supplying educational material to some other course provider is does *not* qualify as gaining experience from this point of view.

Dr. Gomory was Higgins Lecturer and Assistant Professor at Princeton University, 1957-59. He joined the Research Division of IBM in 1959, was named IBM Fellow in 1964, and became Director of the Mathematical Sciences Department in 1965. He was made IBM Director of Research in 1970 with line responsibility for IBM's Research Division. He held that position until 1986, becoming IBM Vice President in 1973 and Senior Vice President in 1985. In 1986 he became IBM Senior Vice President for Science and Technology. In 1989 he retired from IBM and became President of the Alfred P. Sloan Foundation.

He has served in many capacities in academic, industrial and governmental organizations, and is a member of both the National Academies of Science and of Engineering. He has been awarded a number of honorary degrees and prizes including the Lanchester Prize in 1963, the John von Neumann Theory Prize in 1984, the IEEE Engineering Leadership Recognition Award in 1988, the National Medal of Science awarded by the President in 1988, the Arthur M. Bueche Award of the National Academy of Engineering in 1993, the Heinz Award for Technology, the Economy and Employment in 1998, the Madison Medal award of Princeton University in 1999, and the Sheffield Fellowship Award of the Yale University Faculty of Engineering in 2000. He was named to the President's Council of Advisors on Science and Technology in 1990 and served to March 1993.

Dr. Gomory is a director of The Washington Post Company, Lexmark International, Inc., and the Polaroid Corporation. Dr. Gomory's research interests have included integer and linear programming, network flow theory, nonlinear differential equations, and computers. In recent years he has written on the nature of technology and product development, research in industry, industrial competitiveness, technological change, and on economic models involving both economies of scale and technological change.