Virtual Learning: Between Imagination and Challenges

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The concept of a virtual school or university is one that excites the imagination—a linkage of the best in teaching with the newest and most powerful information and communication technology (ICT) interventions. When the vision of online education is linked to the extensive global efforts to alleviate the "Digital Divide," the case is more urgent: to deliver a crucial capability to those in desperate need. The most popular textbook used in Electronic Commerce courses worldwide describes the vision vividly:

> **People in the Third World countries and rural areas are now able to enjoy ....opportunities to learn skilled professions or earn a college degree.** [1]

But that noble vision is very difficult to bring to fruition. In this article I cite some challenges that confront any effort to deliver virtual learning to developing countries and suggest how each challenge can be an opportunity.

Challenge 1: The Bandwidth Divide

No matter what definition of distance learning is used, it is usually assumed that there is a significant component that involves ICT intervention. Unfortunately, many developing countries have low levels of diffusion of the most basic components of ICT: telephones, dependable electricity, personal computers, etc. and in some cases relatively low availability of TV, VCR and even radio. So to assert that bandwidth is a challenge is to state the obvious. The UNDP Human Development report for 2001 gives an example of the bandwidth divide:

> Africa has less international bandwidth than the city of Sao Paulo, Brazil. Latin America's international bandwidth, in turn, is roughly equal to that of Seoul, Republic of Korea.[2]

It is instructive to look at the gross bandwidth statistics by continent to appreciate the magnitude of the divide. **Table 1** gives summary data on bandwidth by continent. Africa and Latin America combined represent less than two tenths of one percent of the world's bandwidth capacity.[3] **Table 2** describes interregional bandwidth[4] showing that developed regions have significant advantage. There are many ways to interpret these figures. On one hand there has been a significant percentage rise in all continents—yet the base numbers for Africa are so low to begin with that it would take a massive infusion of capacity to improve standing relative to the other regions. If Latin American growth continues at the same very high rate, there could be some major changes in the balance shown in **Table 1**. Also, the amount of capacity should not be confused with utilization. Many providers have accumulated large amounts of capacity, waiting for propitious times to deploy it.

Table 1: Bandwidth by Region for 2000 and 2001

Region	2000 Mbps	2001 Mbps	% Growth
Africa	649.2	1,230.8	89.6%
Asia	22,965.1	52,661.9	129.3%
Europe	232,316.7	675,637.3	190.8%
Latin Am.	2,785.2	16,132.5	479.2%
U.S. & Can.	112,222.0	274,184.9	144.3%

Sources: (March 1, 2002) http://www.telegeography.com and http://www.band-x.com/show_news.cfm?itemid=13327

Table 2: Interregional Internet Bandwidth 2001

Country	Country	Bandwidth (Mbps)	%
Asia & Pacific	Europe	1172.4	0.53
L. America &Caribbean	Europe	68	0.03
United States	Europe	162,250.1	73.53
Africa	Europe	444.8	0.20
United States	Africa	766.6	0.34
United States	L. America &Caribbean	14,139.9	6.40
United States	Asia & Pacific	41,820.1	18.95
		220,661.9	100

Source: Packet Geography 2002. (March 2, 2002) http://www.telegeography.com/pubs/books/pg/interregional_figure.html.

Does low national bandwidth mean low probability of success in deploying virtual learning?

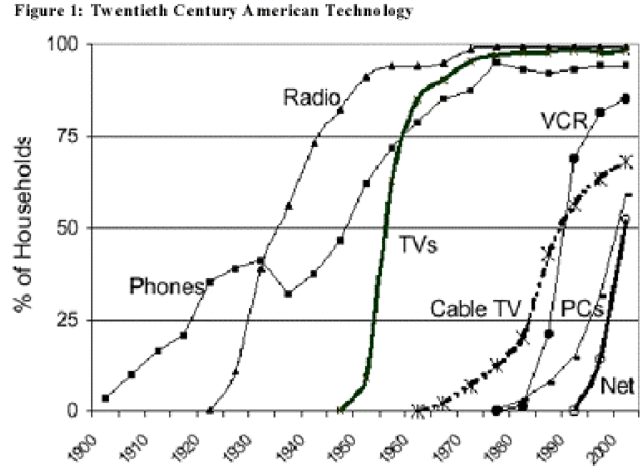
The implication of the bandwidth divide is not that virtual learning is impossible in poor countries. It is often feasible to use simpler, equally effective approaches that do not depend as much on bandwidth. China's trajectory in leveraging ICT over the 1980's and '90's has been exemplary. The national strategy was to begin by emphasizing the simplest, most reliable form of distance learning: correspondence courses. Gradually, they implemented approaches that made increasing use of radio, then TV, then VCR, then combinations of TV/VCR and CDROM, and during the past five years, extensive application of web-based distance learning, with particular emphasis on programs in business and engineering. By migrating from low to higher bandwidth approaches and leveraging technologies only when they were appropriate, China has become a very successful user of virtual learning technologies. This lesson can be useful for any developing nation, and is equally applicable in more technologically sophisticated countries.

Challenge 2: Understanding the Trajectory of Technology Diffusion

Each country or region follows a different path in the development and spread of technology. For one nation technology diffusion takes place at a pace determined by education or health policy. For another, there may be a direct relationship between openness of government and the spread of technology. Whatever the trajectory of technology use, it is vital to have a way to estimate speed, direction and desired destination.

Everett Rogers' studies of technology diffusion have a direct application to the examination of Internet use. He describes the time-phased movement of adoption and adaptation in terms of an "S-curve," which describes a slow initial rise over time, followed by a more rapid acceleration and finally a slowing toward steady state.[5] **Figure 1** shows S curves for adoption of six technologies in the US, beginning with telephone, followed by radio, television, cable television, VCR, Personal Computers and Internet.

Figure 1: Twentieth Century American Technology

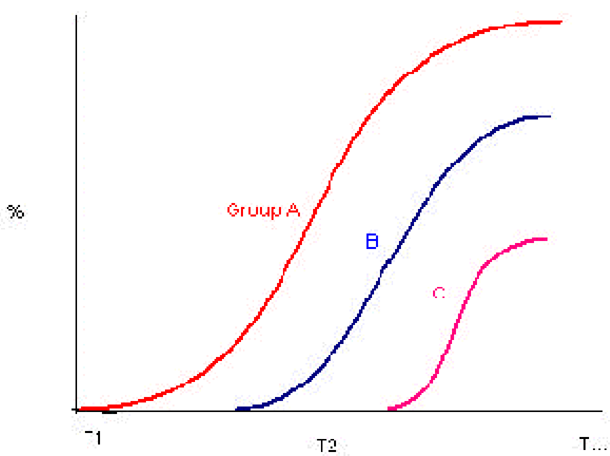


Source: Pippa Norris, The Digital Divide: Civic Engagement, Information Poverty and the Worldwide Internet, Cambridge University Press, 2002, p.33.

Each of the S curves has its own special characteristics. Telephone rises slowly. Radio, TV, VCR and Internet rise very steeply. TV seems to have risen fastest, and, like phones and radio, has achieved almost 100% diffusion. (Internet is unlikely to achieve this 100% saturation as rapidly since about half the remaining non-users in the US have declared themselves uninterested in joining the Internet.)

The US example, which is roughly similar to what is experienced in the other wealthy nations of the world, fits into the "normalization" model of diffusion, shown in figure 2. Normalization refers to the idea that eventually all countries with a high level of development will rise to rough parity in technology with one another. These nations, regardless of when they begin to deploy the technology, can expect that eventually they will have roughly equal deployment percentages—to be normalized with one another. In practical terms, most of Western Western Europe, Japan, Australia, Canada and some of the "tiger economies" in the Pacific will match **Figure 1** for America in a few years. In fact, several of these nations have comparable or higher percentages in these categories already. A small group of about twenty "developed" nations, representing roughly about one fourth of the world's population, can expect this normalization process to predict diffusion of ICT and other technologies in the foreseeable future.

Figure 2: Cumulative S Curve of Technological Diffusion



Source: Pippa Norris, The Digital Divide: Civic Engagement, Information Poverty and the Worldwide Internet, Cambridge University Press, 2002, p. 33.

Stratification: The Inevitable Fate of a Poor Country's Diffusion Process?

But what model predicts the poorer nations' trajectories in ICT diffusion? The most appropriate from my perspective is Rogers' stratification model. **Figure 2** shows stratification and depicts three poorer nations that embark on ICT deployment at different times. Two significant differences between the normalization and stratification models are apparent. First, few of the countries, even early deployers of technology, achieve the high percentages of use reached by the wealthier group. Second, there is considerable unevenness in the diffusion levels reached. While normalization assumes a uniform (and high) percentage of technology use, stratification is characterized by wide swings at generally low levels, even after many years. If one accepts the determinism inherent in Rogers' approach, it can easily lead to accepting the inevitability of poor nations having long term deficits of ICT-- continuing digital divides.

The comparison between stratification and normalization is helpful in examining the potential for the success of virtual universities in developing nations. As in the bandwidth divide challenge described above, the stratification model of virtual learning deployment should not lead to pessimism or frustration in a developing nation. The assumption that technology levels will not rise steeply does not mean that technology cannot be leveraged to great advantage—quite the opposite. Admitting *a priori* that technology levels will grow slowly can lead to much more discriminating and careful selections among competing ICT approaches. For example, assume that a country will have $USD 20 million to invest in distance learning. Among the options are:

- Major investments in infrastructure, like African Virtual University (see article by Wolff in this issue of ***TechKnowLogia***);
- Establishment of learning centers with good equipment and bandwidth, as in Vietnam;
- Prioritizing disciplines like business and engineering and offering higher levels of support in these areas, as described above in China.

The stratification model can be a sentinel or monitor for ICT policy in a developing nation - a reminder that decisions must be made among competing approaches and that efficiencies can lead to results that are more valuable than those for nations that try to do too many different things with ICT learning resources.

Challenge 3: Striking a Balance between High Tech and High Touch

The concept of a virtual learning environment often conjures up the image of a person sitting comfortably at home or in the office and achieving an educational experience that is similar to, or even superior to, being in a classroom. Evaluating the success of such an experience has become the subject of a vast literature with as many optimists as pessimists. The optimists use course evaluation comparisons of students trained in traditional classroom environments and those at distance and claim that there is no significant difference between the treatments. So frequent are these claims for parity that the term "No Significant Difference Phenomenon" (NSDP) has been devised and a web site has been tracking new NSDP claims for several years.[6] The pessimists respond that there is no sound statistical evidence to make any claims—positive or negative. They argue that the self selection of student groups, lack of randomizing of the populations and other statistical problems render the results hopelessly flawed.[7] One significant experiment in the United States examined twenty-five different courses and allowed the same professor to teach the online and traditional versions of each, reducing some of the potential statistical comparison error. This study also found no significant difference but showed that nearly half of the students undergoing the distance experience were not very positive about taking another course online.[8]

The differences between the optimists and the pessimists on assessment of distance learning have important ramifications in evaluating the effectiveness of virtual approaches in developing nations. Many of the multilateral organizations (World Bank, UNDP, etc.) that sponsor distance learning seem to lean toward the optimists in their approach to implementing programs of distance learning. There is a general sense that this approach must be better than traditional classroom learning, since the content, learning approaches and educational tools are far superior to what is currently employed. There is an implicit acceptance of the idea that a technology-mediated solution is part of a nations' destiny - so why not get on with it?

Changing the evaluation paradigm—a middle ground for tech and touch

I think that the evaluation question needs to be approached in a different way. Most of the comparisons are between traditional classroom teaching where the teacher is face-to-face with the student —"high touch/no tech"—and the diametrically opposite case where the teacher is either far away on the Internet or embedded in the courseware—"no touch/high tech." It is possible to consider many options that are in the middle ground between high and low tech and high and low touch. A recent study compared hundreds of programs around the world and found that most of them easily fitted into one of nine types –three levels of tech and three of touch.[9] For example, Stanford University's on line Electrical Engineering master's degree (http://scpd.stanford.edu/scpd/programs/mastersHCP/msee.htm) is the embodiment of **high tech/high touch**, with high bandwidth, high quality student services and content (and very high cost). Graduate School of Management, Indira Gandhi National Open University (http://www.ignou.com/info.htm), and Korean National Open University (http://www.knou.ac.kr/) are **low tech/moderate touch** programs, offering adequate content and relatively high levels of student interaction on Internet. **Low tech/low touch** examples are correspondence centers at Australian Correspondence Schools (http://www.acs.edu.au/21century/) and the University of Nairobi (http://www.uonbi.ac.ke/). When programs of distance learning are classified in this way it becomes easier to appreciate the "low band width" approaches that are legitimate options to traditional teaching. And these simpler, more focused approaches can often have very high utility in a poorer region, since they do not force a technology into inappropriate surroundings, but instead encourage solutions that are fitted to the region's culture and traditions.

Challenge 4: More Realistic Accounting for the Total Cost and Yield of Virtual Learning

Perhaps the most difficult problem in considering the use of Virtual Learning is determining the true cost for donors and providers and true yield to customers/clients. In an article in this journal last year, my colleague and I suggested that both cost and yield were relatively easy to measure, if one is willing to accept the results of the measurement.[10] The yield can be presented in very practical terms, like number of graduates, number of those finding jobs after training, improvements in attitudes and behaviors, salary levels before and after learning, etc. One metric not mentioned on my yield criteria is the students' perception of the course's value or the satisfaction with the instruction. It is a well-accepted principle of course evaluation that initial course satisfaction predicts little. What really matters is changes in attitudes, changes in behaviors and ultimately changes in the value of the trained person to the organization. This Kirkpatrick approach[11] has been widely used in US businesses and is now being employed by World Bank and other multinational organizations. Its premise is simple—learning is supposed to change a person; so to find out if learning is successful, the change must be measured.

Cost of virtual learning is also relatively easy to compute, but true and accurate measurement demands a very disciplined adherence to principles of accounting, including micro-costing and activity-based costing principles. Sponsored by the Andrew W. Mellon Foundation, Dr. John Milam of the University of Virginia has developed a cost model for US universities that literally counts every penny associated with both distance and traditional approaches.[12] When all the costs are taken into consideration, virtual learning is invariably more expensive than traditional approaches. The result is not surprising. During the past twelve months there have been many articles in the Chronicle of Higher Education, Wall Street Journal and other publications describing the decisions of universities like Columbia, Princeton and Duke, among many others, to cut back on some distance learning activities because they were not financially viable. Two systems that *are* viable are Britain's

Open University and the US's University of Phoenix, both highly successful financially and academically.

Counting all the costs leads to a different paradigm for deployment

If we can count all the costs properly and measure the yield with reasonable precision, how does it change the way we look at distance learning? First, it forces a comparison of cost and yield for various alternative delivery methods. I believe such a comparison of costs and yields might result in some data points that look like **Table 3**. The rough estimates of cost and yield are based on my examination of the open literature, and are open to reinterpretation and review. Yet the basic idea is that the decision process must offer options of this type. What decision-maker would have difficulty choosing between approaches that are high in cost and low in yield and others that are high in yield and lower in cost? Public policy decisions can be framed in this way for virtual learning as they are for other types of strategic planning.

Table 3: Examples of Cost/Yield Comparisons for Different Distance Learning Approaches

Method	Example	Unit Cost	Unit Yield
Correspondence courses	University of Nairobi http://www.uonbi.ac.ke/	Low	Moderate
Highly developed, globally deployed DL universities	Open University; http://www.open.ac.uk/ University of Phoenix http://online.uophx.edu/Default.asp	Moderate	Very high
Traditional Teaching	Standard classroom approach	Moderate	Moderate
Moderate tech/moderate touch	Tennessee Board of Regents program (US)	Moderate	High
Continent-specific	African Virtual University; http://www.avu.org	High	Low

Summary: Needed - A Willingness to Be Open to a More Realistic Paradigm

I have cited four challenges that are daunting in terms of public policy options that must be considered in the context of virtual learning. Each can be a cause for frustration and despair, but the recommended perspective is positive and goal-oriented. Each of the four challenges can become a basis for strategic focus, belt-tightening and significant improvement. Bandwidth deficiency will be a serious problem in most developing nations for a decade or more—but that does not mean that virtual learning must languish. If governments are able to examine the cost and yield of various technology investments in more practical terms, the results can be very successful, even near term. For example, the World Bank's Enlances program[13] in Chile, a high tech/moderate touch approach, resulted in yield measurements that were exceptional. In this case, a bandwidth deficiency was alleviated in a region for a specific purpose and application—rural school children.

The advantage of the tech/touch analysis is that it forces decisions that are centered on users, not donors. For example, in Kampala, Uganda, at Makerere University, is it better to insist that Distance Learning be completely Internet –based, or instead use occasional Internet and high levels of VCRs, CD-ROMs and even correspondence courses as the modality of choice. The latter would be low in cost and high in yield—an ideal combination if the government and donor policies were so aligned.

Meeting these four challenges frontally can lead to much wiser allocation of scarce funds for virtual learning in developing nations. A much more focused decision process is necessary, one than recognizes that the glamour of very sophisticated distance learning interventions is fleeting, even in the most highly endowed universities. If Columbia, Princeton and Duke have become more circumspect about the economics of virtual learning, it behooves donors and developing nations to be on guard against programs that emphasize short term goals and relatively gentle measurement standards. It is difficult to subordinate ICT structure (short-term infusions of learning software, hardware and programmatic assistance) to long term strategic vision. This long term view will often give surprisingly successful cost vs. yield opportunities that can begin to be experienced early in the cycle, and continue long term success, like a gift that keeps on giving.

[1] Turban, Efraim, et al. *Electronic Commerce 2002*. Prentice Hall 2002, p 27.

[2] *UNDP Human Development Report 2001. Making New Technologies Work for Human Development.* http://www.undp.org/hdr2001/ (March 1, 2002), p 3.

[3] http://www.telegeography.com and http://www.band-x.com/show_news.cfm?itemid=13327 (March 1, 2002).

[4] Packet Geography 2002. Retrieved on February 21, 2002 from http://www.telegeography.com/pubs/books/pg/interregional_figure.html (March 2, 2002).

[5] Rogers, Everett, 1995, *Diffusion of Innovations*, New York 1995, Free Press.

[6] Russell, Thomas L., "The No Significant Difference Phenomenon" http://teleeducation.nb.ca/nosignificantdifference/.

[7] Phipps, R. & Merisotis, J., What's the Difference? A Review of Contemporary Research on the Effectiveness of Distance Learning in Higher Education. Washington, DC: American Federation of Teachers, 1999. http://www.nea.org/achievement/student/details/02.html (March 1, 2002).

[8] PROJECT 25: First Semester Assessment: A Report on the Implementation of Courses Offered on the Internet as Part of Project 25 in the Fall Semester, 1997; January 1998. http://courses.ncsu.edu/info/f97_assessment.html#fsr (March 2, 2002).

[9] Ruth, S. and Giri, J., "The Distance Learning Playing Field: Do We Need Different Hash Marks?," *Technology Source*, September October 2001. http://ts.mivu.org/default.asp?show=article&id=889 (March 2, 2002).

[10] Ruth, S. and Shi, M., "Distance Learning in Developing Countries: Is Anyone Measuring Cost-Benefits", *TechKnowLogia*, Volume 3, Issue 3, 2001, pp 35-38.

[11] Kirkpatrick, D., Evaluating Training Processes. Second Edition. San Francisco, Berett, Kohler, 1998.

[12] Ehrmann, Stephen C. and John H. Milam Jr. (1999). Flashlight Cost Analysis Handbook: Modeling Re-source Use in Teaching and Learning with Technology. Washington, D.C.: The TLT Group.

[13] http://www.redenlaces.cl/ (March 1, 2002).

There is an implicit acceptance of the idea that a technology-mediated solution is part of a nations' destiny - so why not get on with it?