THE QUALITY OF HIGHER EDUCATION INTERNET AND COMPUTER TECHNOLOGIES:

EXACERBATING OR LESSENING DIFFERENCES ACROSS COUNTRIES?

AN ANALYSIS AT THREE LEVELS: NATIONAL, INSTITUTIONAL, AND CLASSROOM

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Only connect!
That was the whole of her sermon.
Only connect the prose and the passion and both will be exalted,
and human love will be seen at its height. Live in fragments no longer.

E. M. Forster, Howard's End

What has been will be again,
what has been done will be done again;
there is nothing new under the sun.

Ecclesiastes 1: 9-10 (NIV)

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CHAPTER I

INTRODUCTION

The English novelist E.M. Forster once wrote the words, “Only connect!” And though Forster’s intent was certainly not to presage the development of the Internet almost a century later, it does propose an interesting question - does connectivity make a difference? This dissertation explores this notion – specifically, it addresses the gaps in higher education access and quality between high-income countries and low-to-middle income countries, and the role that Internet and computer technologies play in association with those gaps. It addresses the question of whether the increased use of Internet and computer technologies will exacerbate the gaps, or whether they will assist universities in low- and middle-income countries to close the gaps. The answer to such a question is far from clear, considering the complicated nature of the factors involved.

To address this question, an analysis will be conducted at three levels, employing a mixed methodology. This analysis begins by addressing the diffusion of Internet and computer technologies at a *national* level – assessing the differential Internet adoption levels between high-income and low-to-middle income countries, and inquiring whether this trend will continue or whether adoption of the technology will normalize over time. It will attempt to determine whether these technologies will offer increased access to higher education for students in low-to-middle income countries. Then, the apparent tradeoff between higher education *quality* and *access* is addressed by analyzing the impact of Internet and computer technologies at the *institutional* and *classroom* levels.

Different variables are important at different levels of the analysis in this dissertation. The analysis at the *national level* uses Internet users/population as the main dependent variable to assess whether a low or middle income country will be able to access the technologies for higher education's use. At the *institutional* and *classroom levels*, the main dependent variables are higher education access and quality. Part of the challenge of the analysis at this level is arriving at a consensus definition for *quality.*

The following premises, explored in further detail below, provide the starting point for this investigation: (1) There are demonstrable gaps between high-income and low-to-middle income countries on many developmental measures, including higher education access and quality; (2) Technology, particularly the Internet and computer technology, is playing a increasingly important role in higher education and offers significant potential for increasing *access* to higher education as the technology is further diffused into low- and middle-income countries. (3) Technology also offers significant potential for improving higher education *quality* through at least five mechanisms: (a) electronic content delivery, (b) enabling visualization of complicated materials, (c) artificial intelligence, (d) enhanced communications between and among students and teachers, and (e) electronic access to libraries and databases.

The Differences between High-Income and Low-to-Middle Income Countries

The first premise listed above asserts that there are demonstrable differences between high-income countries and low-to-middle income countries. Beyond income, these differences include gaps in health, longevity, access to safe water, transportation, communications and education in both access and quality. All of these development factors are interrelated and impact the quality of life in low-to-middle-income countries.

Income Differences

High-income countries have distinct advantages over low-income countries in macroeconomic measures such as GNP/Capita, GDP/Capita, and PPP/Capita.[1] For illustration, income measures for two high-income, two middle-income, and two low-income countries are shown in Table 1. Note that the per-capita income level for the low-income countries is almost two orders of magnitude lower than that of the high-income countries, even after adjustments are made for purchasing power parity.

Table 1
Differences in National Income for
Selected High, Middle, and Low-Income Countries
in GDP/Capita (PPP 2000 in US Dollars)
Source: UNDP. (2002) *Human Development Report*

US	$34,142	High-Income
Canada	$27,840	
Mexico	$ 9,023	Middle-Income
Malaysia	$ 9,068	
Mali	$ 757	Low-Income
Malawi	$ 615	

Differences in Human Development

In addition to these purely economic measures, large differences often exist between high, middle, and low-income countries in indicators of *human development* – measures such as literacy levels, health and life expectancy, school enrollment, and

[1] GNP – Gross *National* Product is a measure of income earned by the nationals of a particular country, and includes income earned abroad by these nationals. GDP – Gross *Domestic* Product is the income earned by all persons within the borders of a certain country, and can therefore include the income of foreign workers in its calculation. Purchasing Power Parity (PPP) measures the "purchasing power" of national income – how far income will go in a country in purchasing a standard grouping of products. It is an adjustment to GDP or GNP figures, and is typically computed based on the cost of a certain "basket" of consumer goods.

educational attainment. Table 2 shows the differences among the same countries on two measures of human development – life expectancy and literacy levels.

Table 2
Human Development Indicators:
Adult Literacy Levels and Life Expectancy at Birth
for Selected High, Middle, and Low Income Countries
Source: UNDP. (2002) *Human Development Report*

Country	Literacy %	Life Expectancy (years)
US	99%	77.0
Canada	99%	77.8
Mexico	91.4%	72.6
Malaysia	87.5%	72.5
Mali	41.5%	51.5
Malawi	60.1%	40.0

It is not unexpected that there would be differences on measures of *human development* in addition to the differences in income among these countries. In fact, research has shown that (1) economic growth contributes to human development, and (2) human development contributes to economic growth. One of the human development factors that contributes most strongly to economic growth is education; it has been shown through multiple studies that education and economic performance are closely connected. (e.g. Becker, 1962, 1993; Behrman & Birdsall, 1983; Heyneman & Loxley, 1983; Heyneman & Siev-White, 1986; Mankiw, Romer, & Weil, 1992; Oketch, 2002; Oketch & Nafukho, 2004; Porter, 1990)

Differences in Education

Many studies (e.g. Altbach, Psacharopoulos, Hopper, Bloom, & Rosovsky, 2004; Behrman & Birdsall, 1983; Brown, 2000; Heyneman, 1990, 1997a, 1997b; Johnstone,

Arora, & Experton, 1998) have confirmed the observation that there are gaps between low, middle and high-income countries on measures of educational access, attainment, quality, and effectiveness.

Such gaps exist at all levels of education, but are sometimes particularly acute in higher education. Not only is there greater access to higher education opportunity in high income countries, but there is considerably more money spent on the quality of higher education. For instance, the allocation is $US 16,000/student in Switzerland and about $US 3,000 in Greece. (OECD, 1997) Low-income countries also have to make more of an *effort* to finance higher education. In France, for example, the per-student allocation for higher education amounts to 30% of the GNP/capita. It amounts to 25% of the GNP in the US, whereas in Vietnam it is 149% of GNP/capita and in Kenya, it is 496% (www.nationmaster.com). Such differences in financing translate to differences in *quality*. As a consequence, university students in high-income countries often have access to a greater number and variety of materials, a more up-to-date curriculum, and more science and technological facilities.

The Challenges to Higher Education in Low-to-Middle Income Countries

There is no question but that daunting challenges confront developing countries' higher education systems. Researching low-to-middle income countries' higher education institutions, the overall picture that emerges is one of increasing pressure brought by increasing populations, higher enrollments, declining infrastructure, large financial, political, and social pressures on the institutions, and restrictions to the free flow of information. However, on the positive side, in some countries there is a move toward a more differentiated system that will respond to different students' needs (e.g.

establishing technical trade schools and community colleges), and a willingness to try alternatives such as distance education and open universities to meet the increased demand. (World Bank, 1988, 1994, 2000) This willingness to try new alternatives comes at an opportune time, when there is an increasing emphasis on the use of technology in higher education to try to meet the increasing demand.

The Increasing Use of Technology in Higher Education

In their groundbreaking study of *How People Learn,* Bransford and his colleagues (2000) note that the usage of computers in education is hardly a new phenomenon: "Attempts to use computer technologies to enhance learning began with the efforts of pioneers such as Atkinson and Suppes...The presence of computer technology in schools has increased dramatically since that time, and predictions are that this trend will continue to accelerate." (p. 206)

The authors' prediction has been confirmed – the use of computer technology in higher education has accelerated dramatically within the last decade. Perhaps the primary reason for this increased use of computers was the development of the Internet. The stage was set for the usage of the Internet in a university setting by the role that universities played in the 1970s during the development of the Department of Defense's ARPANET, the backbone of which later became the Internet. In fact, both the Internet and the digital computer had their genesis in a university setting. (Castells, 2001; Duderstadt, Atkins, & Van Houweling, 2002)

Widespread usage of Internet and computer technologies in U.S. higher education began to accelerate in the early 1980s with the provision of desktop computing for students and faculty. The Internet was adopted by some universities starting in 1992, and

quickly accelerated. Now, the Internet and computers give faculty and students the opportunity to use multimedia, simulation, access to information databases, virtual laboratories, and submission and transmission of assignments electronically. (Smith, 2000)

But, what will be the ultimate effect of this growing use of Internet and computer technology in higher education? Are these changes to higher education evolutionary or revolutionary? Duderstadt, Atkins, and Van Houweling (2002) assert that they are *potentially revolutionary* for higher education because they (1) are active rather than passive, (2) remove the constraints of space and time, (3) evolve by factors of 100 or more each decade[2], and (4) use and emulate the power of the marketplace. We now turn to look at some specific ways Internet and computer technologies may be used in higher education.

The Potential Offered by Internet and Computer Technologies for Higher Education

Not all applications of computer and Internet technologies to higher education have yet been developed or conceived, but the present application of such technologies can provide some gauge of this potential.

Five Focus Areas

Ways in which Internet and computer technologies are being used in high-income countries today include:

[2] In 1966, Gordon Moore, co-founder of microprocessor giant Intel Corporation, observed a phenomenon that has since come to be known as Moore's Law – the observation that the number of transistors that can be physically placed on a silicon chip tends to double every 18 months. This measure provides one indication of the growth of computing power. This pace of growth results in a $2^{13} = 8000$ fold increase in chip capacity in two decades. Source: Moore, G. E. (1965). "Cramming More Components onto Integrated Circuits." *Electronics, 38*(8).

- Providing for efficient and rapid course *content delivery* to students to include course syllabi, assignments, reading materials, and examinations;
- Enabling students and researchers to *visualize* complicated models in science, engineering, and other technical and visual subjects through the use of three dimensional modeling, simulations, and even virtual reality;
- Using *artificial intelligence* to quickly ascertain student knowledge and skill, and to enable students to build upon that knowledge and skill (also known as *scaffolding*);
- Enhancing *communications* among students and between students and faculty through electronic mail, classroom electronic bulletin boards, faculty and student web pages, and chat rooms; and
- Enabling *electronic access* to libraries, journals, databases, and research materials.

Examples of each of these applications of Internet and computer technologies in U.S. higher education abound. The electronic Course Management systems *Web-CT*, *Blackboard*, and *Prometheus* pioneered the delivery of *course content* and Course Management software at U.S. universities. Many colleges and universities in the United States now use one or more of these tools. Wu, Krajcik, and Soloway (2001) have shown how computer-based *visualization* tools can improve students understanding of molecular chemistry. The Aleks Corporation (www.aleks.com) uses computer interactivity and *artificial intelligence* routines to help college students learn mathematics. Both the Graduate Record Examination (GRE) and Graduate Management Admissions Test (GMAT) also use *artificial intelligence* subroutines to quickly ascertain the test taker's

potential and aptitude for study at the graduate level.[3] Palmer (2001) showed how engineering students can use computer based teleconferencing to enhance *communications* and integrate on-campus and off-campus students. Most universities of any size in the United States now provide extensive *electronic access* to electronic journal materials online through their university library portal. *Google* recently announced plans to collaborate with Harvard University, Stanford University, the University of Michigan, Oxford University, and the New York Public Library, to digitize millions of books and to make them searchable by sentence to researchers and academic uses, creating a true revolution in *electronic access*[4]. (Carlson & Young, 2004)

The Potential Impact on Higher Education Gaps

Because of this revolutionizing influence, Internet and computer technologies have significant potential to narrow the gaps in higher education between high-income

[3] These tests are now known by the acronym CAT, for Computer Adaptive Tests. The test's *artificial intelligence* subroutines work by feeding the test-taker a medium-level difficulty question first. With each successive correct answer, the question difficulty level is increased automatically by the testing software. At the outset of a CAT examination, if several questions in a row are answered incorrectly, the difficulty level decreases substantially, making it difficult for a CAT test taker to recover from a slow start to achieve a high score. Source: Kaplan Educational Services,(2000) *GMAT Preparation Handbook*

[4] One of the continuously astonishing features of computers and electronic technologies is that their potential capabilities are so often underestimated, even by their founders. Of *electronic access*, the early Internet pioneer J.C.R. Licklider wrote "It seems reasonable to envision, for a time 10 or 15 years hence, a 'thinking center' that will incorporate the functions of present-day libraries together with anticipated advances in information storage and retrieval and the symbiotic functions suggested earlier in this paper…[but] When we start to think of storing any appreciable fraction of a technical literature in computer memory, *we run into billions of bits and, unless things change markedly, billions of dollars. The first thing to state is that we shall not store all the technical and scientific papers in computer memory. We may store the parts that can be summarized most succinctly – the quantitative parts and the reference citations – but not the whole*." Source: Licklider, J. C. R. (1960). Man-Computer Symbiosis. *IRE Transactions on Human Factors in Electronics, HFE-1*(March 1960), p. 7.,Italics added. This quote, though it underestimates the power of modern day computer storage and access via an Internet connection, it is not nearly as far off the mark as some other industry giants' words. For example, IBM Chairman Thomas Watson opined in 1943, "I think there is a world market for maybe five computers." Ken Olson, the President of minicomputer giant Digital Equipment Corporation, said in 1977 "There is no reason anyone would want a computer in their [sic] home." Of storage requirements, Microsoft's Bill Gates said in 1981, "640K ought to be enough for anybody." All of these industry leaders underestimated the growth and potential of computers and the Internet to achieve quantum leap improvements and to revolutionize society.

and low-to-middle income countries. But, it is also possible that the technological head-start that high-income countries have will make these gaps even wider – the key question is how the diffusion of higher education technologies in low-to-middle income countries has affected the traditional gap in higher education access and quality.

As these technologies are further diffused into higher education in low-to-middle income countries, will the rate and pattern of such diffusion simply replicate the diffusion of other innovations and so exacerbate the gap in higher education quality? Or are the communication characteristics of the Internet and of computer technologies different from previous technologies? Is it possible to suggest that in certain respects the quality gap may be narrowed by these new technologies? All of these questions will be examined in detail in the pages that follow.

The next chapter introduces a model that will be used to guide the research into these questions.

CHAPTER II

A MODEL FOR HOW INNOVATIONS DIFFUSE IN HIGHER EDUCATION

Overview

New technologies don't just appear. Once developed, technologies follow a *diffusion process* that is governed by variables that promote or inhibit the adoption of such technologies. The eventual effectiveness of such technologies is often dependent upon this diffusion process. In this chapter, models developed by the major diffusion theorists are addressed, and a model for diffusion of technology in higher education is developed that addresses diffusion at three levels – national, institutional, and classroom.

Review of Major Diffusion Theories

Swedish geographer Torsten Hägerstrand (1952, 1967) developed many of the theoretical underpinnings of modern diffusion theory. He envisioned diffusion as a spatial/geographic process. To Hägerstrand, close *geographic* proximity is an important component of the diffusion process. Though Hägerstrand's theory involves some sophisticated mathematical techniques, in essence it is based on quite simple premises – it breaks the diffusion problem into several discrete parts. The first step is to construe the diffusion problem as an "*information* dissemination problem" which is governed by geographical proximity, i.e. information about the innovation is passed from person to person based on close spatial proximity. Hägerstrand's second step is to use Monte Carlo or other mathematical simulation techniques to model the dissemination of the information. The third step is to introduce what Hägerstrand calls "the resistance

concept." At this step, the *innovation diffusion* problem is viewed as being distinct from the *information diffusion* problem because some who hear the information about the innovation are still reluctant to adopt it. This "resistance concept" puts limits on how quickly and how uniformly an innovation might be diffused. For the diffusion of modern technical innovations, we find that not only geographical proximity is important, but also is cultural and political proximity. The "resistance concept" becomes important when looking at some of the characteristics (technical, social, cultural, and political) of countries that are adopting the Internet. It is conceivable that certain country's political characteristics, for example "corruption" or "lack of political freedoms," may serve as *resistance concepts* to the full diffusion of the Internet in that country, thereby inhibiting its availability for use in the higher education domain.

The "resistance concept" is also relevant when addressing diffusion at the *institutional* or *classroom* level, because there may be some actors at these levels who serve as resisters of the technology. Not all university faculty and staff are technophiles. Some are unconvinced of the utility of technology in higher education. Others merely resist change, whatever the source. Some may welcome the introduction of technology, but are unwilling to make the investment of time and effort in order to become fully proficient in its use, especially when such time can be spent pursuing other tasks which are more likely to be viewed positively by tenure-review committees.

The work of another diffusion theorist, Everett Rogers, offers illumination about the reaction of such diverse organizational actors to institutional change. Rogers approached the analysis of diffusion from a psychological/social perspective. In his magnum opus, *Diffusion of Innovations* (1995), Rogers shows the diffusion of innovations to be a process governed by five attributes relating to perceptions about the

innovation: *relative advantage*, *compatibility*, *complexity*, *trialability*, *and observability*. According to the theory, innovations that are perceived to be *more* advantageous, compatible, easily tried, observable, and *less* complex, will be diffused faster and more thoroughly in a population.

Rogers, himself, traces the history of diffusion research to the work of the French sociologist Gabriel Tarde (1903), who was the first to recognize the crucial role of "opinion leaders" in promoting diffusion, and that the adoption of an innovation by a population tends to follow an S-shaped (sigmoid) curve over time (See Figure 1).

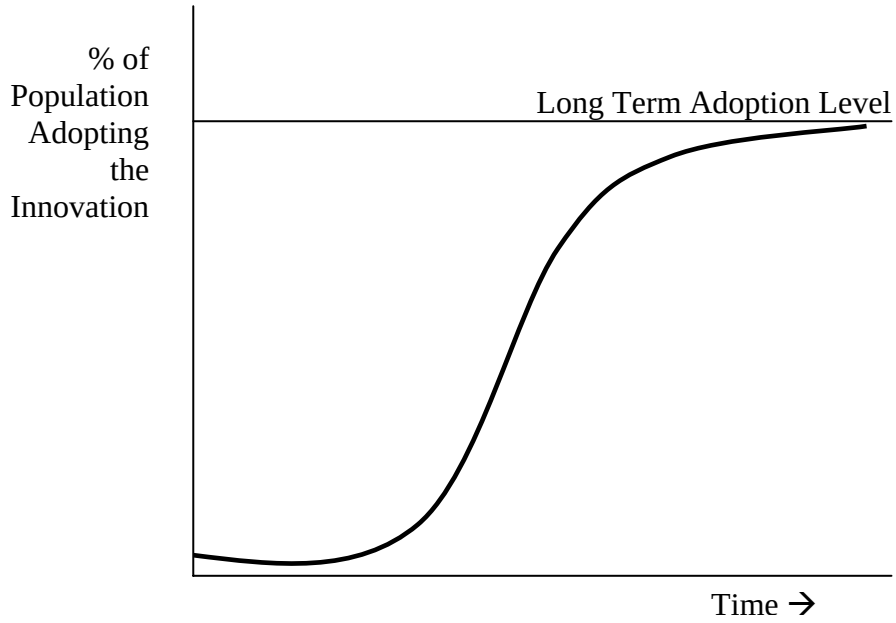
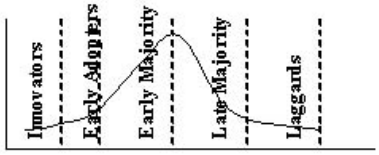


Figure 1: The S-Curve Model of Innovation Adoption by a Population[5]

[5] Differentiating this curve with respect to time yields another familiar curve – the "bell curve." In this form it has been used to describe the various adopters of a technology and their characteristics.



From the figure, it is easy to see that most innovations exhibit an initial period of slow growth, leading to faster growth with time, and eventually leveling off to a plateau. Those innovations that never truly catch on never make it past the slow growth stage. A glance at the above diagram hints that the relevant questions about diffusion are (1) will the innovation experience rapid growth and when, (2) how fast is the growth during the rapid growth stage, and (3) what is the eventual plateau level?

Research Model

The diffusion processes modeled by Rogers and Hägerstrand are instructive but are not sufficient to provide a framework for understanding how Internet and computer technologies are diffused into higher education. How might the diffusion of technology into higher education be understood? First of all, it is important to be precise about what is meant by the term *diffusion.* As defined by Katz, Levin, and Hamilton (1963), diffusion of a technology is "…the (1) *acceptance,* (2) over *time,* (3) of some specific item – an idea or practice, (4) by individuals, groups or other *adopting units,* linked (5) to specific *channels* of communication, (6) to a *social structure,* and (7) to a given system of values, or *culture.*" (p. 240, italics in the original) The unique *channels, social structure,* and *culture* of higher education institutions make the analysis of the diffusion of Internet and computer technologies into these institutions a challenging research problem. But Katz, Levin, and Hamilton's fourth item, the *adopting units,* hints at a possible conceptual framework for analyzing diffusion into higher education.

The characteristics of *innovators, early adopters, early majority, late majority, and laggards* are explored in depth in the writings of Geoffrey Moore (1999, 2000) and Clayton M. Christensen.(1992a, 1992b, 2000).

For this, a three-tiered model is constructed, shown below in Figure 2, which models the diffusion/adoption process at three levels: (1) *national*, (2) *institutional*, and (3) *classroom*. At each level of diffusion, different factors are important in the process.

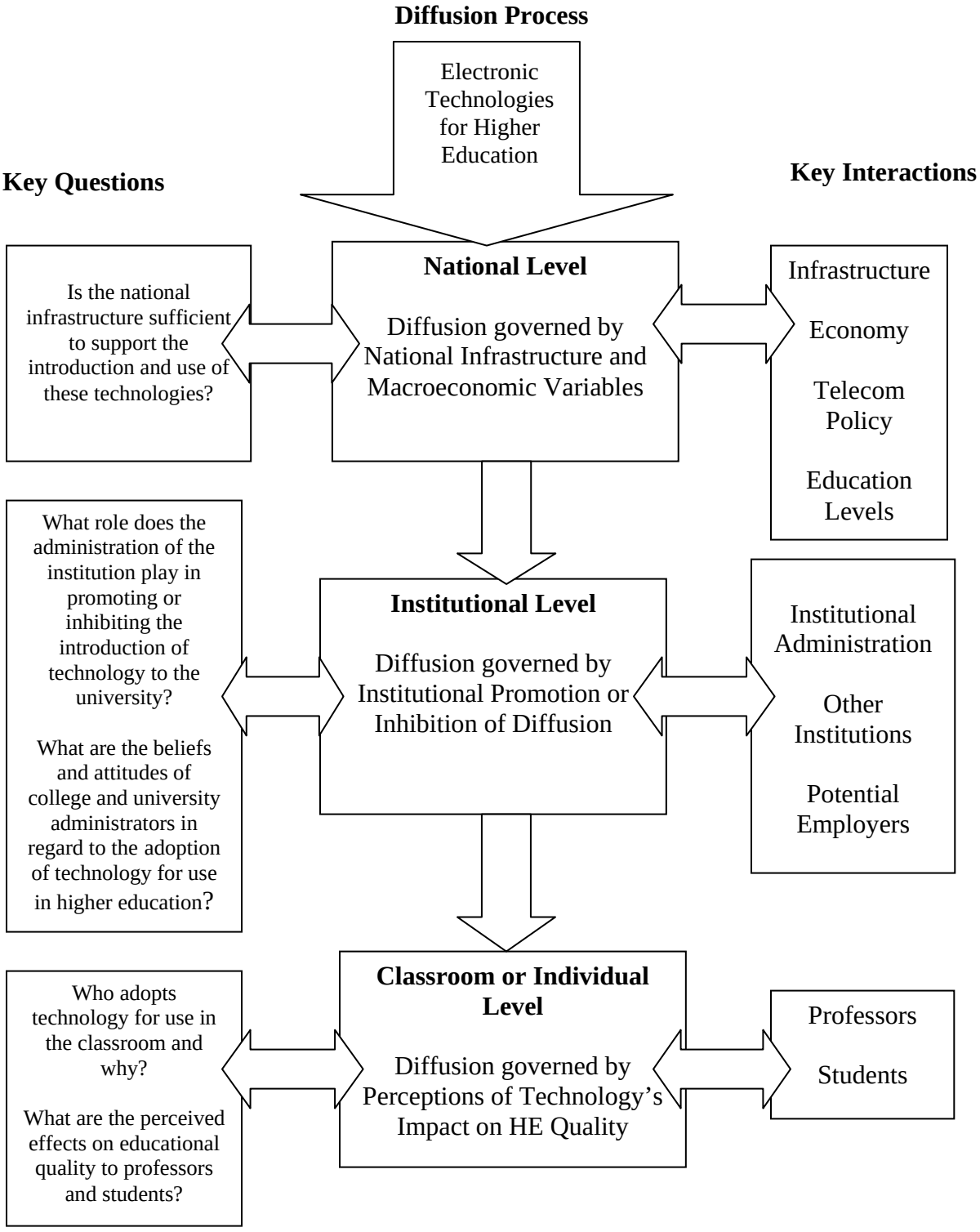


Figure 2:
Conceptual Model for Diffusion of Internet and Computer Technologies Into Higher Education

National Level

At the national level, the key interactions are with the national infrastructure. In short, at the national level, it is difficult for the Internet to fully take hold if the national technological infrastructure is insufficient to enable it. Therefore, the key question to be answered at this level is: "Is the national infrastructure sufficient to support the introduction and use of these technologies?" A corollary question is, "What factors influence or govern the national infrastructure?" Figure 3, below, shows the first level of the diffusion model presented above and indicates what understandings will be gained from the analysis at this level.

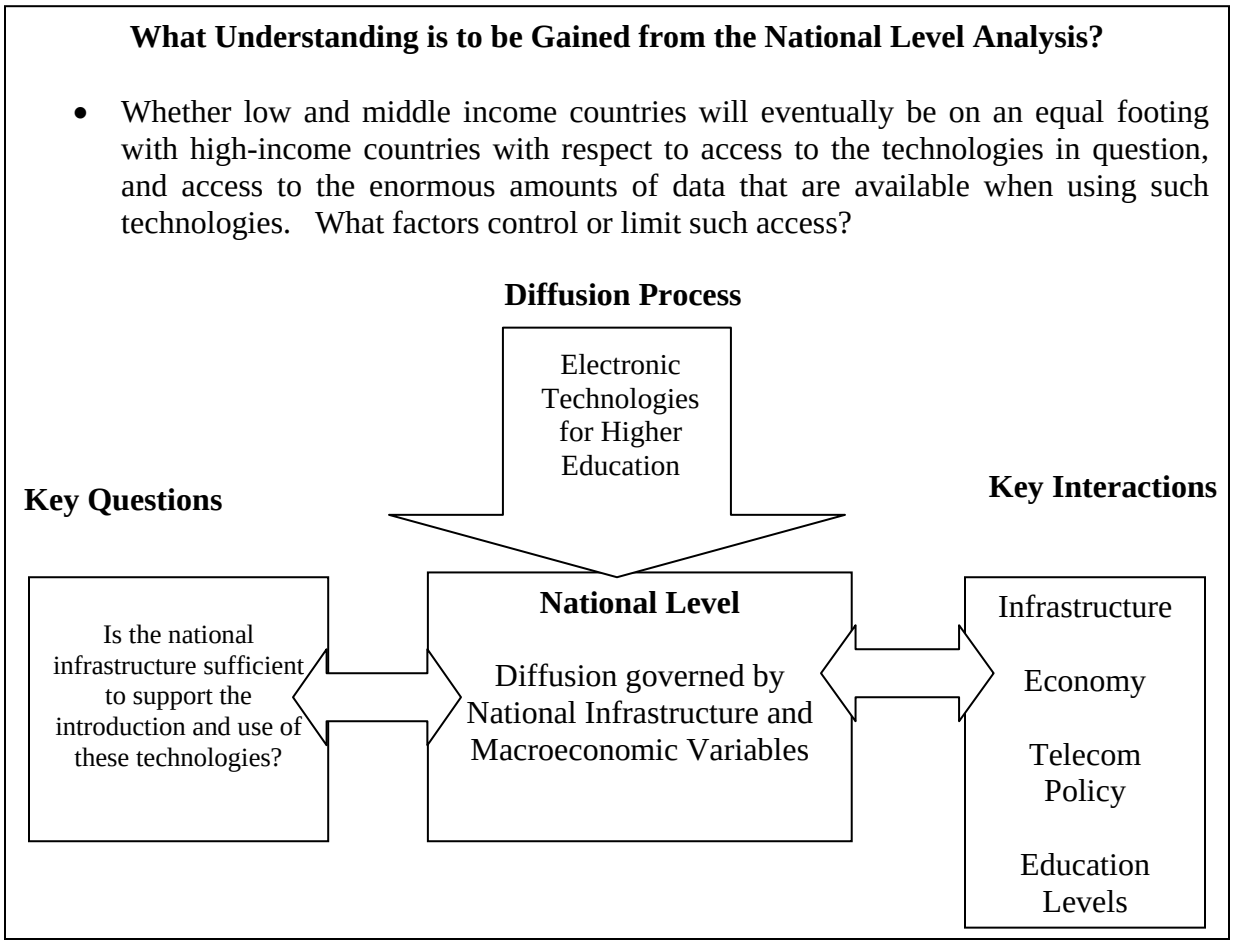


Figure 3: Conceptual Model – National Level

Why is understanding diffusion at the national level important in addressing the questions posed by this research? Because it leads to an answer to the question: "Will low and middle income countries ever be on an equal footing with high-income countries with respect to access to the technologies in question, and access to the enormous amounts of data that are available when using such technologies?" Availability of Internet and computer technologies in higher education in low-to-middle income countries is dependent upon the availability of these technologies for the population as a whole. If the infrastructure, economy, telecommunications policies, and education levels are not sufficient to support diffusion/usage of these technologies, higher-education institutions are much less likely to be able to take advantage of such technologies.[6]

Institutional Level

The next level is the institutional level. Figure 4, below, shows the second level of the diffusion model presented above in Figure 2. At this point, to understand the diffusion, one must answer the questions: "What role does the administration of the institution play in promoting or inhibiting the introduction of technology to the university?"; "What are the beliefs and attitudes of college and university administrators in regard to the adoption of technology for use in higher education?"; and "What specific

[6] At this point, however, a couple of caveats are in order. If a country's Internet use is sparse, this does not *necessarily* mean that these technologies will be unavailable for use in higher-education institutions. Yook's research (reviewed in the Literature Review section below) showed that even in low-income countries where Internet use is small, such use is concentrated in population centers, so that universities located near population centers are more likely to have access. Source: Yook, S.-H., Jeong, H., & Barabasi, A.-L. (2003). Modeling the Internet's Large-Scale Topology. Department of Physics, University of Notre Dame. The U.S. Department of Commerce, in its study of Internet diffusion in the United States, showed that for individuals Internet use is highly dependent upon education and income. So, since university students and faculty in low-to-middle income countries are likely to come from the elite (both in terms of income and education), it is also more likely that these individuals will be exposed to the Internet and computer technologies. Source: National Telecommunications and Information Administration. (2002). *A Nation Online: How Americans are Expanding Their Use of the Internet*. Washington, DC: Department of Commerce.

actions can administrators and institutional leaders take to foster the diffusion and use of technology in the institution?"

What Understanding is to be Gained from the Institutional Level Analysis?

- How the technology is introduced and diffused into the institutional environment.
- The role of administration in promoting or inhibiting its diffusion.
- The role of other institutions, potential employers, and other external influences in promoting or inhibiting diffusion.
- The assumptions or beliefs about what technology has to offer.
- Whether the technology is equally or differentially diffused.
- The contribution of Internet and computer technology to increasing *access* to higher education.
- The contribution of Internet and computer technology to higher education *quality*.

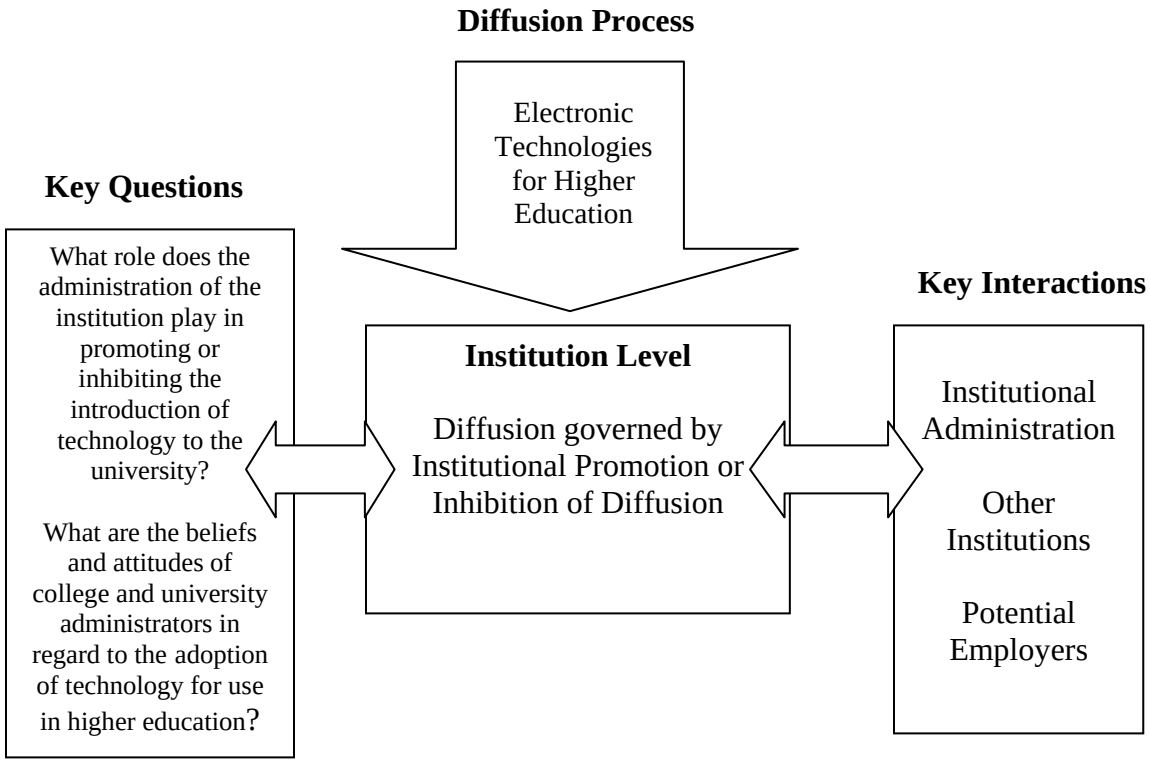


Figure 4: Conceptual Model – Institutional Level

Why is understanding diffusion at the institution level important? Because it leads to an answer to the questions:

- What are the perceptions of institutional administrators about the impact of Internet and computer technologies at the university?
- Do administrators believe that institutional efficiency, student access, or educational quality will be improved by the introduction of such technologies?
- What priority does technology occupy in comparison to university administrators' other concerns?
- What would lead administrators to champion or to discourage greater use of Internet and computer technology in the institution?
- What is the influence of other external actors – other institutions, potential employers, alumni – on the diffusion of technology at the institution?

Classroom Level

Figure 5, below, shows the third level – classroom level – of the diffusion model presented in Figure 2. At this level, the relevant questions are: "Who adopts technology for use in the classroom and why?" and "What are the perceived effects on educational quality to professors and students?"

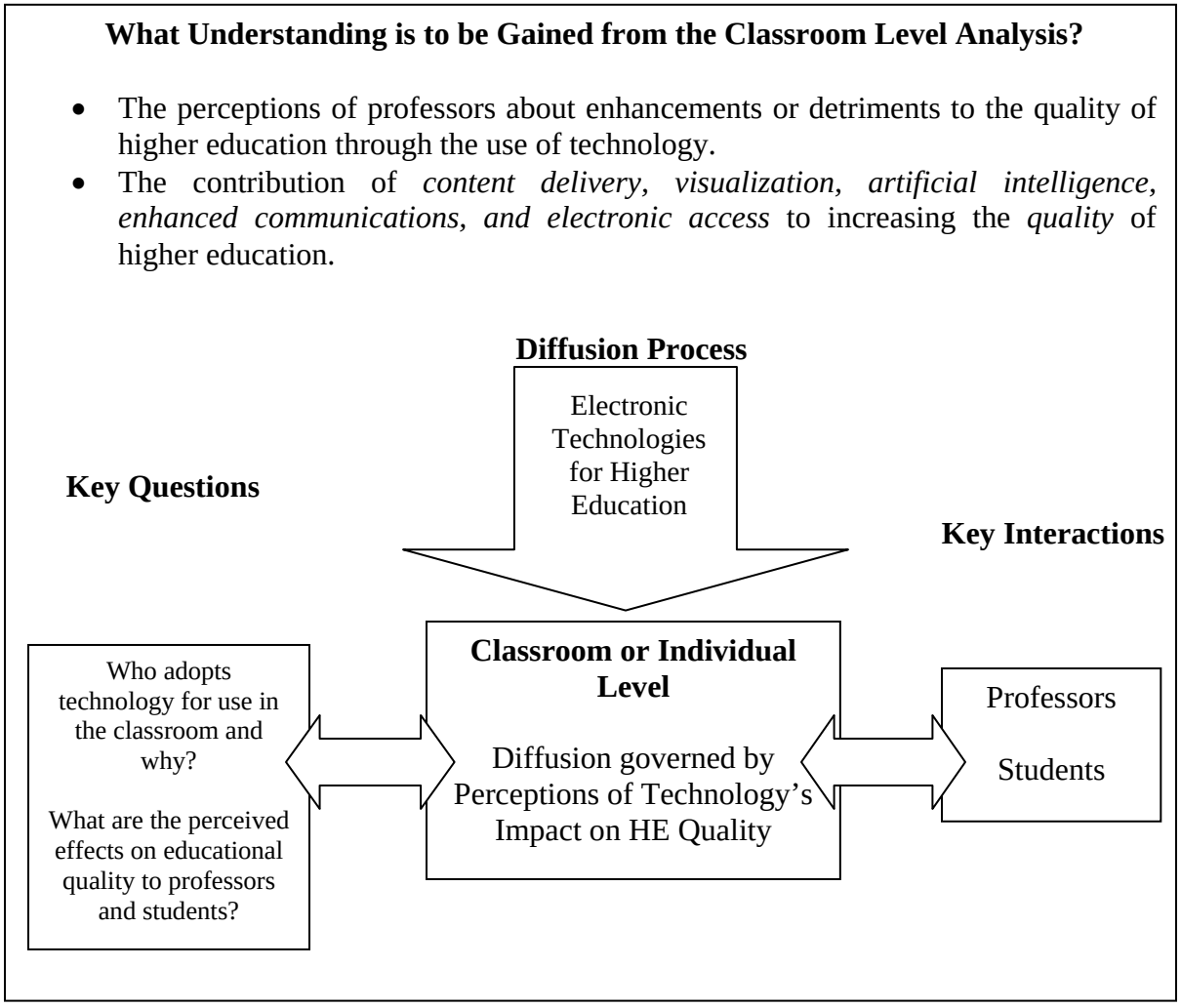


Figure 5: Conceptual Model – Classroom Level

Why is understanding diffusion at the classroom level important? Because it leads to an answer to the questions:

- What do professors believe will be the effects of greater use of Internet and computer technologies in their courses through things like Course Management software, computerized presentations, email and chat communications, and course and research materials being available electronically?

- Which technology applications (enhanced *content delivery, visualization* of academic material, *artificial intelligence* to gauge and enhance learning, enhanced *communications* through Email, chat and other electronic communications, and *electronic access* to library and research materials) are viewed by faculty as providing to most potential to enhance access and quality?
- Will enhanced use of technology in the course/classroom help professors and students overcome other impediments to quality learning in low-income countries?
- What are the assessments of the *relative advantage, compatibility, complexity, trialability, and observability* of Internet and computer technologies by institutional faculty.

The next chapter will revisit this three-tiered model to assess the relevant research and literature relating to the diffusion and impact of computer and Internet technology in higher education, addressing the literature at each of the levels of the model, in turn.

CHAPTER III

TECHNOLOGY DIFFUSION: RESEARCH UNDERPINNINGS

This chapter reviews the literature that is pertinent to the process of technological diffusion in higher education; there is indeed a wealth of such literature. Following the typology introduced in Figure 2, this review is divided into issues of diffusion at the *national, institutional* and *classroom* levels. A mini-summary, integrating the lessons from the literature, appears at the end of each section of this review – national, institutional, and classroom – and a general summary integrates all of the relevant literature at the conclusion of the chapter.

Review of the Diffusion Literature at the National Level

For large systems such as the Internet, there often exist barriers or facilitators at the national level due to the strength or weakness of a nation's infrastructure. Various infrastructure factors such as teledensity[7] and presence of other media such as radios and televisions can sometimes provide an indication of likelihood of Internet or computer use in a country. The literature reviewed in this section examines the effect of some of these infrastructure variables on the adoption of the Internet at the national level.

In addition, according to the literature on telecommunications, a country's *telecommunications policy* has a significant impact on the growth of the *telecommunications infrastructure* and its ability to accommodate a growing Internet

[7] *Teledensity* is defined as the number of phone lines per capita in a country.

population in that country. Therefore, the literature on telecommunications policy is examined as well.

In addition, the diffusion of nationwide technologies such as railroads, electricity, and automobiles is relevant because the diffusion of the Internet parallels the diffusion of these other *nationwide technologies*.

Internet and Information Technology Diffusion Studies

There are many studies that aim to analyze the global spread of the Internet and the forces driving its diffusion. Some of the most important of these studies are reviewed below. It is important to note that different researchers have often used different measures as dependent variables in their research, and the choice of different dependent variables can sometimes seem to produce contrasting, and therefore confusing results.

Milner (2002), drawing from several diffusion theories and applying them to the global spread of the Internet, asserts that there are four main pressures that are driving its diffusion: (1) the superpowers affect policy choices of smaller, less powerful countries; (2) competitive market pressures affect the process to drive countries toward more efficient and effective technological solutions; (3) countries practice what Milner calls "rational learning," that is, they actively seek to learn the best practices and adopt them; and (4) countries often emulate what their neighboring countries do[8]. Milner also asserts that "political and economic groups that lose politically from the spread of the Internet may also try to retard its diffusion." (p. 9). Therefore, there may be some built-in "resistance elements" within a population of a country. Milner's further assertions about political and social variables that are likely to impact Internet diffusion include (1) level

[8] Note the similarity of this assessment to Hägerstrand's emphasis on spatial proximity. Such geographic effects will be examined at the national level.

of democratic government, (2) civil liberties, (3) freedoms of the press, religion, etc. She writes, "We would expect that autocratic regimes and ones where civil liberties are restricted would not create environments that facilitated the growth of the Internet."[9] (p. 9)

Campbell (2001) examines the relationship of several national level variables to the diffusion of the Internet. Of the relationship between Internet penetration and GNP, he writes:

> Not surprisingly, the two are closely related. The interesting point, however, is the correlation's imperfection. It implies that despite their very different per capita incomes some countries show a similar degree of spread and use of the Internet. Conversely, countries displaying largely similar per capita incomes appear to be on opposite sides of the digital divide. *In short, national income, though clearly important, is by no means the only explanation for the digital divide.* Evidence shows that, in addition to income, the extent of political and civil liberties, the level of education, and the extent and affordability of the telecommunications infrastructure are important predictors of Internet use. (p. 121, Italics added)

Campbell recommends that developing countries focus on a strategy to increase education, training, industry, trade policy, and infrastructure in order to make these countries more competitive in the information economy and to close the "digital divide."

Also focusing on the policy implications of the "digital divide," Dasgupta, Lall, and Wheeler (2001) divide the problem into two components – *Internet intensity* (Internet subscriptions per telephone mainline) and *access to telecommunications services*. They find that relatively simple changes in telecommunications competition policy can result in substantial increases in Internet intensity. Yet, according to the study, *Internet intensities* for developing countries are already comparable to that of developed

[9] These effects will also be examined at the national level.

countries. The authors conclude that "…the digital divide is not really new, but reflects a long-standing gap in per-capita availability of mainline telecom services." (p. 15)

In another national-level study aimed at understanding the global diffusion of the Internet, Harvard University political scientist Pippa Norris (2001) addresses the subject of the "digital divide" both among nations and within nations. Studying 179 nations, Norris finds significant correlations between a nation's usage of other media and the penetration of the Internet. The highest correlation of Internet use is with the penetration of personal computers and mobile phones (what Norris terms the "new media"), followed by mainline phones, radio, newspapers, and television ("old media"). Norris also found a significant interrelationship of Internet and computer use with socioeconomic status, education level, gender, democratization, and other variables.

Maitland and Bauer (2001) studied Internet diffusion at the national level using three categories of independent variables: economic, infrastructure, and culture. Economic variables included GDP/capita, access to mass media, education, computers per capita, and international trade. Infrastructure variables included centrality, telephone density, cost of Internet access, and availability of computer peripherals. Cultural variables included uncertainty avoidance, gender equality, and usage of the English language as a national language. The first two of the three cultural variables were drawn from the work of the Dutch sociologist Geert Hofstede (1980a, 1980b, 1980c, 1983, 1997) on national cultures. The third cultural variable, the usage of the English language, stems from the dominance of the English language as the language of the Internet[10]. The

[10] Though this is changing – recent research indicates that the percentage of English websites is declining in proportion to websites in other languages, though it still remains well above 50%. Furthermore, websites are now able to be designed in languages that use non-alphanumeric characters – languages such as Chinese, Japanese, Korean, and Arabic. This advance makes it much easier for websites to be produced in these languages.

authors found the cultural variables to be least influential in the national diffusion of the Internet.

Using Internet *hosts*[11] as a dependent variable, Maitland, Bauer and Berne (2000) also analyzed the factors affecting Internet use in OECD countries, noting that, within Europe, "…a wide gap a wide gap existed between the richer (northern) and the poorer (southern) member states. At the end of 1999, Greece reported 4 Internet hosts per 1,000 compared to 91 in Finland." (p. 3) The authors analyzed Internet use according to three sets of factors: structural (income, education, market size, local content, competing systems, and cultural factors), access conditions (regulatory framework, access business model, and telecommunications regulatory framework), and corporate strategies (telecommunications companies, Internet Service Providers[12], and business firms). The authors' thesis is that these sets of variables determine the eventual levels of Internet penetration in OECD countries.

Early in the history of the Internet's diffusion, Hanna, Guy, and Arnold (1995) studied the diffusion of information technology in eight high-income OECD countries and propose that the lessons of effective diffusion in these countries are equally applicable to low-to-middle income countries. The authors found that the factors that were most effective in influencing diffusion at the national level were:

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[11] Internet *hosts* refer to the top level web pages, such as www.vanderbilt.edu, that reside on an Internet node in order to be accessible at all times. Although Internet content may be hosted and accessed from anywhere in the world, the number of pages *hosted* by a country provides some indication of its level of sophistication with the Internet and associated technologies. However, the problems associated with using *hosts* as a measure of a country's Internet penetration is highlighted by Internet Software Consortium (1999) on its website: "There is not necessarily any correlation between a host's domain name and where it is actually located. A host with a .NL domain name could easily be located in the U.S. or any other country. In addition, hosts under domains EDU/ORG/NET/COM/INT could be located anywhere. There is no way to determine where a host is without asking its administrator." Source: http://www.isc.org. For this reason, the number of a country's Internet *users* is used as the dependent variable in the national level analyses in this dissertation.

[12] Often abbreviated by the acronym ISP.

- Information on the technological options, costs and benefits, and alternative sources of supply and know-how (information markets);
- Technical and managerial skills necessary to invest, adapt, and use the new technology (labor markets);
- Finance, particularly for intangible investments, and services and new technologies (financial markets);
- Research and development (R&D) to absorb knowledge and complex technologies; and
- Infrastructure, networks, and technical support institutions (externalities). (Executive summary, p. xii)

These results echo the crucial importance of infrastructure, financial investments, and human capital in promoting Internet and computer technologies in a country, and put increased emphasis on the role of research and development, and of information markets.

Physicists Yook, Jeong, and Barabási (2003) employed a mathematical fractal model to examine the Internet's worldwide topology, and conclude that this fractal model is determined by global *population density patterns*. Their model is based upon the location of Internet routers rather than upon data for Internet use. The authors note the significant relationship between economic development and Internet diffusion, but also point out that, even in areas where Internet use is quite sparse, such use is concentrated in urban areas where population density is highest. This is an important conclusion for *institutional* diffusion, since many higher-education institutions are located in urban, rather than rural areas – this is particularly true in the developing world.

A collection of studies focusing on the national diffusion of information technology, edited by Tan, Corbett, and Wong (1999), provides illumination for what national governments can do to foster the diffusion of information technology countrywide. The studies focus on information technology diffusion in several Asian countries including China, India, Singapore, Malaysia, the Philippines, Thailand, and Indonesia. Among the most significant factors they identified as influencing the

diffusion of information technology are human capital levels, national telecommunications infrastructure, and national policy regarding privatization or liberalization of the telecommunications sector.

An analysis of information and communications technology policy in Africa by Van Audenhove (2000) puts an equal emphasis on the strategic importance of telecommunications infrastructure, telecommunications privatization policy, and human capital in the diffusion of information technology.

Employing an entirely different approach, Fink and Kenny (2003) examine the worldwide diffusion of Internet and communications technologies (ICT). Challenging the conventional wisdom about a global "digital divide," the authors measured the *growth rates* of ICT in less developed countries, and measure that growth versus income levels and conclude that,

> "…in relative terms developing countries show faster rates of growth in network development than developed countries. This suggests that at present ICT growth rates, the *developing world would eventually catch up to the developed world, in absolute levels*. Moreover, when employing a per-income measure of access to a variety of ICTs, we find that developing countries already 'digitally leapfrog' the developed world." (p. 15, Italics added)

The International Telecommunications Union (2000a, 2000b, 2001a, 2001b, 2001c, 2001d, 2001e, 2002a, 2002b, 2002c, 2002d, 2002e, 2002f, 2002g, 2002h, 2003a, 2003b, 2003c, 2004a, 2004b, 2004c, 2004d), the International Research and Exchanges Board (IREX) (2000, 2002), the Markle Foundation (Liang, 2003), the Open Net Initiative (2004, 2005a, 2005b, 2005c), and others (Baqai, 1999; Ein-Dor, Goodman, & Wolcott, 1999) have performed country case studies of Internet penetration issues, addressing variables such as telephone density, regulatory regime, telecommunications competition, and freedom as factors promoting or inhibiting diffusion of the Internet in

these countries. Results of these case studies are compared with the prediction of Internet use from the regression model developed in the analysis section below.

The next section addresses the literature on the development of national telecommunications infrastructure and the current policy debate surrounding the impact of telecommunications liberalization and privatization.

Telecommunications Diffusion and Reform

Closely related to diffusion of the Internet is the diffusion of telecommunications. The reason for this is because many countries still use an Internet system that is based upon a dial-up procedures and telephone lines for Internet connectivity. Furthermore, the studies reviewed above confirm the strategic importance of the telecommunications infrastructure to the successful diffusion of the Internet and other information technologies. Consequently, this section addresses some of the important literature concerning the development and diffusion of telecommunications infrastructure, and the role of telecommunications reform in such diffusion.

Atkin, Jeffres, and Neuendorf (1998) propose telecommunications behavior as a model for understanding the diffusion of the Internet, and test a number of hypotheses that relate to characteristics of individual Internet adopters: education, income, cosmopolitan mindset, and technology orientation. All of these factors proved significant, but an orientation toward technology use was more significant in explaining Internet adoption than the other factors.

There has been a great deal of research done on the effect of different telecommunications policies on the growth of the telecommunications infrastructure. For example, Petrazzini and his colleagues (Petrazzini, 1995; Petrazzini & Guerrero,

2000; Petrazzini & Kibati, 1996) have argued that telecommunications and Internet penetration is related to telecommunications *liberalization* and *privatization*[13] where countries are the unit of analysis. With in-depth studies of the telecommunication sector in Argentina and Mexico, Petrazzini (1995) showed that economic factors (overall economic performance and growth, availability of domestic and foreign capital, and investors' assessments of risks) played a larger role in fostering liberalization, whereas political factors (state autonomy, concentration of power in the executive branch) played a larger role in successful privatization efforts.

Buchner (1988) showed that telecommunications diffusion is related to regime type, again where countries are the unit of analysis. He showed that, in the case of former Eastern European Communist regimes, the centralized governments promoted and favored the diffusion of televisions over telephones. The author's explanation for this phenomenon relates to the centralized government's desire for control over the channels of communications. Considering the liberal nature of some Internet communications, countries that have centralized, authoritarian governments may be even more likely to resist the diffusion of this technology.

Ono (1996) performed a worldwide study that assessed the telecommunications gap between rich and poor nations. Through surveys of 752 national delegates and representatives of international and regional organizations to the International Telecommunications Union (ITU), he found that both a *qualitative* and a *quantitative* telecommunications development gap existed between rich and poor nations. Qualitative

[13] *Privatization* is defined as the sale of government-owned telecommunications facilities to private industry or investors. *Liberalization* is defined as government policies which foster greater competition in the telecommunications sector. By these definitions, the 1984 breakup of U.S. telecommunications monopoly provider AT&T is *liberalization*, but not *privatization.* A related concept, *deregulation*, refers to a reduction in government intervention in the telecommunications market. All three policies are often encountered in parallel or in tandem.

gaps refer to such things as quality of service and the length of the waiting period encountered when trying to obtain telephone service. Quantitative factors refer to telephone line density per capita population (teledensity), and the overall capacity of the national telecommunications system. Ono found 127 obstacles that promoted or reinforced the telecommunications gap between developed and developing nations, which he then classified into 12 categories: (1) Policy and Regulation-oriented Obstacles, (2) Planning and Implementation-oriented Obstacles, (3) Organization and Administration-oriented Obstacles, (4) Finance-oriented Obstacles, (5) Technology-oriented Obstacles, (6) Human Resources-oriented Obstacles, (7) Knowledge-oriented Obstacles, (8) Politics-oriented Obstacles, (9) Economy-oriented Obstacles, (10) Social System/Culture-oriented Obstacles, (11) Geography-oriented obstacles, and (12) Corruption-oriented Obstacles. The obstacle rated most significant to the telecommunications gap by survey respondents was the following: "The lack of political stability in most developing countries widens the gap because financiers are not willing to risk their finance in unstable countries." (p. 239) In contrast to the results of Atkin, Jeffres, and Neuendorf cited above stressing the importance of *technology orientation*, Ono found technology orientation relatively insignificant in the telecommunications gap. His *lowest* scoring obstacle was the following: "Illiterate citizens find it difficult to use telephones as they cannot independently operate the telephone." (p 254)

Fink, Mattoo, and Rathindran (2001, 2002) found, through multi-country studies at the World Bank, that telecommunications *privatization* and *liberalization* both contributed to improved telecommunications service in low-income countries. They found that the greatest gains were accomplished when a country undertook a comprehensive reform program, and that "…the sequence of reform matters: mainline

penetration is lower if competition is introduced after privatization, rather than at the same time." (2002, p. 1) They furthermore found that technological progress had a significant effect on telecommunications performance.

Cho (1995), Jayakar (1999), and Williams (1999) also performed multi-country studies on telecommunication reform. Cho's study focuses on the *policy diffusion* of telecommunication reform. He notes that a number of countries have almost simultaneously decided on policies of telecommunication reform and he aims to find out why: "Is there an underlying, unifying cause to the wave of the institutional reform in telecommunications around the world?" (p. 32) Cho finds a simultaneous information technology *push* and an economic globalization *pull* that seem to be associated with the telecommunications reform phenomenon. Jayakar's intent was to explore whether telecommunications reform policies furthered the policy aim of universal service for a country's inhabitants. His thesis was at odds with prevailing wisdom because, for many years, one of the main arguments for the maintenance of a monopoly telephone service was to ensure universal service. The mechanism through which this was done was by *cross subsidy* – the high-volume city and long-distance customers often paying for the service of the low-volume, high-cost rural customers. (Marti, 2001) Jayakar found that *complementarity* of telecommunications reform policy (pursuing liberalization, privatization, and deregulation in parallel or in tandem) had a positive effect on universal service, and that "the effects of telecommunications reform in the poorer countries was stronger than they were in the rich countries." (p. 120) Williams's research focus is on the structure of the institutional environment, and its ultimate effect on the realization of telecommunication privatization plans. Through both multi-country quantitative analysis and case studies of Peru and Malaysia, she demonstrates that a nation's policy

environment, property rights protections, and administrative capabilities have effects on the realization of telecommunications privatization plans.

Alfaori (1990) studied the privatization of Jordanian telecommunications, as did Prateapousanand in Thailand (2001), Ohene-Ntow (1994) in Ghana, and Mbarika in Africa's least developed countries.(2000) Alfaori's study utilizes three economic models (natural monopoly model, second-best pricing model, and the Averch-Johnson model) to predict the effects of privatizing the Jordanian Telecommunications Corporation (JTCC). He concludes that privatization would likely lead to higher prices for most customers, and that universal service to remote areas would likely suffer. On the positive side, he predicts that urban customers would likely gain in quality of telephone service, and that Jordanian citizens would have additional investment opportunities due to privatization. Prateapousanand's Thailand study is much more optimistic about the effects of privatization. He finds that "…privatization works and…[the Telephone Organization of Thailand – TOT] would greatly improve its profitability, operating efficiency, output, service delivery, output, service delivery, and capital investment spending without lowering the employment level after privatization."(p. ii) Ohene-Ntow's study emphasizes that privatization of telecommunications in a country must be analyzed in terms of "the overall need to strengthen the capital and financial capacities of local financial, industrial and commercial entities." (Ohene-Ntow, 1994, p. 161) He also emphasizes how some low-income countries rush to adopt the policies of higher-income countries without reasoned empirical analyses of the impact of those policies in the special circumstances of low income countries: "So far, telecommunications policy discourse in Ghana has been guided less by the results of empirical studies of telecommunications and economic development, and more by the generally perceived

usefulness of telecommunications in all societies today." (p. 3) This statement has large implications for the notion of the diffusion of Internet technology and its impact on higher education. Will the diffusion of the Internet into low-income countries follow the same model, or will the special circumstances of low-income countries channel this diffusion in a different direction?

Mbarika has written extensively on telecommunications in Africa. His dissertation (2000) focused on analyzing the obstacles to telephone density growth in Africa's least developed nations. In order to analyze these obstacles, he surveyed 71 government and non-government telecommunications stakeholders in these African nations. Obstacles were grouped into four categories: Organizational/Policy-Oriented, Technology-Oriented, Financial-Oriented, and Geographical-Oriented. The Financial-Oriented obstacles were ranked to be the most significant in contributing to the slow growth of telephone density in these African nations. Geographical-Oriented obstacles were rated to be the least significant. In a later study, Mbarika and his colleagues (Mbarika, Musa, Byrd, & McMullen, 2002) focused on the Technological-Oriented obstacles. The conclusions of this study are that African telecommunications policy makers should focus on technological self-sufficiency and the building of regional alliances for the promotion of telecommunications infrastructure.

Entman (2000) also studied the impact of telecommunications deregulation, privatization, and liberalization, primarily in a U.S. context. This Aspen Institute conference report also focuses on the asymmetric application of telecommunications

regulation, and whether such regulation should be "harmonized" for all players in the telecommunications industry[14].

The diffusion of telecommunications is a model that parallels the diffusion of the Internet. Thus, the results of the studies of telecommunications, its diffusion, and the impact of different regulatory regimes are important for the understanding of Internet diffusion. The studies reviewed above point to numerous economic, technological, political, and social variables that impact the development of the telecommunications infrastructure in a country. In assessing the diffusion of the Internet at the national level, these variables will be used to determine which are the most important in promoting its diffusion at the national level.

Telecommunications is but one of numerous *systemic* technologies that have impacts throughout a society where they are diffused. The diffusion of other systemic technologies such as electricity, radio, automobiles, and railroads is addressed in the next section.

Systemic Technologies: Diffusion of Electricity, Semiconductors, Radio, Automobiles

Since the Internet and the telecommunications infrastructure represent systemic changes to a nation's infrastructure, it is instructive to also look at other technologies that have had such systemic effects in the past, and to assess the path of their diffusion. Studying the diffusion of other technologies such as electricity, automobiles, and radio

[14] Regulation asymmetries have come about mainly because of the phenomenon of *convergence*. Convergence refers to the firms that currently focus on the telecommunications market, firms which may have begun in different industries – long distance, local telephone service, wireless telecommunications, broadcasting, cable television, satellite television, and even Internet service providers – all of which are now becoming competitors in the information/telecommunications business. All of these businesses, once distinct, are now *converging* and competing for the same customer base.

gives some illumination to the subject of Internet diffusion at the national level. We first look at the diffusion of electricity through three country studies.

Myllyntaus (1991), Coopersmith (1992), and Minami (1987) studied the diffusion of electrification in Finland, Russia, and Japan, respectively. These studies note that the decisions to implement electrification were not merely technological decisions, but were also political decisions. Technologists had a powerful role as the experts, but their role was subordinated to the political authorities. Such large systems changes have to wrestle with problems of reorganization and bureaucracy, often resulting in centralized decision making. Therefore, such systemic changes sometimes play a role in creating the very bureaucracies they are meant to improve. In addition, these studies show that innovations compete for resources with other state priorities – in the case of electrification, they competed with the extension of the railroad and other transportation networks. The diffusion of electricity confronted the notion of *absorptive capacity*,[15] i.e. how much technology the countries were able to absorb given existing levels of infrastructure, human capital, and economic development.

For these authors, the changes wrought by electrification were both *revolutionary* and *conventional*. They were *conventional* in the sense that they did not ultimately do anything that could not be done another way (e.g. kerosene lamps could still provide light; factories could be powered by wind, water, or even animal power). But they were *revolutionary* in their ability to simultaneously achieve multiple missions (providing light and heat, powering factories and household appliances) and in the complementary changes they wrought in societies that adopted them (inventors began to design electrical

[15] For an in-depth discussion of *absorptive capacity* see W. Cohen and D. Levinthal, "Absorptive Capacity: A New Perspective on Learning and Innovation," *Administrative Science Quarterly* 35:(1990) 128-152.

appliances, businesses were created to build, maintain, and repair electrical apparatus, and most non-electrical applications were eventually displaced by their electrical counterparts).[16] Internet and computer technology is the same – fundamentally it is just another means of transferring information, albeit much faster. But *convergence*[17] has placed Internet and computer technology at the center of a nexus that includes conventional telecommunications, cable and satellite television, wireless communications, entertainment, and education.

The authors of the electrification studies also point out that late adopters of a technology often have to depend on help from abroad – as all three countries borrowed heavily from the West in their adoption of electricity. This practice, however, can have its advantages. Gerschenkron (1962) argues that late comers have an advantage – they can learn from the mistakes of others – a theme that is also echoed in Christensen (2000) and Radeoševic. (1999)

Tilton (1971) studied the international diffusion of semiconductors. He concluded that there is both inter-country and intra-country diffusion of technology. He also notes that there are early-adopter countries that follow the innovating countries somewhat quickly, and there are late-adopter countries that are challenged to ever "catch up" to the leaders, particularly in an industry as rapidly changing as the semiconductor industry. Studies of national level diffusion have also been performed for telephones (Fischer & Carroll, 1988; Sicilia, 1997), automobiles (Fischer & Carroll, 1988), radio

[16] One of the industries that was revolutionized by electrification was the petroleum industry. John D. Rockefeller's *Standard Oil Company* established its business providing oil for lamp lighting. When electrification displaced this use of petroleum, *Standard Oil* transferred its market focus to the railroad and the emerging automobile industry. Sources: Chernow, R..(1998) *Titan: The Life of John D. Rockefeller, Sr.* New York: Vintage Books, and Yergin, D. (1993) *The Prize: The Epic Quest for Oil, Money, and Power*. New York: Free Press.

[17] See footnote #14 above for an explanation of *convergence*.

(Hargittai, 2000), and newspapers (Smythe 2002). These studies echo the results of the electrification studies that there are national level variables that influence diffusion and there are capacity constraints of the diffusion due to these variables.

Finally, the United Nations (1989), through its Technology Atlas Project, has identified the following determinants of a national technology climate: economic development status, status of the country's physical infrastructure, stock of the country's technological personnel (human capital), industry innovativeness level, university innovativeness, and laws and incentives.

Summary of the Diffusion Literature at the National Level

The literature reviewed above supports the assertion that the diffusion of the Internet confronts various barriers and facilitators at the national level, and that among these facilitators and barriers are education levels, income levels, existing telecommunications infrastructure and regulation, usage of existing and old media, political policies, and national culture. Some study results seem to conflict with one another, or offer ambiguous evidence of the effects of certain national variables on the diffusion of the Internet and computer technologies. Such national level variables that were identified in the literature as being significant to the diffusion of these technologies will be used as independent variables in the analysis of the national diffusion of Internet and computer technology in Chapter 5, below.

The next section addresses literature related to technology diffusion at the institutional level. The role of institutional administrators in promoting or inhibiting diffusion is also addressed.

Review of the Diffusion Literature at the Institutional Level

"Traditional universities have a robust capability to resist change," writes Berge (2000, p. 211) in a provocative piece on the re-engineering of higher education. In this section, some of the challenges to the diffusion of technology at the institutional level are reviewed. In addition to higher-education institutions, additional literature that relates to the diffusion of technology into institutions in different cultures is reviewed.

Barriers to the Diffusion of Technology at Higher Education Institutions

Echoing Berge's analysis, Inter-American Development Bank education advisor Claudio de Moura Castro notes the institutional barriers to the usage of Internet and computer technologies in traditional universities:

> The traditional universities are reluctant to transform their classrooms. They do not see much to be gained. Their increasing offer of distance education courses does not seem to affect mainstream teaching. It remains an enclave, perhaps managed by extension departments. By contrast, Open Universities are progressively moving to the use of browsers, the Internet, video technology and whatever else is available. On the other extreme, new institutions such as the University of Phoenix and Jones University, lacking tradition and even disdaining traditional means, are more than willing to experiment with whatever technology is around. They see in technology a means to bring something better to students who do not have access to conventional high quality education. (Castro, 2000, p. 15)

This passage indicates that there are significant institutional barriers to the usage of Internet and computer technologies in higher education institutions. This section addresses some of the research on the institutional barriers to diffusion of technology in higher education.

The U.S. Department of Education studied the development and growth of Internet-facilitated distance education at U.S. degree granting institutions (Waits, Lewis, & Greene, 2003). One of the goals of this study was to identify the major factors

preventing institutions from starting or expanding distance education offerings. Among the top factors cited were: (1) program development costs, (2) lack of fit with the institution's mission, (3) limited technological infrastructure to support distance education, (4) concerns about faculty workload, and (5) concerns about course quality (p. 58). But, the same report noted a number of factors that were pushing the institution to consider such innovations. Among the top reasons offered were access, quality, and cost.

> Of those institutions that offered distance education courses in 2000–2001, a majority reported that *increasing student access* in various ways was a very important goal of their institution's distance education program. Sixty-nine percent of the institutions indicated that increasing student access by making courses available at convenient locations was very important, and 67 percent reported that increasing student access by reducing time constraints for course-taking was very important...In addition, 36 percent reported that making educational opportunities more affordable for students, another aspect of student access, was a very important goal of their distance education program. On issues related to institutional enrollment and cost, 65 percent of institutions offering distance education indicated that *increasing the institution's access* to new audiences was very important, 60 percent reported that increasing institution enrollments was very important, and 15 percent reported that *reducing the institution's per-student costs* was very important...In addition, *improving the quality of course offerings* was considered to be an important goal for 57 percent of the institutions, and meeting the needs of local employers was rated as very important by 37 percent of the institutions. (p. vi, Italics added)

Jackson (2003) cites research by the Pew Foundation to assess *institutional readiness* for the vigorous application of technology at the higher education institution to achieve the dual goals of increasing quality and reducing cost. *Institutional readiness* was assessed based on the institution's actions in the following eight categories:

1. [The] Institution must really want to increase achievement and reduce cost;
2. It should be committed to using technology strategically, rather than just making it available to all faculty;
3. It must have made computing part of the campus culture;
4. It needs a mature information technology infrastructure;
5. It should have a substantial number of faculty who already have some experience integrating computer-based instruction into existing courses;
6. It should be committed to learner-centered education;
7. It must be preparing students to use technology in education; and

8. It must be prepared to forge partnerships among the faculty, IT staff, and administrators for the planning and execution of the course redesign.(p. 42)

Technology as a Means to Increase Access

The issue and challenge of increasing higher-education *access* through technology is addressed in detail in a report by the National Postsecondary Education Cooperative (NPEC) (Phipps, 2004). This report, entitled "How Does Technology Affect Access in Postsecondary Education? What Do We Really Know?," divides the issue of access into four themes: (1) access to postsecondary education in general, (2) access to technology-based learning, (3) preparation for using technology in postsecondary education, and (4) effectiveness of technology in the learning process. (p. 3) The report concludes that "evidence suggests that distance learning efforts can increase the number of people enrolling in postsecondary education," (p. 5) but that digital-access divides by race, gender, income, and family status (single parent vs. two parent households) make the extension of technology-mediated higher education access to everyone a difficult barrier. In addition, the report notes the special challenges encountered by small higher-education institutions in joining the digital club – a phenomenon termed the "institutional divide":

> [The] Institutional digital divide pertains to the perceived gap between institutions that have access to the latest technologies and those institutions that do not. Educause…in its report to the President's Information Technology Advisory Committee, asserted that the federal information technology investment in postsecondary education had resulted in a network capability at the largest universities that far outpaced that of other 4-year degree-granting institutions. These smaller institutions faced severe challenges in meeting the advanced networking requirements necessary to educate the 21st century student. The report identified the following obstacles from a technological perspective:
>
> - Lack of campus infrastructure;
> - Lack of reliable middleware (security, authentication, and network management tools);
> - Lack of cooperation from telecommunication companies in providing service;

- A difficult economic environment for information technology and networking at smaller institutions because advanced networking is often a new budgetary item;
- Lack of high-level support from campus decisionmakers [sic];
- A return on investment that is difficult to articulate; and
- Difficulty recruiting and retaining information technology staff. (p. 11)

Certainly some portion of the "institutional divide" derives from differential institutional resources available for investment in Internet and computer technologies. The NPEC report notes that institutions with generous endowments were much more able to spend the capital associated with developing information technology infrastructure, and were consequently more prepared to take advantage of some of the potential that Internet and computer technologies had to offer:

> The data from the Cost of Supporting Technology Services project (COST) show that for 2000–2001, the median spending on information technology was $1,299 for each student and employee at the most selective and wealthiest liberal arts colleges taking part in the study. By contrast, the less selective and less endowed undergraduate colleges showed a median spending of only $459 per student, professor, or staff member. (p. l2)

One can infer from the foregoing that the institutional administration at all institutions, but particularly at smaller institutions, is challenged by the potential of Internet and computer technologies for higher education. Notwithstanding the budget and manpower challenges at small institutions, the research literature suggests that diffusion of technologies into higher education institutions is a daunting challenge in itself.

Factors in Successful Diffusion of Technology into Higher Education Institutions

Getz, Siegfried, and Anderson (1997) studied the adoption of 30 innovations at 238 institutions of higher education in the United States. These 30 innovations fell into six categories: (1) computing and telecommunications, (2) libraries, (3) student life, (4) curriculum, (5) classroom services, and (6) financial services. They found that, "on

average, about *26 years* elapse from adoption by the first percentile institution to adoption by the median institution." (p. 605, Italics added) However, the researchers found that innovations in the first two categories – computing and telecommunications, and libraries – were adopted more quickly than those innovations from other categories. This result suggests that, in a university setting, Internet and computer technologies may be diffused in a more efficient manner than other types of innovations, and that institutional administrations may have more impact in promoting such diffusion. But, the literature also suggests that the diffusion of these technologies in an academic setting may be less efficient than in a business setting, where the profit motive makes efficient diffusion a priority.

Duderstadt, Atkins, and Van Houweling (2002) examined this phenomenon, asking the question, "What explains the reluctance of higher education to implement digital technology in the ways that other sectors such as business and government have adopted these tools?" (p. 176). Dr. Duderstadt, as President Emeritus of the University of Michigan, was in a strategic position to observe the key issues on this question. He and his co-authors explain that,

> "[even now] the university stands apart, moored to its past traditions and practices, particularly in such areas as education. In spite of the information explosion and the profound impact of digital communications technology in areas such as scholarship, the nature of learning remains fundamentally unchanged in higher education. The traditional classroom remains the overwhelming focal point for learning, with the faculty still functioning largely as 'talking heads' and students as passive learners...Although both scholarship and administration have become heavily dependent on digital technology, *many universities believe that it remains simply too costly to implement technology on a massive scale in instructional activities – which, of course, it certainly does as long as they insist on maintaining their traditional classroom-based character rather than reengineering educational activities to enhance productivity and quality.* Their limited use of technology thus far has been at the margins, to provide modest additional resources to classroom pedagogy or to attempt to extend the physical reach of our current classroom-centered, set time-based teaching paradigm. It is

> ironic that the very institutions that have played such a profound role in developing the digital technology now reshaping our world are among the most resistant to reshaping their activities to enable its effective use in their core activity, education." (p. 275-276, Italics added)

The Administrator's Role

Bates (2001), exploring the role of institutional administration, notes that there are both institutional pressures and constraints on the diffusion of the Internet and computer technologies in higher education. Among the institutional pressures promoting diffusion is the potential for increased student interaction and access to resources without additional faculty and staff needed to support the interactivity. Institutional administrations sometimes see the Internet and computer technology as a way to drive down per-student costs while increasing the total number of students in an institution. Institutional constraints to the diffusion include the substantial investment required (of both time and money) to adjust to the new technology, the need for redesigning some aspects of the academic experience, and concerns about technology's suitability and reliability to the academic mission.

The administrator's perspective on Internet-Based distance education is explored in a research article by Shea, Motiwalla, and Lewis (2001). Surveying distance education coordinators at 68 institutions, the authors conclude that such technology-based initiatives often require much more staff and technical support than initially designed for. Such support, they conclude, is especially crucial in a growing program:

> "Coordinators of programs that are more established, *especially those moving from reliance on early-adopter faculty to reliance on late-adopter faculty* to fuel a growing program, are surprised by (a) the amount of increased support required for the faculty who are less comfortable with technology and (b) the second level of resistance as D[istance] E[ducation] moves to becoming institutional." (p. 115, Italics added)

Another important role of institutional administrators in promoting Internet and computer technologies is implied in a case study of instructional technology adoption in higher education (Groves & Zemel, 2000). The authors write,

> "The extent and rate of technology adoption is related to availability of resources and acceptance of innovations by faculty and teaching assistants. Yet, college teachers often feel unprepared for the demands of using technology in their teaching because they have had little instruction in its use." (p. 59)

In order to meet this burgeoning need, many institutions are now recognizing the need to provide administrative support to assist faculty members to learn the technology themselves. But, such a role for institutional administrators – training the faculty – is sometimes resisted by both the administration and the faculty.

Banks (2002) has shown how institutions can foster faculty familiarity with and usage of available technologies in her study of Virginia Tech's Faculty Development Institute (FDI). In this study, she shows how the university could function in a strategic way through the Faculty Development Institute to promote a greater understanding of computer and Internet technology, and ways in which it might be effectively used by faculty:

> The vision of FDI as initially implemented at Virginia Tech is as follows:
> 'A major initiative in instructional computing will transform the academic lives of all students and faculty and change the nature of teaching and learning at Virginia Tech. Anticipated outcomes include courses with more emphasis on active and independent learning strategies, problem solving and collaboration; strengthened student competitiveness in the job market; improved student retention; improved quality of interactions among students and faculty; and improved use of computer skills by students and faculty throughout the entire academic enterprise. The University will gain from making a major commitment to its teaching mission that will enhance our competitiveness in student recruiting and placement while strengthening the long-term appreciation of alumni for the institution.' (pp. 5-6)

New Ideas: Creating a New Higher Education Paradigm

Moving far beyond just viewing the administrator's role as assisting faculty to become comfortable with the technology, Hitch (2000) argues that the emergence of virtual universities will require higher education administrators to rethink such basic concepts as the academic credit hour, teacher workload and expectations, and student services. All are potentially revolutionized by the widespread adoption of virtual education.

Institutional Administration in an International Context

Studying the diffusion of Internet and computer technologies into education in an international context, Naidoo and Schutte (2001) and Robertshaw (2001) point out that institutions with a tradition of open learning and educational innovation, such as the Korea National Open University, the Open University of Hong Kong, and the University of South Africa (UNISA), often have an easier time transitioning new technologies into their institutions. Still, there are institutional challenges. In the case of UNISA, Naidoo and Schutte (2001) write:

> The university itself has the most modern computing, telecommunication, and other infrastructure at its campus in Pretoria needed to make this transition to technology-enhanced distance education. However, it is almost hobbled by indecision about its role in the world of modern telecommunication and computing, since it feels that some of its students are not ready for the transition. However, it is paving the way with its virtual arm, which still does not form a part of its main operations but does make it ready for its task. At the same time, this virtual arm benefits those students with the required technologies, such as Internet connectivity. (p. 103)

The African Virtual University (AVU) is an initiative of the World Bank that aims to use computer and Internet technology to tie together universities in several Sub-Saharan African countries and to provide courses taught by professors from institutions in

Africa, North America, and Europe. (Diagne, 2000) Its objective is to "to bridge the digital divide and knowledge gap between Africa and the rest of the world by dramatically increasing access to global educational resources in Africa." (World Bank, 2003) However, the success of this initiative has heretofore been very limited, according to a recent assessment by Amutabi and Oketch. (2003) The reasons for the limited success appear to be as much related to insufficient attention to administrative concerns as they do to the promotion of good pedagogy.

Also in an international context, Al-Jalahma (2003) studied the factors influencing diffusion of computer based communications (mainly Email) at Bahrain University. He concluded that the implementation and usage of computer based communication was more of a *bottom-up* phenomenon, driven by individual student and faculty use, rather than as a response to an institutional initiative from the top down. He writes, "If anything, Email succeeded despite lagging leadership and weak institutional endorsement." (p. 154)

These examples underscore the thesis that the varying national, cultural and infrastructural variables in low-to-middle income countries will make a significant difference in the adoption and ultimate success or failure of the Internet and computers as an educational medium in these countries. Exploring the unique perspective of developing countries, Kante and Savani (2003) get to the heart of this issue, explaining that developing countries will have to find their own path for implementing the Internet and computer technologies, and that this may be in great contrast to the way in which such technology is diffused into education in high-income countries:

> Some pundits may argue that the low-level of connectivity, or lack thereof, in the developing world remains a major obstacle for sustainability of an e-learning exercise. Arguments go even further to say that e-learning is especially attractive

> because people can log on in their homes, while in the developing world, the learners still need to go out of their homes, and still pay too much for Internet access! In our opinion, both arguments raise a fundamental question: can e-learning be provided in the developing world under the same premises and assumptions as in Western countries? The unequivocal answer is NO.
>
> While the PC-per-household ratio in developing countries will remain low for many more years to come, innovative community-based access points are proving more and more successful. When owned and managed by communities themselves (trained, of course, to plan and manage such centers), such public access centers allow for considerable economies of scale both in terms of hardware and access costs…
>
> [W]hile being alone at home on one's own PC might be important for a learner in the Western Hemisphere, the same may not be true in many parts of the developing world, where a critical attraction to learning still remains tied to social interaction. In fact, getting together with peers at the community learning center is a powerful driver for enrolling in courses. Thus, the combination of a blended e-learning approach, meshed with the use of community access points for delivery of the training provides a social learning environment, which merely increases the motivation of most learners. (p. 18)

The next section addresses research on the diffusion of Internet and computer technology into other types of institutions in an international context. From this literature, the notion that culture (both institutional and national) makes a crucial difference in promoting or inhibiting diffusion is reinforced.

Diffusion of Technology into Institutions in Other Cultures

Institutions other than universities have had challenges implementing Internet and computer technologies also. Malling (2000) studied the diffusion of information technology into business institutions in Nepal. He found that the culture (both of the business institution and the Nepalese culture) had a profound impact on the ultimate diffusion of non-diffusion of information technology in these institutions. Rohitratana (2000) found the same result in a study of the diffusion of computer-based Material Requirements Planning (MRP) at a business institution in Thailand. Walsham (2000),

studying the implementation of a geographic information system in India, argues that diffusion of technology will fail if it fails to take into consideration "local norms, values, and ways of doing things." (p. 299)

Summary of the Literature at the Institutional Level

Institutional cultures, in particular the culture of higher education institutions, tend to resist revolutionary changes. But, this is precisely the kind of change that is offered by the Internet and computer technologies. The literature reviewed above points to some of the barriers to diffusion of Internet and computer technology at the institutional level, the second level in the conceptual model.

This literature also suggests some of the opportunities for improvement of higher education *access* and *quality* that are offered by Internet and computer technologies, if diffused in such a way as to promote efficient and effective use among the staff, faculty, and students of the institution. The role of the institutional administration in promoting or inhibiting this diffusion is also addressed in this literature.

The literature also indicates why some institutions have an advantage over others in the diffusion of this technology. This advantage may derive from (1) institutional push – strong institutional leadership and promotion of the technology and willingness to transform the curriculum to take advantage of the capabilities offered; (2) institutional pull – collective efforts of faculty and/or students to introduce the technology even in the face of administrative resistance; (3) institutional mechanisms – faculty development institutes and the like that were created to facilitate the introduction and diffusion of technology; (4) institutional infrastructure – existing technology and communications infrastructure that serves as a scaffold for improvement of technological alternatives at

the university; (5) institutional resources – financial endowments and manpower that makes the purchase and operation of new technology possible, and (6) institutional history and culture – familiarity with and comfort about such things as distance-learning and computers in the classroom.

The section below addresses the literature relating to the diffusion of technology at the classroom level.

Review of the Diffusion Literature at the Classroom Level

In their seminal study on *How People Learn*, Bransford, Brown, and Cocking (2000) write, "The romanticized view of technology is that its mere presence in schools will enhance student learning and achievement." (p. 206) Of course, as the authors point out, the reality is often somewhat different from the idealized vision. In this section, literature that affects the diffusion of technology at the classroom level is reviewed. In addition, studies that address the impact of information technology on higher-education access and quality are reviewed.

Studies of the Internet and Computer Technologies

Green (1996) predicted in 1996 that information technology would become ubiquitous in universities in the United States. He based this assertion based on results obtained from the annual Campus Computing Survey, for which he served as director for several years. Despite Green's prediction, there are a number of barriers that exist for the diffusion of information technology at the classroom level. This section addresses some of them that have been identified in the literature.

The Pew Foundation (Jackson, 2003) studied *classroom readiness factors* for technology diffusion in higher education, and concluded that classes which had the

largest enrollments, standardized curricula, and objective criteria for learning outcomes, had the most likelihood for successfully integrating technology. The Foundation also identified the following in its list of *classroom readiness factors*:

1. There must be good potential for substituting technology for part of the normal instructor time;
2. The course redesign must be decided collectively by a program, department, or school, rather than one faculty member; and
3. The IT enhanced course must be able to use existing materials (either in use at the institution or available from elsewhere) to avoid devoting considerable time to material development. (p. 43)

This notion of *classroom readiness factors* is a crucial element in the study of technology diffusion in higher education, because it indicates that more is necessary than just *institutional* support. In a case study performed at a large, Midwestern research university, Smith (2000) found that, even in an institutional environment that evinced strong support for technology diffusion, there were barriers that inhibited the diffusion of technology at the classroom level. If the institution failed to promote and adopt technology standards, faculty who wished to use classroom technology in several different classrooms became confused due to the different equipment or operating systems used. In addition, when faculty were unable to get real-time help or timely training in order to use the technology, they became less enthusiastic about the use of the technology.

Sechrist and Finnegan (2000) studied the impact of and rewards for becoming technologically-proficient faculty members. According to the authors, technologically proficient faculty can become organizational catalysts in the diffusion of information technology, but at some risk to themselves and their careers:

> The major disadvantage of acting as the departmental techno-prof seems to be the amount of time it takes to help the faculty who ask for assistance. Concomitant with the time drain comes the inability to get one's own work done, often at the

> expense of performing research and scholarship. This expense in turn can ultimately have negative consequences upon promotion and tenure decisions for the faculty…the academic reward system has not been adjusted in most cases to incorporate the activities of the faculty necessary to effect the adaptation. In the end, neither the technoprofs nor the mainstream faculty receive organizational credit for complying with institutional goals. Faculty therefore are often left to their own devises to learn about, adopt, and employ computer technology into their courses and academic pursuits. (pp. 139-140)

Hart (2000), studying the use of Internet and computer technology at the University of Arkansas for Medical Sciences, concluded that the "…successful integration of information and educational technology into health sciences education depends on the interest and commitment of the teaching faculty, the clinical educators, the support personnel, and the students themselves." (p. 206) Furthermore, she noted that the faculty, clinical educators, and support personnel were well attuned to reading the commitment signals from the administration in terms of funding levels, and provision of sufficient personnel, hardware, and software in order to do the job well.

Kumari (2000) interviewed faculty at a large state-supported doctoral university in order to determine the factors that influence faculty in technology adoption decisions. She found that faculty look for both technical support structures and institutional incentives when deciding when and how much to make use of technology. In the words of one interviewee, "The innovators [early adopters of the technology] are being evaluated by the resistors in the tenure review process." (p. 238)

In a study that predates the Internet, Scott (1986) studied the factors influencing adoption of computers by Community College faculty in Virginia. Using a survey designed to elicit faculty knowledge and attitudes about computers, perspective on opinion leaders, and assessment of the college's computer facilities, Scott concludes that familiarity with computers was more likely to result in usage in the classroom,

confirming Rogers' notion about the importance of *trialability* and *observability* in promoting diffusion. But Scott's study produced counterintuitive results about opinion leaders. The opinion leaders' effect was negative on the diffusion of computers at the community college. He concludes, "Obviously there are more important considerations in adopting computer use than the fact that one's colleagues are using them." (p. 71)

Jaber and his colleagues (1997; Jaber & Moore, 1999), studying the factors influencing secondary school teachers to adopt computer-based technology, concludes that *access* is the most important variable. By *access*, Jaber is referring to the same concepts that Rogers calls *trialability* and *observability.* This emphasis on the importance of *access* to the technology is echoed in a study of adoption in Malaysian higher education by Zakaria (2001).

Assessing Internet and computer diffusion at primary and secondary schools in the U.S., Attewell (2001) proposes that there are two "digital divides" – one of *access* and one of *use.* There is first a divide (by income, race, and other factors) in *access* to the technology. Then, those who have *access* may not know how to *use* the technology productively. This dual divide of *access* and *use* may be particularly important in the context of low-to-middle income country diffusion.

Studying college business teachers and the factors influencing their adoption of computer technologies, Chapman (2003) found that *relative advantage* was the most important of Rodgers' five factors influencing the adoption of this technology. Though some would argue that these technologies offer no advantages, or perhaps even produce a deleterious effect upon education, some evidence that a potential educational advantage (or at least educational parity) exists comes from studies of what is called the "no significant difference" phenomenon.

Technology, Higher Education Quality and the "No Significant Difference" Phenomenon

An address by the President of Rice University, Malcolm Gillis, underscores the crucial importance of high-quality higher education.

> Today, more than ever before in human history, the wealth – or poverty – of nations depends on the quality of higher education. Those with a larger repertoire of skills and a greater capacity for learning can look forward to lifetimes of unprecedented economic fulfillment. But in the coming decades the poorly educated face little better than the dreary prospects of lives of quiet desperation. (Gillis, 1999)

With quality higher education being of such importance, it is imperative that technology be diffused in a way that enhances the quality of higher education. As stated earlier, the Internet and computer technologies offer the potential for enhancement through *content delivery, visualization, artificial intelligence, enhanced communications, and electronic access* to library and research materials. But such enhanced quality is not guaranteed. Consider the current debate on the viability of distance education, and in particular, Internet-mediated distance education, as an alternative to meet burgeoning enrollment. Some feel that distance education offers a quality alternative to classroom-based education, while others malign it as being inferior. One of the chief proponents of distance education is Thomas L. Russell.

Russell, who is Director Emeritus of Instructional Telecommunications at North Carolina State University, performed a meta-study of 355 research reports, summaries, and papers for distance education. He concludes that there is "no significant difference" in learning outcomes for students who use distance study versus students who study in traditional classrooms. (Russell, 2003a, 2003b) Understandably, Russell's conclusions are not without controversy, not only because of Russell's controversial research method, but also because of the elusive nature of a definition of higher-education *quality*.

What Makes a Successful Distance Learner?

The "quality" of such a higher-education process may be highly dependent upon the intellectual and emotional maturity of the student involved. This is one of the conclusions of early distance-education researcher Michael Moore. Dr. Moore (1972, 1973), who is also a proponent of distance education, argues that the successful autonomous learner is somewhat different from the successful campus-based student.

Numerous other studies have shown that attitudes towards technology, personality characteristics and cultural characteristics of distance learning students play a part in their success or failure. (Harnar, Brown, & Mayall, 2000; Harris & Davison, 1999; Jurich, 2000a, 2000b; Liang & McQueen, 1999; Mei-Yan, Walker, & Huang, 1999; Osciak & Milheim, 2001) In summary, a successful distance learner is likely to be more disciplined, independent, self-directed, and goal-driven than a classroom-based student. For success in an Internet/computer-based environment, it is also likely that he/she may need to be more technologically proficient as well.

Further exploring this theme, a recent Department of Education study, reported in Phipps (2004), noted the characteristics of students using distance education alternatives at U.S. institutions.

> Students whose primary language was English were more likely to participate in distance education than students whose primary language was not English (8 vs. 6 percent)—although there were no differences among racial/ethnic groups. Also, undergraduates age 24 and over were more likely than students under 24 to participate (10 vs. 6 percent). Married students were more likely than those who were unmarried to participate (11 vs. 7 percent), and among independent students, those who earned $50,000 or more were more likely to take distance education classes than those earned less than $50,000 (11 vs. 9 percent). Twenty-nine percent of undergraduate students who took distance education courses enrolled in distance education for their entire program.
>
> Students at the graduate/first-professional level exhibited similar patterns of participation in distance education as undergraduates. However, unlike

> undergraduates, there were no gender differences, although there were racial/ethnic group differences. White students (11 percent) were more likely than Hispanic (5.8 percent) and Asian (5.5 percent) students to take distance education classes, but no differences were found between White students and either Black or American Indian students. Thirty-eight percent of graduate/first-professional students who took distance education courses enrolled in distance education for their entire program. (p. 12-13)

Phipps reports that 60 percent of these students used Internet technology to attend the distance education classes.

Distance Education Worldwide: Disappointing Results

In contrast to Russell and Moore's conclusions, Potashnik and Capper (1998) examined the recent worldwide growth of distance education (particularly technology-mediated distance education) and concluded that "[t]he quality of some distance education programs and institutions is perceived to be poor, with their deficiencies often attributable to inadequate planning and the use of superficial materials delivered in a piecemeal fashion." (p. 43-44) Furthermore, the authors point out that education quality can suffer when the technology becomes an end in itself rather than as an enhanced means to connect with students.

Internet and computer technologies as a means for delivering course content represent an evolution from earlier electronic technologies used for higher education. One of these technologies, instructional television, had very limited success despite the great potential it offered. The next section looks in detail at one study that investigated why some faculty members were enthusiastic about this technology, while others were ambivalent about it.

Lessons from the Case of Instructional Television

Evans (1967) studied the resistance to the diffusion of technology (specifically Instructional Television – ITV) in higher education by the professoriate. He found distinct differences between professors who were accepting of Instructional Television (pro-ITV) and those who were not accepting of this innovation (anti-ITV), even on measures seemingly unrelated to the innovation. Evans attributes this result to the idea of a "constellation of values" that are held by individuals. This idea, based on social psychology research (Krech & Crutchfield, 1948; Krech, Crutchfield, & Ballachey, 1962), proposes that people have beliefs and values about many things that can be grouped into "constellations" to describe the individuals' preferred behaviors. For the adoption of innovations such as Instructional Television, faculty can be grouped into "innovators" – those who are accepting of the innovation and are quick to adopt it – and "laggards" – those who will likely be among the last to adopt the innovation, if at all.

By surveying the faculty of a large, unnamed metropolitan university, and conducting interviews with a smaller group of faculty, Evans was able to determine some of the differences between "pro-ITV" professors and "anti-ITV" professors. "Pro-ITV" professors had more experience teaching at other institutions than "anti-ITV" professors. They also were more accepting of other innovations such as video tape. Interestingly, Evans writes that "pro-ITV" professors "…were judged to be tolerant and sophisticated and less hostile and bland [than 'anti-ITV' professors]…they appeared to be less opposed to instrusions [sic] into their own lives by others." (Evans, 1967, p. 84)

In contrast, Evans found that "anti-ITV" professors were focused on the traditional academic values of a university. He writes that "they viewed with considerable indifference, or even hostility, those items which were peripheral to the university as they

perceived it." (pp. 84-85) Some of these "peripheral" items were things such as extra curricular activities, athletic scholarships, and training in teaching methods for professors.

Summary of the Literature at the Classroom Level

The diffusion of Internet and computer technologies at the classroom level faces additional barriers beyond those at the national and institutional levels. Though numerous studies have shown that distance education outcomes are comparable to campus-based education, faculty are still often skeptical of the quality and efficaciousness of Internet-mediated instruction. Faculty who are early-adopters are not necessarily rewarded for doing so, and may in fact suffer sanctions from other faculty, who are often more skeptical about the role of technology in higher education. Students and faculty with different personalities, culture, and backgrounds respond differently to technology, and student success is often different for campus-based or technology-mediated distance learning. When technology employed as an end in itself rather than as an enhanced means to connect with students it is likely to be viewed as of low quality and unsuccessful in its application. In conclusion, there are many variables to consider, and much remains to be learned about the impact of technology on the quality of higher-education instruction and outcomes. The potential that it offers is high, but ineffective application can color the faculty's and students' perceptions of the quality.

General Summary of the Literature

The literature reviewed in this chapter has examined the diffusion of Internet and computer technology at three levels: national, institutional, and classroom. At each level, the literature has offered some insight into the factors for success and failure of the

diffusion of Internet and computer technology at that level. At the national level, it was noted that infrastructure variables such as teledensity, national income, and education levels are likely to play a large part in that diffusion. The influence of these variables will be tested below.

At the institutional level, it was noted that the diffusion of Internet and computer technology into the institution may help to increase student access to higher education. The case for technology's role in enhancing quality is less clear. The institutional literature showed that there are several pathways by which technology diffusion may be promoted or inhibited: through institutional push, institutional pull, institutional mechanisms, institutional infrastructure, institutional resources, and institutional history and culture.

At the classroom level, it was noted that faculty adopt technology for a variety of reasons, and that there may or may not be rewards for doing so. It was noted that successful distance-learners are likely to exhibit personality traits that are different from campus-based students. In short, such learners are likely to be more independent, more self-directed, and more self-disciplined than their campus counterparts. Last, this section addressed the "no significant difference" phenomenon – which asserts that campus-based students and distance-learners perform equally well on tests of content knowledge derived from the different learning modalities.

CHAPTER IV

METHODOLOGY FOR MEASURING WHETHER TECHNOLOGY WILL AMELIORATE OR EXACERBATE THE DIFFERENCES

Overview

Based on the equivocal evidence offered in the literature, it is conceivable that the differential diffusion and use of Internet and computer technologies will result in an enduring higher education gap between rich and poor nations. However, it is equally conceivable that the liberating nature of these technologies will enable greater and greater access to high-quality higher education in all quarters, resulting in a declining gap over time. The research literature generally indicates that high-income countries have an advantage in diffusion and effective use of the technology at all levels: national, institutional, and classroom. But, the literature also indicates that the technology offers promise for low-to-middle income countries trying to close the gap. How will this dilemma be resolved – will low-to-middle income countries close the gap, or will it endure? This chapter presents the research methodology used to examine the question.

Summary of the Research Methodology

This dissertation employs a mixed methodology research model that addresses diffusion of the Internet and computer technology at three levels: *national, institutional,* and *classroom.* Research at the national level uses quantitative methods and publicly available data and results in a predictive equation for Internet use in a particular country. Research at the institutional level uses a mixture of both quantitative and qualitative methods, and addresses how technology has been diffused at several U.S. universities of

differing organizational structure and resource endowment, and the perceived effects of such diffusion on higher education *access* and *quality*. Research at the classroom level uses qualitative interviewing methods in order to determine the reaction and attitudes of professors and faculty to the introduction of technology, and the effect on higher education *quality*.

Understanding the diffusion of the technology at these three levels will enable a greater understanding of the higher education gap between high-income and low-to-middle income countries, and the possibilities for a reduction of the gap. Before addressing the details of the methodology, the existing evidence is examined – both the case for a widening or enduring gap and the case for a narrowing one.

The Case for an Enduring Gap

The first fact confronted by an observer of the technology gap between high income countries and low-to-middle income countries is that high-income countries have such an appreciable head start. Internet and computer technologies were invented in the West and have achieved wide diffusion there. The introductory chapter addressed the higher education gaps between high and low-to-middle income countries. In addition to these gaps, the diffusion of the Internet and computer technologies is much more thorough in high-income countries. This head start is likely to persist for some time, because diffusion of Internet and computer technologies in low-to-middle-income countries depends upon communications infrastructure, which is often poor. Computer and Internet use appears to be highly correlated with national income, and hence poor countries are further at a disadvantage. One would expect from this correlation that,

without concurrent increases in income, attempts to promote diffusion of computer and Internet technology will founder.

Looking at the gaps from the *institutional* perspective, we find a similar head start for high income countries. Since technology often takes a long time to diffuse in higher education, the changes wrought by the diffusion of Internet and computer technologies in low-to-middle income countries may take some time to work their way into the higher education sector in these countries. It is also arguable that higher education institutions in low-to-middle income countries are more conservative in their approach to pedagogy than institutions in high-income countries, and hence less likely to make changes that offer the potential for improvement[18]. Research studies at higher education institutions in the United States have shown that institutions with more resources and prestige have been more successful at integrating Internet and computer technologies into the institution, and institutions with fewer resources less so. Such *institutional divides* will likely be exacerbated in low-to-middle income country institutions. Finally, although there is some *evidence* that technology is of use in improving higher education outcomes, the case for technology's impact on higher education quality is yet unproven. Institutional administrators and faculty are often skeptical of the role that Internet and computer technologies can play in improving higher education. These attitudes limit the impact that such technologies can ultimately have.

[18] Much education in low-to-middle income countries follows a *rote learning* model, whereby the student is responsible for memorizing and reciting what the teacher considers to be important. Such an environment is likely to be more resistant to technology-induced changes in pedagogy than those systems (such as the U.S.) that are more amenable to experimentation and change.

The Case for a Narrowing Gap

At a national level, although high-income countries have a substantial head start in diffusion of Internet and computer technologies, recent data show that gap is *decreasing*, not increasing. Furthermore, Fink and Kenny's (2003) research showed that, at each level of personal income, computer and Internet use in low-income countries is often higher. Other research has shown that on other measures of information technology adoption, low-to-middle income countries are comparable with high-income countries. This evidence suggests that low-income countries may be catching up in the diffusion and use of Internet and computer technologies.

It was noted above that a country's telecommunications sector plays a crucial role in promoting and catalyzing the diffusion of Internet and computer technologies. Recent emphasis on telecommunications reform in low-to-middle-income countries increases the potential for diffusion of these technologies to proceed at a higher pace. Lack of existing infrastructure opens the door for more high-tech solutions, offering low-to-middle income countries the opportunity to "leap-frog" high-income countries.

At the *institutional* level, as diffusion increases, electronic access could equalize access to course materials, journals, and other academic materials in higher education. Such electronic access would likely even the playing field for faculty and researchers in low-to-middle income country higher education institutions, who have heretofore had limited access to such academic materials when provided via paper medium.[19] Even if high-income countries have a head start, research has shown that technology followers

[19] The Indian information-access researcher Subbiah Arunachalam reports that, as of 1998, the finest Indian science library received fewer than 2100 journals, whereas many American academic libraries have subscriptions numbering in the tens of thousands. However, he is skeptical about the ability of technology to close this gap. See Arunachalam, S. (1998) Information Technology: Equalizer or Separator of Developing Countries? *The Technology Source* (August 1998), available at http://ts.mivu.org

often have an advantage, because low-to-middle income countries' higher education institutions will be able to benefit from the lessons learned in institutions in high-income countries. All of these factors promote a decreasing gap.

The assertions made in the sections above will be analyzed to determine the most likely future for the diffusion of Internet and computer technology in higher education and their ultimate effects in both high-income and low-to-middle income countries. The effects will be analyzed at the *national*, *institutional*, and *classroom* levels.

Research Methodology: National Level

In order to assess the potential for Internet and computer technology to be diffused at the national level, an analysis will be done on data available through public sources relating to Internet diffusion and its relationship to other national variables – education levels, national income levels, region, usage of other media, human development indices, democracy, freedom, and corruption indices, telecommunications infrastructure and investment, and other national variables. The main dependent variable to assess Internet diffusion will be *Internet use per population*. Assessment of the data in this manner presents a picture of Internet diffusion to date, indicating trends, and revealing its relationship with social, political, technical, and economic variables at the national level.

Correlation Analyses

Using public data from public sources, the relationship between Internet use and other national-level variables will be developed through correlation analysis:

- Internet use, Internet hosts, and personal computers
- Internet use and National Income
- Internet use and Education Levels

- Internet use and National Infrastructure (Phone lines/Cap, Electricity Consumption)
- Internet use and Geographic Region
- Internet use and Religion
- Internet use and Freedom and Corruption Rankings

Development of the Regression Equation

The correlation analyses will be used to determine the variables that are most significant in relation to Internet use. These variables will be used in developing a regression equation which enables prediction of the percentage of Internet use in a country based on the values of those economic, political, infrastructure, culture, and education variables for a particular country. Once the equation is developed, it will be used to predict Internet use in various countries with known independent variables. The predicted values for Internet use from the regression equation will then be compared to the actual values, and the reason for substantial variation will be examined.

Significance of the Analysis at the National Level

Analysis of Internet and computer technology diffusion at the national level is necessary but not sufficient to answer the question about its eventual effect on the higher education *access* and *quality gap* between high-income and low-to-middle income countries. This analysis will, however, allow some conclusions to be drawn about the information technology environment in low-to-middle income countries that is likely to be encountered by the higher-education sector. The more readily available such technologies are in the country, the greater will be the opportunity for higher-education administrators, teachers, and students to assess the utility of the technology. This opportunity for assessment of the technology will have an effect on the ultimate diffusion

or non-diffusion of the technology in the higher-education institutions of low-to-middle income countries.

Research Methodology: Institutional Level

The analysis of the diffusion of Internet and computer technology and its impact at the Institutional Level will be done using a mixed methodology – both quantitative and qualitative methods will be used to elicit the institution's role in the promotion or inhibition of the diffusion of these technologies, and the likelihood of institutions in low-to-middle income countries to close the gap.

Quantitative Methods

An analysis will be performed on the correlation between Internet and computer technologies in use at universities in the United States and the institution's quality as determined by their ranking in the 2004 *U.S. News and World Report* listing of top U.S. universities. In this way, the relative importance of various technological elements will be determined. Though the *U.S. News* rankings are highly debatable, it does provide one benchmark by which higher education quality might be judged. The results of this analysis will be compared with other institutional rating schemes, some which use explicit technology variables in developing their institutional rankings, and others which do not. A comparative analysis will also be done on a random sample of institutional websites in high-income and low-to-middle income countries. This analysis will enable comparison in the sophistication and level of information available on these websites, and will provide an indication whether institutions in low-to-middle income countries are

adopting Internet and computer technologies at the institutional level in the same manner as they are being adopted in high-income countries.

Qualitative Methods

In order to determine how Internet and computer technologies are diffused in institutions, and their perceived impact on the quality of the institution, qualitative interviews, following a methodology popularized by Rubin and Rubin (1995), will be conducted with university administrators at several higher education institutions of different models in the Northern Virginia/Washington DC area. The subject of the interviews will be the institutional administrators who have technology management as part of their management portfolio. Interviews will be conducted at five types of institutions: a state university, a community college, a private research university, a corporate university, and an online institution.

Research Methodology: Classroom Level

The focus of the research at this level will be to determine the means by which Internet and computer technology will have the greatest impact on the classroom, and to determine the barriers and facilitators to diffusion at this level. In order to determine these things, faculty at five distinct types of institutions – a state university, a community college, a private research university, a corporate university, and an online institution – will be interviewed to determine how much impact the following aspects of technology will have on classroom instruction and course quality: (a) Content delivery, (b) Visualization, (c) Artificial Intelligence, (d) Enhanced Communications, and (e) Electronic Access to Library and Research Materials.

This dissertation now turns to the analysis at the national level, followed in turn by the analyses at the institutional and classroom levels.

CHAPTER V

NATIONAL LEVEL ANALYSIS

The analysis here begins by looking at data for Internet usage in both high and low-to-middle income countries over time. Although high-income countries have a substantial head start, there is already much evidence that low-to-middle income countries may be closing the gap. There is evidence of Internet and computer use reaching a plateau in high-income countries, and evidence of continued growth in low-to-middle income countries.

Internet Use Growth by Country

Internet Growth in High-Income Countries: Evidence of Leveling Off

Data on Internet and computer use at the country level is often available through public sources, of varying quality. One source, NUA Internet surveys (www.nua.ie)[20] has been cited by a number of researchers, notably by Norris (2001) in her study of the digital divide, by Heyneman and Taylor-Haynes (2003) in their analysis of international

[20] In its compilation, NUA reports not only its own Internet use research data, but that of many other sources such as the International Telecommunications Union (ITU), Reuters, Nielsen NetRatings, and other more obscure research organizations such as SANGONeT, Ajeeb.com, and CommerceNet Research. Research on growing Internet use from its inception is thus complicated by the fact that no single organization has produced reliable longitudinal data for Internet use across the globe. A recent United Nations (UNCTAD) report has noted other causes for imprecision in international Internet use data:

> "…[T]here is no precise and commonly accepted definition of who can be considered an Internet user. The fact that many people have access to the Internet but that they never or almost never use it is one typical issue. Another major cause for imprecision is that sources of data are often privately owned Internet Service Providers that tend to inflate their own figures for commercial reasons." Source: United Nations Conference on Trade and Development.(United Nations Conference on Trade and Development, 2004) *Use of the Internet for Efficient International Trade: Guide for SME Managers*. Geneva, Switzerland: United Nations, p. 2.

uses of educational technology, and by Maitland and Bauer (2001) in their assessment of the national level factors influencing Internet use. In addition to the NUA statistics, data from the International Telecommunications Union was used in the analyses.

The first step in analyzing Internet use at the national level is to characterize it in terms of the S-curve diffusion model. This is done by taking existing Internet user data by country, plotting it versus time, then fitting an S-curve (a 3rd order polynomial) to the data. If we do this for the United States we find that there is already some evidence of leveling off. The data are shown below along with a trend line projected three years into the future. Note that the trend line even indicates that there might be some decline in Internet use.

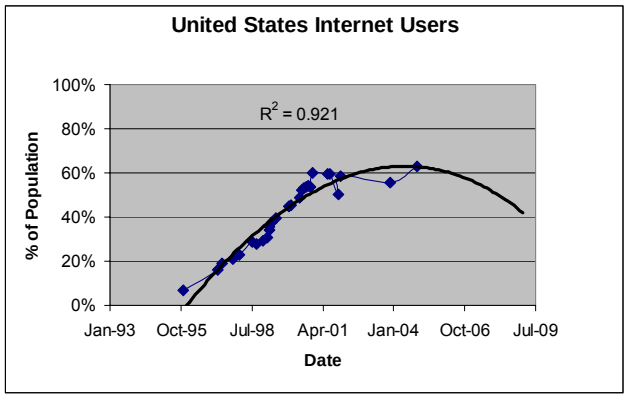

Figure 6: Internet Usage Growth in the United States

The plateau phenomenon is also observed for many of the high-income countries of North America and Western Europe – Internet usage appears to be leveling off somewhere between 50 to 70 percent of the population. The following diagrams show Internet growth data for the United Kingdom, Germany, Sweden, and the Netherlands.

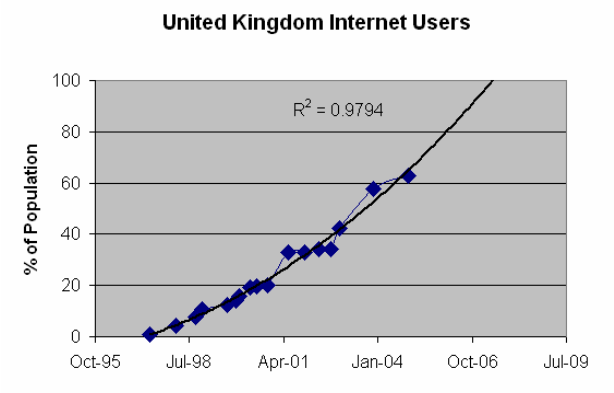

Figure 7: Internet Usage Growth in the United Kingdom

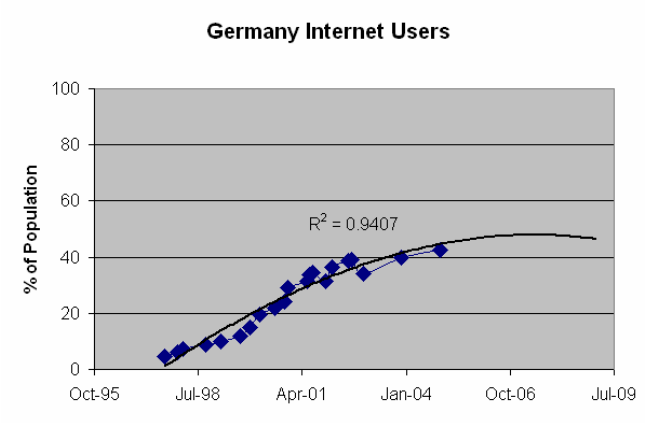

Figure 8: Internet Usage Growth in Germany

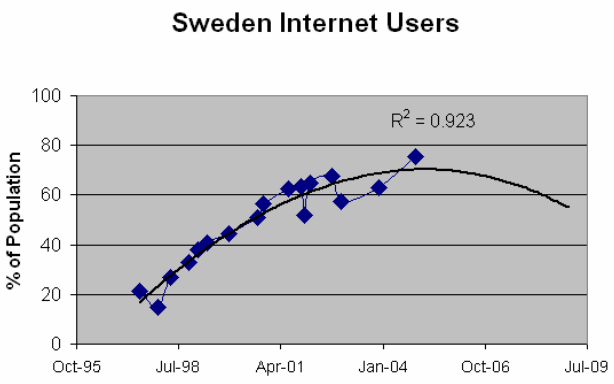

Figure 9: Internet Usage Growth in Sweden

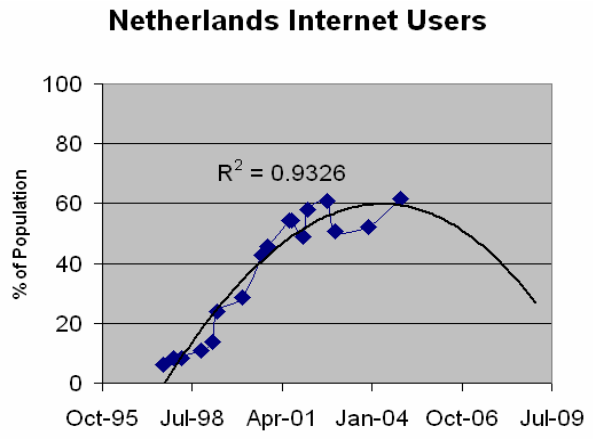

Figure 10: Internet Usage Growth in the Netherlands

What do these curves indicate? They first indicate that the adoption of the Internet in these countries has been both rapid and wide. They show rapid growth in the adoption of the Internet, particularly through the late 1990s. But, significantly, they also indicate that usage of the Internet begins to level off shortly after the end of the decade. They indicate that a substantial percentage of the general population of the country (sometimes as high as 70%) purport to be Internet users. With such widespread usage of the Internet in these countries, the road toward greater and more effective usage in higher education has, in a sense, already been paved. Furthermore, the Internet, at least in the West, appears to be a medium dominated by the young. A study by the U.S. Department of Commerce (National Telecommunications and Information Administration, 2002) reported that "[c]hildren and teenagers use computers and the Internet more than any other age group…Ninety percent of children between the ages of 5 and 17 (or 48 million) now use computers…Seventy-five percent of 14-17 year olds and 65 percent of 10-13 year olds use the Internet." (p. 1) Therefore, in high-income countries where the Internet has already achieved wide penetration, matriculating higher-education students are likely

to already be familiar with many applications of computers and the Internet that would be used in their institutions.

What is the situation in low-to-middle income countries?

Internet Growth in Low-to-Middle Income Countries: Ambiguous Results

In contrast to the results for high-income countries, the data exhibit a much less clear pattern when the growth of the Internet in low-to-middle income countries is analyzed in this way. For the data shown below, almost all countries are presently below 20% Internet penetration. Does this indicate that the growth will peak at a plateau below this level – a permanent gap – or do we conclude that the country is merely in the slow growth stage and that growth has not yet begun to truly accelerate? In short, there are two possible long term results – *normalization* or *stratification*. (Ruth, 2002) These two possibilities are shown in Figure 11 below. *Normalization* represents the adoption curve for a low-to-middle income country that has an *adoption time lag* compared with the high-income countries, and *stratification* represents the experience of a country that has both a *time lag* and an *enduring adoption level gap.*

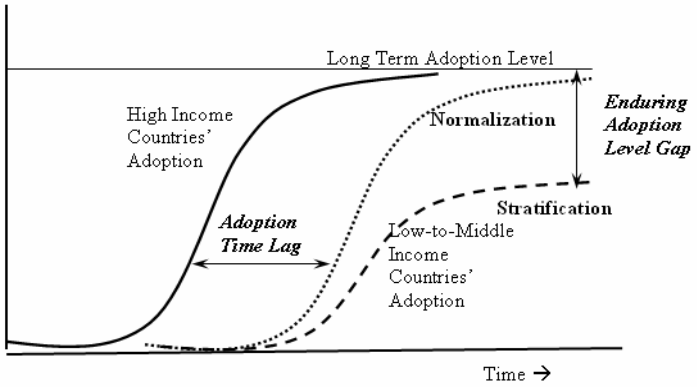

Figure 11: The *Normalization* and *Stratification* Models

Shown below are Internet use growth curves (% population vs. time) for several low-to-middle income countries. Data for Internet usage in these countries are often more sparse than for high-income countries, thus complicating the analysis of the already ambiguous results for low-income countries.

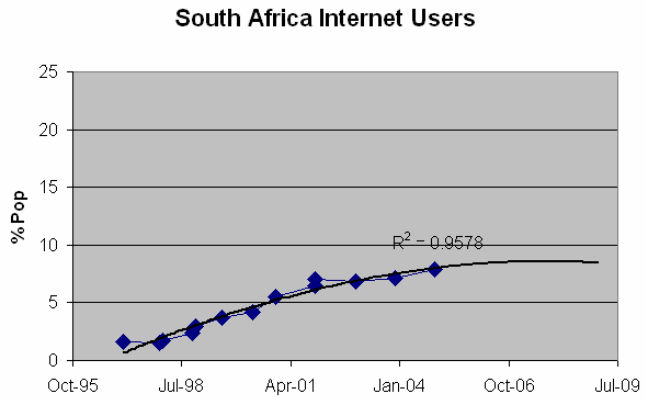

Figure 12: **Internet Usage Growth in South Africa**

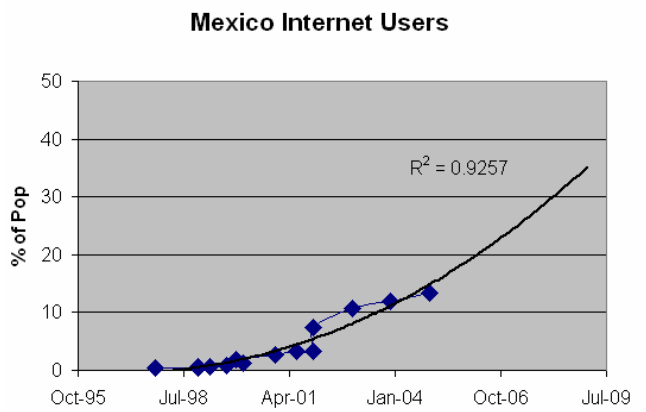

Figure 13: **Internet Usage Growth in Mexico**

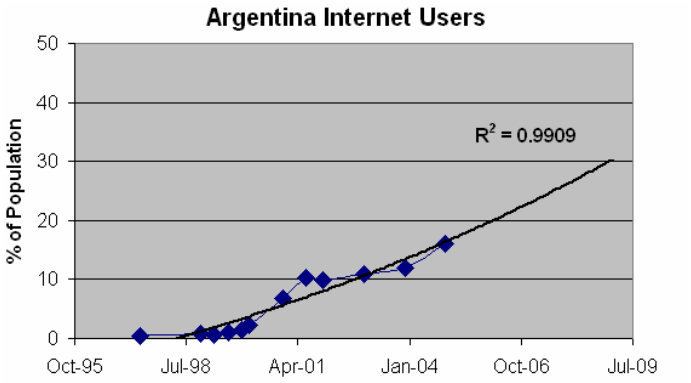

Figure 14: Internet Usage Growth in Argentina

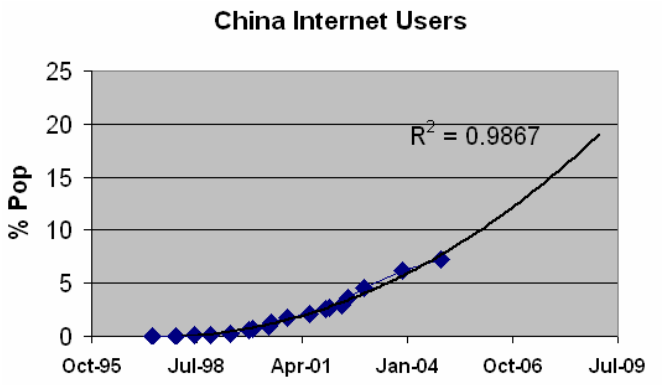

Figure 15: Internet Usage Growth in China

The final curve is for Malaysia – a middle income country that is rapidly developing along the lines of the Asian tigers.(World Bank, 1993) If Malaysia's economic situation is improving in accordance with this model, then it might also be expected that Internet use is growing faster than in other countries. This is precisely the case for Malaysia. Internet use was well above 30% of the population by 2003, and still growing. Below, we will examine some of the rationale for this growth.

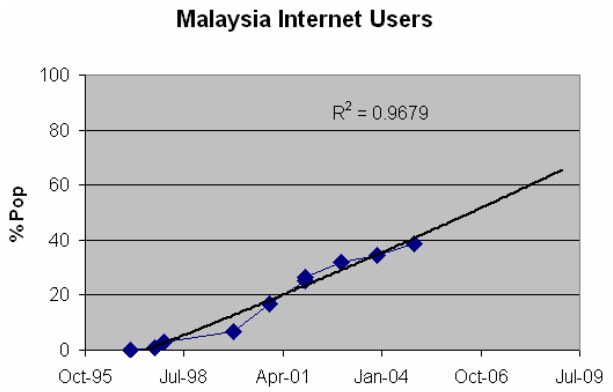

Figure 16: Internet Usage Growth in Malaysia

Evidence for a Narrowing of the Gap

It was noted above that Internet use and growth exhibit an ambiguous pattern in many low-to-middle income countries. What does seem clear, however, is that global Internet use is not as dominated by users in high-income countries as it was previously. When Internet usage data for the U.S. and for high-income countries is plotted in the same chart with *all* users, it is apparent that the gap is closing, albeit slowly.

The diagram below illustrates that the United States had the lion's share of Internet use in the early days of the Internet (mid-to-late 1990s), but that the United States' percentage of the world's total has been declining ever since.

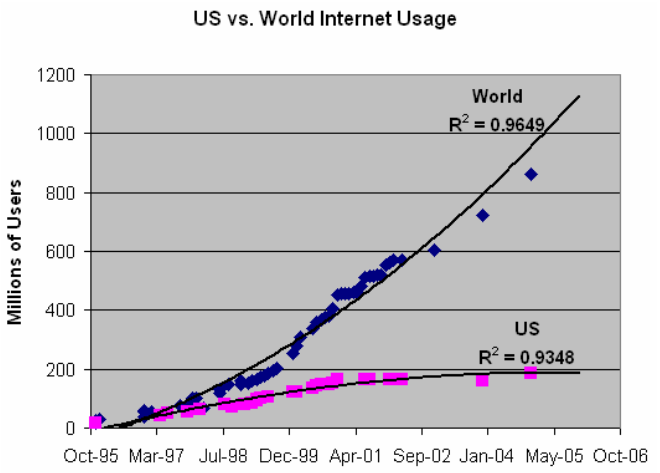

Figure 17: World Internet Growth vs. U.S. Growth

The same pattern is evident in the diagram below, where Internet use for high income countries (the U.S., Canada, Western Europe, Japan, Korea, Singapore, Taiwan, Australia and New Zealand) is shown on the same chart with world usage. Though the high-income countries dominated well into the late 1990s, it is apparent now that their percentage of the whole is declining. This trend can be seen explicitly in Figure 19, where the percentage of high-income country internet use is plotted as a percentage of world usage, and a moving average trend line is added.

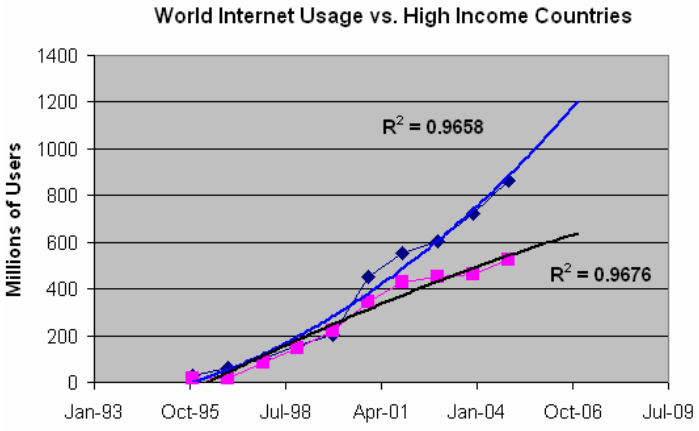

Figure 18: World vs. High-Income Internet Growth

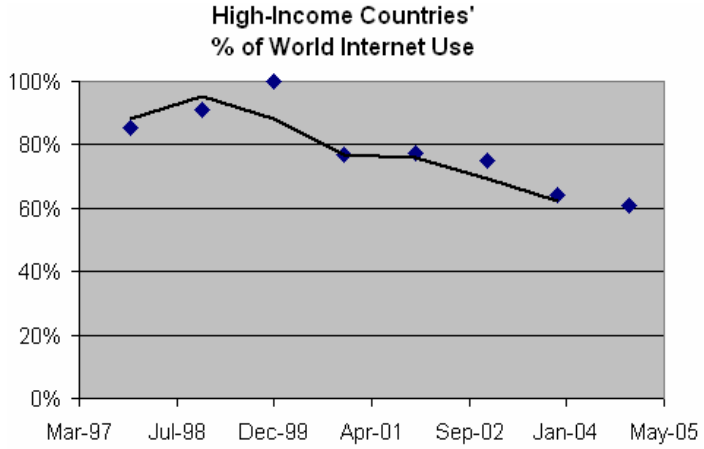

Figure 19: High Income Countries' % of World Internet Use – A Decreasing Trend

If the number of Internet users is leveling off for high-income countries, then the growth in usage, as shown by the *World* curve above, must be coming from low-to-middle income countries. Indeed, as shown in Figures 12 through 16 above, there is growth in Internet use in many low-to-middle income countries. What are the characteristics of this growth, and, in particular, can that growth be classified according to Ruth's *normalization* and *stratification* models in Figure 11 above?

When Internet use growth for low-to-middle income countries is plotted and projected to 2009, the following trends appear (Figure 20).

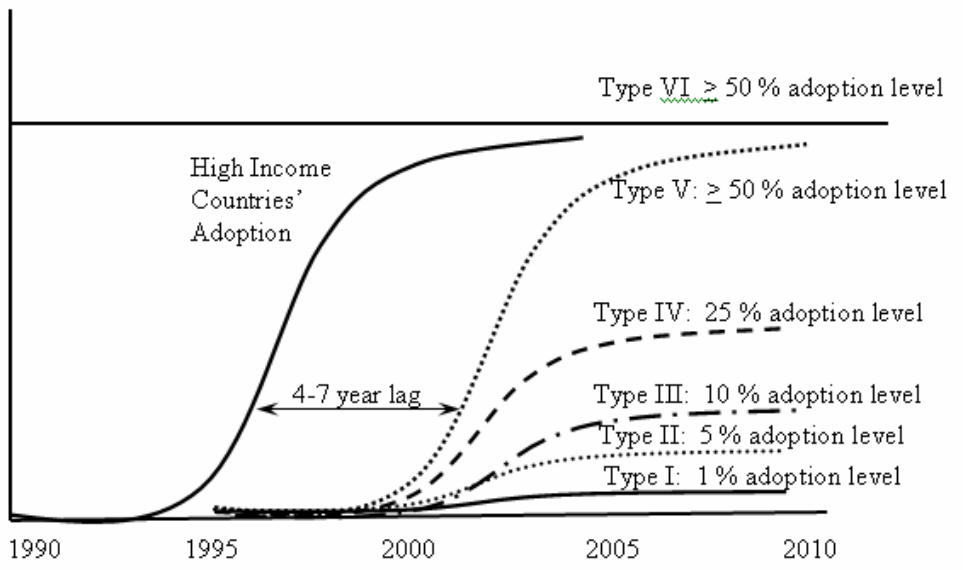

Figure 20: Six Levels of Long Term Adoption

This figure indicates that the period of rapid growth in Internet use in high-income countries mostly occurred during the period 1995-2000. As noted above, much of the growth in use for high-income countries began to reach a plateau in the late 1990s or the early years of the 21st century. It was at this time, however, that growth in Internet use for low-to-middle income countries began to emerge. This indicates that there has been a four-to-seven year lag time from the high-income countries' rapid growth to the same phenomenon for low-to-middle income countries.

What are the eventual plateau levels in low-to-middle income countries? This is an unknown, but the analysis of the present growth data and projection of that data to the future provides some indication what might occur. When this is done, there emerge at least six plateau levels for Internet use growth in low-to-middle income countries. They are shown graphically in Figure 20, and are defined below:

- Type I: The country's Internet use indicates a 1% adoption level or below.
- Type II: Internet use is at 5% of the population or lower

- Type III: Internet use up to 10% of the population
- Type IV: Internet use from 10% to 25% of the population
- Type V: Internet use up to 50%
- Type VI: Internet use that will exceed 50% of the population

Tables 3 and 4 below show a breakout of the penetration levels by region in 2004. Africa has the largest percentage of countries (37.0%) whose Internet penetration is 1% or less, followed by Asia and the Pacific (26.8%), and the Middle East (8.3%). Latin America and the high-income nations have no countries with such low Internet penetration. What this says is a reprise of what has been said before – the high-income nations have a head start in Internet penetration, and have already achieved high levels of diffusion. Other nations have varied levels of connectivity, which seems to be related to national income levels.

Table 3
Internet Penetration Use Levels in 2004 by Region
Source: ITU Data

		Category					
		I	II	III	IV	V	VI
2004	# of Countries	< 1% penetration	1-5 %	5-10 %	10-25%	25-50%	> 50%
Africa	54	37.0%	44.4%	9.3%	5.6%	3.7%	0.0%
Asia & Pacific	41	26.8%	51.2%	7.3%	7.3%	7.3%	0.0%
Middle East	12	8.3%	16.7%	25.0%	33.3%	16.7%	0.0%
Latin America	39	0.0%	15.4%	23.1%	35.9%	25.6%	0.0%
US & Canada, Europe & High Income Asia	50	0.0%	2.0%	8.0%	18.0%	36.0%	36.0%

For all 196 countries, Internet use was plotted over time using the NUA and ITU data, and a trend line was added, projecting the percentage of Internet use in each country to 2009. The phenomenon that seems to be emerging from these projections is that some high-income countries are continuing to add Internet users, but that the plateau for such diffusion tends to reach a maximum between 50 and 70 percent of the population. For low-to-middle income countries, there is substantial growth in Internet use in this time, with some countries likely to attain Internet use levels that rival that of high-income nations. These are the countries in Categories V and VI of the table below. The projections also indicate that the number of countries with very low diffusion levels – those in Categories I and II – are substantially fewer in number in 2009 than in 2004, due to the higher growth rates of Internet use in low-to-middle income countries. The results are shown in Table 4 below, by region.

Table 4
Internet Penetration Use Levels by Region Projected to 2009
Source: ITU Data

		Category					
		I	II	III	IV	V	VI
Projections to 2009	**# of Countries**	**< 1% penetration**	**1 - 5 %**	**5 - 10 %**	**10-25%**	**25-50%**	**> 50%**
Africa	54	20.4%	33.3%	22.2%	18.5%	5.6%	0.0%
Asia & Pacific	41	19.5%	14.6%	24.4%	17.1%	17.1%	7.3%
Middle East	12	0.0%	16.7%	8.3%	33.3%	16.7%	25.0%
Latin America	39	0.0%	7.7%	12.8%	38.5%	15.4%	25.6%
US & Canada, Europe & High Income Asia	50	0.0%	0.0%	6.0%	10.0%	16.0%	68.0%

What these data indicate is that African countries tend to be transitioning from Category I (<1% Internet penetration) above to Category II or III (1-5% or 5-10% respectively). Countries in the Middle East and countries in Asia and the Pacific are transitioning from Category II to Categories III or IV. Latin America is transitioning from Categories III and IV to Categories V and VI. This phenomenon can be seen more clearly in Figures 21 through 25 below, where the first bar in each category represents the number/percentage of countries in that region with those connectivity levels in 2004. The second bar in each category represents the number of countries with those projected levels of Internet use in 2009.

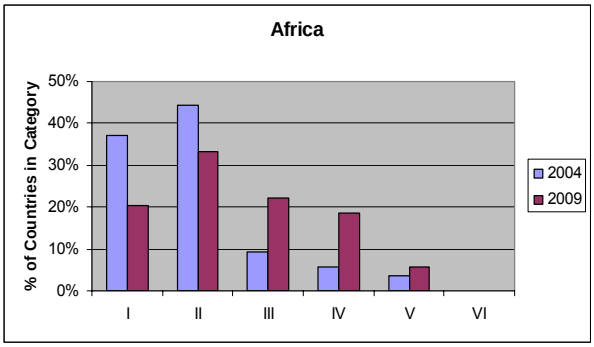

Figure 21: Africa: Categories of Internet Penetration – From 2004 to 2009

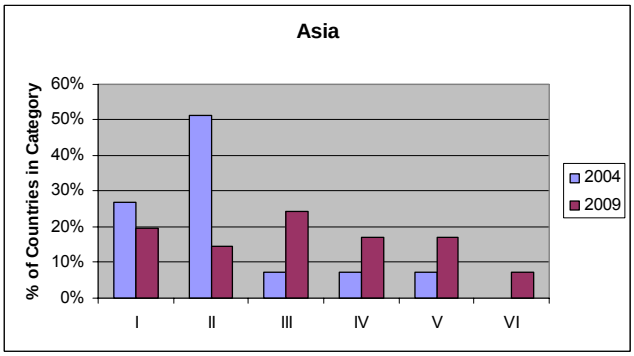

Figure 22: Asia: Categories of Internet Penetration – From 2004 to 2009

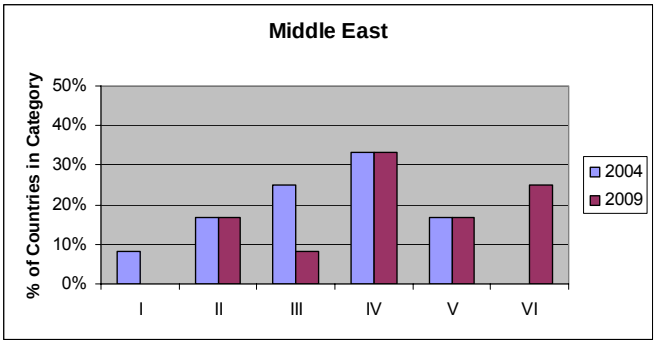

Figure 23: Middle East: Categories of Internet Penetration – From 2004 to 2009

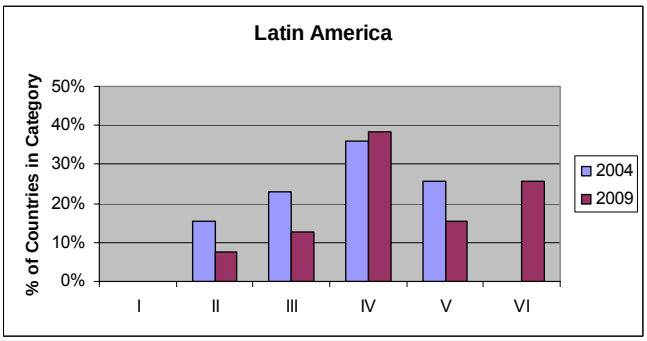

Figure 24: Latin America: Categories of Internet Penetration – From 2004 to 2009

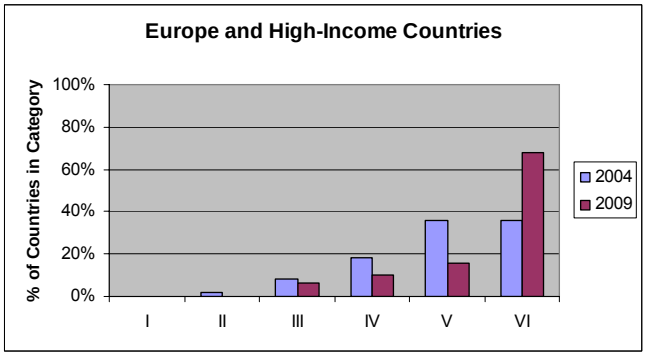

Figure 25: Europe and High-Income Countries
Categories of Internet Penetration – From 2004 to 2009

The reader should note two things at this point: first, these data represent projections from existing and sometimes sparse data drawn from multiple sources; and second, the data represent *Internet use*, and provide no information about connectivity

speeds, bandwidth, or anything else. But, even with these limitations, there are some conclusions that can be drawn.

Connectivity at the 1% level, or even up to 5% of the population of a country means that the use of the Internet will be a preserve of the elite, dominated by the well-to-do, and the well (and mostly foreign) educated. It will also likely be used by expatriates or by multinational corporations (or even non-profits) located in the country[21], but is likely to have little or no impact on the daily lives of ordinary citizens. Connectivity at the 10% level begins the transition to wider use. It is at this point that it may begin to have some impact on higher education access, since not only those with education achieved outside the country will have access. Countries which are at this connectivity level are likely to make their universities accessible through websites[22].

Though still an elite phenomenon at this point, it is apparent that such connectivity will begin to have more impact on the lives of ordinary citizens, since one out of every ten persons will now be able to connect. However, at this point, it is still very likely that such use will be heavily concentrated in urban areas.

Connectivity up to the 25% level indicates that the Internet has begun to have effects in several areas in the lives of ordinary citizens, and that many people will have contact with some of these uses. Usage in higher education will expand. Some rural

[21] As a personal example, I served as a Peace Corps Volunteer in the Central African country of Gabon from 1992 to 1994, shortly before the explosion of Internet use in the United States. At that time, I had the distinction of being one of the first Peace Corps Volunteers in Africa to have a telephone installed in my residence. It involved substantial cost and bureaucratic red tape to have it done, and connectivity was still poor. Upon returning to the U.S. in early 1995, I found most of my personal friends beginning to get connected to the Internet. I also found, a short time later, that the Peace Corps' national office in Libreville, Gabon became one of the early users of the Internet in that country. When I later worked as a volunteer for Habitat for Humanity in Indonesia starting in 1998, I played a part in getting Internet access for the National and Affiliate offices of that organization. While in Indonesia, I also observed a number of Internet cafés in the country that seemed to have high use by university students.

[22] See the analysis at the Institutional Level below for an analysis of the services offered by university websites in high-income vs. low-to-middle income countries.

usage of the Internet will complement heavy urban use. Connectivity from 25 to 50% will signal that the country with such a connectivity level is approaching the connectivity levels of high-income countries, and it is likely that many of the applications in high-income countries will also be available in low-to-middle income countries with such connectivity levels.

Since the data seem to indicate a leveling off of Internet usage for high-income countries, and multiplicity of possible usage patterns for low-to-middle income countries, the question arises as to what national level variables influence the adoption of the Internet, and whether Internet use levels can be predicted from these variables. To analyze this question, data were collected on national level variables to include: macroeconomic variables, telecommunications infrastructure variables, usage of old and new media, education variables, political variables, and social/cultural variables. The next section reports the results of these analyses.

Correlation of Internet and Computer Usage with National Level Variables

Relationship between Internet use, Internet hosts, and Personal Computer Use

The first relationship tested was the correlation between the number of Internet *users,* number of Internet *hosts*, and number of *personal computers* in a country. As noted in the literature review, Norris (2001) tested relationships among these same variables and found significant correlations between these variables using slightly older data from the International Telecommunications Union (ITU).

The data below are based on three-year average data from 2000 to 2002 for the number of Internet hosts, Internet users, and Personal Computers (PCs), based on ITU data for 167 countries.

Table 5
Correlation of Internet Hosts, Users, and PCs
Source: ITU (n=167)

Correlation	*Hosts*	*Users*	*PCs*
Hosts	1		
Users	0.699	1	
PCs	0.694	0.925	1

All relationships are significant at the .01 level.

Correlation with National Income

As has already been noted, high-income countries have a substantial head start in the adoption and use of these technologies. Accordingly, one would expect to find a significant relationship between these variables and *GNP/capita*. This is precisely what is found when these relationships are tested. The results are shown in Table 6 below.

Table 6
Correlation of Hosts, Users, PCs and National Income
Source: ITU and World Bank (n=145)[23]

	Hosts	*Users*	*PCs*	*GNP*
Hosts	1			
Users	0.706	1		
PCs	0.702	0.943	1	
GNP	**0.654**	**0.885**	**0.928**	1

All relationships are significant at the .01 level.

There is a significant correlation of *GNP/capita* with all variables. When domestic income (GDP) measured on a purchasing power parity basis is used as an independent variable, there are only very slight changes in the correlations with the other

[23] Since, for this analysis, the number of countries has changed due to unavailability of some GNP data (n=145), the relationships among *Internet Users*, *Hosts*, and *PCs* has changed very slightly (< 2% change in correlation coefficients).

variables. The correlation with PCs declines about 3% when GDP PPP data are used, whereas it remains essentially the same for the other variables.

Plotting Internet Use vs. National Income

It has been shown above that Internet use and other related variables are strongly correlated with national income. Figure 26 shows the relationship when all countries (n=159) are included. The R^2 value of 0.7617 shows the strength of this relationship.

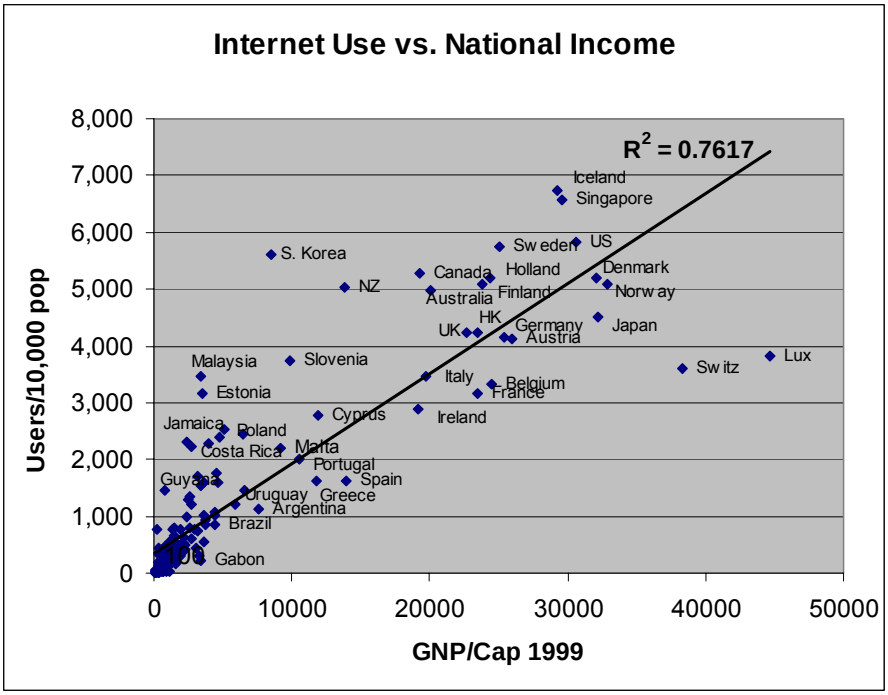

Figure 26: Internet Users vs. GNP/Cap

GNP Relationship for High, Middle, and Low Income Countries

When the same graph is divided into three equal parts – for high, low and middle income countries – an interesting thing happens. The relationship between national income and Internet use is much stronger for high income countries (R^2 = 0.5667, n=52), less so for middle income countries (R^2 = 0.3315, n=54), and mostly non-existent for the

lowest-income countries (R^2 = 0.0918, n=53). This suggests that some other variable is affecting Internet use (or non-use) in these countries. If national income (GNP/capita) is not sufficient to explain Internet use, particularly in the poorer nations, the question arises as to what other variables might influence the adoption and use of the Internet. In fact, an examination of Internet user growth rates shows that low-to-middle income nations are growing at a faster rate than high-income nations.

Examining Internet User *Growth*

The S-Curves above hint that Internet growth has leveled off in high-income countries and yet is continuing to grow in low-to-middle income countries. Yet, when recent Internet use *growth rates* for 2000-2004 are correlated against region, the results are mostly inconclusive. In most cases, the Z-Test values are too small to draw conclusions, but Africa has the strongest positive correlation, and Europe the strongest negative correlation.

Table 7
Correlation of Internet User Growth vs. Region
Source: ITU

	Growth
Growth	1
N A	-0.048*
L A	0.053*
Asia	-0.031*
Africa	0.203**
Europe	-0.149***
Oceania	-0.083*
MENA	-0.045*

* Not statistically significant
** Significant at the .01 level
*** Significant at the .05 level

However, in what may be a more meaningful measure, the correlation between *GNP/capita* and *Internet user growth* from 2000-2004 is a negative 0.241 (significant at the .01 level), indicating again that *Internet user growth is happening to a greater degree in low-to-medium income countries than it currently is in high-income countries*.

Table 8 is a list of the countries having the highest growth rate in Internet use from 2000 to 2004. Almost all of the countries on the top 25 of this list are low-to-middle income countries.

Table 8
Top 25 Countries in Internet User Growth: 2000-2004
Source: ITU

#	Country	Users growth rate 2000-2004
1	D.R. Congo	9900%
2	Haiti	8233%
3	Somalia	7400%
4	Congo	7100%
5	Sudan	3700%
6	Guyana	3525%
7	Azerbaijan	3300%
8	Vietnam	2835%
9	Iran	2100%
10	Albania	2043%
11	Martinique	2040%
12	Libya	1950%
13	Syria	1933%
14	French Guiana	1800%
15	St Lucia	1733%
16	Morocco	1650%
17	Algeria	1590%
18	Zimbabwe	1540%
19	Guam	1480%
20	Barbados	1400%
21	Pakistan	1394%
22	Dominican Rep	1355%
23	Belarus	1267%
24	Jamaica	1234%
25	Bhutan	1233%

In stark contrast to the above list are the bottom ten countries in Internet use growth rates from the same period. This list is dominated by high-income countries. Norway, which nevertheless has a strong percentage of Internet use, has a negative growth rate during this period.

Table 9
Bottom 10 Countries in Internet User Growth: 2000-2004
Source: ITU

#	Country	Users growth rate 2000-2004
188	Solomon Islands	50%
189	South Africa	49%
190	Germany	47%
191	Japan	36%
192	Iceland	34%
193	Hong Kong	34%
194	Peru	29%
195	Papua New Guinea	26%
196	Portugal	18%
197	Norway	-19%

Influence of Income Distribution

If income *distribution* were influential in Internet use, we would expect to find a relationship between a country's Gini Coefficient (a measure of income distribution) and Internet penetration. When that relationship is tested, a moderate negative correlation (-0.431; Significance=.01, n=105) is found between a nation's Gini Coefficient and Internet use. A negative correlation coefficient is to be expected, since the higher the Gini Coefficient, the more unequal is the distribution of the income. For Internet use to be distributed more thoroughly throughout the population, a lower Gini Coefficient Score would seem to be beneficial.

Relationship of Media and Infrastructure to Internet Use, Hosts, and PCs

A central thesis of this section is that a nation's existing infrastructure and media have a substantial influence on its adoption of the Internet. This is precisely what is found when infrastructure and media variables are correlated with Internet hosts, users, and PCs. The strongest correlation with Internet *hosts* in a country is the Rand Science and Technology Index, an index composed of science and technology indicators[24] compiled by the Rand Corporation and documented in its recent report on science and technology collaboration. (Wagner, Brahmakulam, Jackson, Wong, & Yoda, 2001)[25]

The strongest correlation with both Internet *use* and PCs in a country is the number of phone lines. The link between phone lines and Internet use is an intuitive one, given that most Internet access is still via phone line. The link between phone lines and PCs is more obscure. The *number of phone lines per capita (teledensity)* is the media/infrastructure variable that will be used in developing the regression equation for Internet use.

[24] The Science and Technology index is a composite index composed from data on (1) GNP/capita, (2) Scientists and Engineers per population, (3) Journal Articles, (4) National Expenditures for Research and Development, (5) Higher Education Institutions per population, (6) Number of Patents, and (7) Students studying in the United States. Each factor is given a different weight in calculating the final score.

[25] In its *Recommendations* section, this report also underscores the importance of the Internet in higher education and as a means to building science and technology capacity in developing countries:

> "Helping developing countries to build good reference libraries is critical. Researchers and graduate students in developing countries are often handicapped in their scientific queries because they have poor access to professional journals, textbooks and information about the research activities and grant sources overseas. Another way to address this weakness may be through the Internet. Grants could help pay for reference/information services operated via the Internet. However, this may not work in places where bandwidth is limited or without support to upgrade and expand hardware and software capabilities in developing countries." Wagner, C. et al,(2001) Science and Technology Collaboration: Building Capacity in Developing Countries?, Santa Monica, California: RAND Corporation, p. 82.

Table 10
Correlation of Internet Hosts, Users and PCs with Other Media
Source: ITU, World Bank, CIA, RAND Corporation

Correlations	*Hosts*	*Users*	*PCs*
Hosts	1		
Users	0.719	1	
PCs	0.740	0.949	1
Phone Lines	0.631	**0.909**	**0.882**
Cell Phones	0.496	0.856	0.792
Radios	0.776	0.819	0.809
TV Sets	0.611	0.771	0.733
Electricity	0.641	0.819	0.790
S&T Index	**0.790**	0.814	0.816

All correlations are significant at the .01 level.

Relationship of Education Variables to Internet Use, Hosts, and PCs

National level educational variables that were tested for correlation with Internet users, hosts, and PCs include (1) educational expenditures per capita, (2) primary, (3) secondary, and (4) tertiary education enrollment percentages, and (5) average number of years of schooling. The strongest correlation with Internet hosts, users, and PCs was with the *tertiary education enrollment percentage*. This variable will be used as the education variable in developing regression equation for Internet use.

Table 11
Correlation of Internet Hosts, Users, and PCs with Educational Data
Source: ITU, World Bank (n=78)

Correlations	***Hosts***	***Users***	***PCs***
Hosts	1		
Users	0.709	1	
PCs	0.738	0.962	1
Ed Exp	0.300	0.388	0.365
Primary	0.056*	0.100*	0.075*
Secondary	0.517	0.773	0.728
Tertiary	**0.695**	**0.826**	**0.800**
Years School	0.617	0.785	0.734

Significant at the .01 level except where noted.
* Not significant at either the .10, .05, or .01 levels.

From the data shown in the table above it is apparent that, the more education you have, the more likely you are to be an Internet user, and the strongest predictor of Internet use at the national level for education variables is the *tertiary education enrollment percentage.*

Social Variables: Religion

Max Weber (1930) made the now-classic argument that the values of the Protestant Reformation promoted economic success in those countries that were heavily influenced by the Reformation. This thesis is still controversial almost one hundred years after Weber advanced it. Weber's theory is tested here in the context of Internet use. When the data for hosts, users, and PCs are correlated against the percentages of persons adhering to a particular religious tradition in a country, the nations that are predominantly Protestant have the highest correlation coefficients. The correlation coefficients for other religions are all negative. However, as many countries' adherents to a particular religion are not reported in the data, and Catholic, Other Christian, and Protestant are sometimes not differentiated. (Central Intelligence Agency, 2000) For the regression equation, the *total percentage of Christians* in a country will be the socio-cultural variable used in predicting Internet use.

Table 12
Correlation of Internet Hosts, Users, PCs, and Religion % of Population
Source: ITU, CIA (n=154)

Correlations	*Hosts / Cap*	*Users / Cap*	*PCs/ Cap*
Hosts	1		
Users	0.679	1	
PCs	0.676	0.930	1
% Muslim	-0.218	-0.241	-0.262
% Catholic	-0.155*	-0.016**	-0.005**
% Protestant	**0.481**	**0.474**	**0.447**
% Other Christian	-0.387	-0.434	-0.432
% Hindu	-0.340	-0.377	-0.339
% Buddhist	-0.353	-0.084**	-0.072**

Correlations are significant at the .01 level except where noted.
* Significant at the .05 level
** Correlation is not significant at either the .01, .05, or .10 level

Relationship of Political Variables to Internet Use, Hosts, and PCs

Freedom House (www.freedomhouse.org) publishes an annual hierarchical listing of countries on two measures of freedom – political and civil liberties. Transparency International (2004) publishes an annual hierarchical listing of countries based on perceptions of corruption. When Internet hosts, users, and PCs were correlated with the Freedom House and Transparency International listings, the TI index was the most significant, though each measure showed a significant correlation with Internet users, hosts, and PCs – indicating that political and civil freedoms and lack of corruption are all significant to these Internet measures.[26]

[26] The connection between the Internet and political freedoms and corruption is a reciprocal one, a theme explored in depth in Kalathil and Boas (2003), Hachigian and Wu (2003), Norris (2001), Green, (2001), Castells (2001), and Hongladarom (2001).

Table 13
Correlation of Internet Hosts, Users and PCs with Freedom and Corruption Ratings
Source: ITU, Freedom House, Transparency International (n=100)

Correlations	*Hosts*	*Users*	*PCs*
Hosts	1		
Users	0.734	1	
PCs	0.719	0.936	1
FH1	-0.352	-0.533	-0.494
FH2	-0.472	-0.635	-0.610
TI	**0.667**	**0.884**	**0.868**

All are significant at the .01 level.

Regression Model

On the basis of the correlation results, the most significant correlation variables in each category – economic, political, infrastructure, educational, cultural – were chosen as independent variables in the development of a regression equation to predict the level of Internet connectivity given the value of these variables for a particular country. In developing the regression equation, several iterations were necessary to determine the variables that were most significant in predicting Internet use. Independent variables that had low *t Statistic* values were dropped from the equation, and the regression was recalculated.

For the first iteration, the following independent variables were used: GNP/capita, Gini coefficient, phone lines/capita, percentage of tertiary education enrollment, percentage of Christians in the country's population, and the Transparency International Corruption Index – two macroeconomic variables, one infrastructure variable, one educational variable, one cultural variable, and one political variable – in order to predict the number of Internet users in a country.

However, for the independent variables GNP/capita, Gini Coefficient, and percentage of Christians, the *t Statistic* values were quite low. In an attempt to increase

the predictive quality of the regression equation, several different iterations were run with different variables omitted – in order to determine the most significant variables without suffering a reduction in the value of R^2. In the final iteration, only three independent variables – the number of phone lines/capita, the Transparency International Corruption Index, and the Tertiary Education percentage – were sufficient to predict Internet use to 85% of the variation of the dependent variable. The equation that expresses this relationship is:

Number of Internet Users per 10,000 population =

-1110.591 + 33.444 x (Phone)+ 369.064 x (TI)+ 11.043 x (Tertiary)

Predicting Internet Use/Capita Based on Regression Results

For the 97 countries used in developing the regression equation, it is therefore possible to predict Internet use per population based on the values of the independent variables: Phones Lines / capita, TI Index, and Tertiary Education Percentage.

This data is presented in graphical form in Figure 27, where predicted values and actual values are shown on the same graph. They are presented in tabular form in Appendix A.

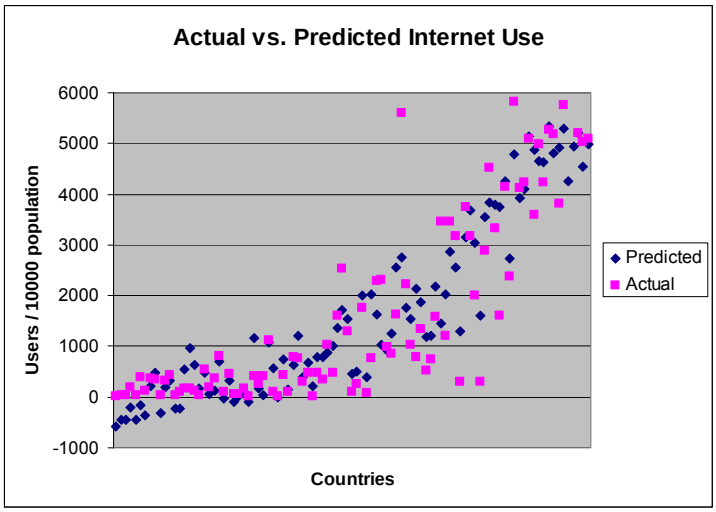

Figure 27: Actual vs. Predicted Internet Use for 97 Countries

Figure 28 shows the variation from the predicted values by country. Positive values indicate the countries are gaining Internet use at a higher percentage than predicted by the independent variables, and negative values indicate the countries are not meeting the predicted values. Outlier countries are evident on this graph, and the circumstances of some of these outliers are investigated in more detail below.

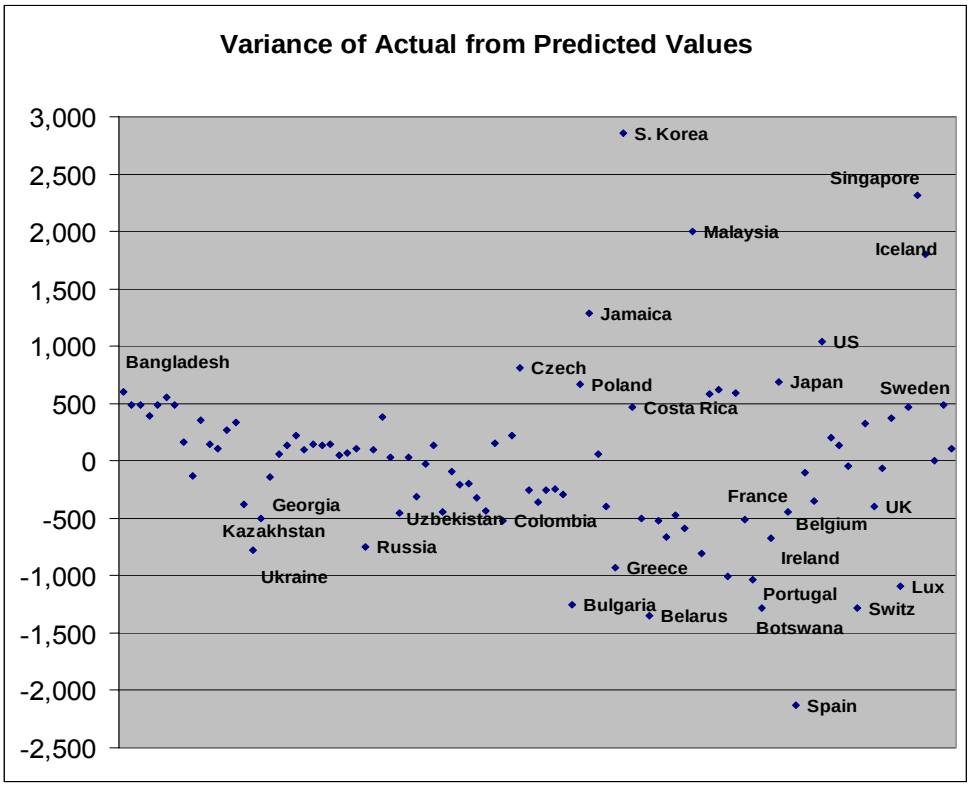

Figure 28: Positive and Negative Variances from Predicted Values

Outliers Above

Several countries stand out on this graph as being in excess of where they are predicted to be in terms of Internet use/population. South Korea, Singapore, and Malaysia are three countries on this graph with a large positive variance from the predicted values. What might be the reason(s) for such performance in excess of predicted values?

Of South Korea, a recent ITU (2003b) study of Internet diffusion reports

> With 26.3 million users at the end of 2002, Korea represents the world's fifth largest Internet market. Its Internet penetration rate, 55.2 per cent at end of 2002, makes it the third highest in the world. These are astounding statistics considering that five years previously, it had less than a million Internet users for a penetration rate of 1.6 per cent. Furthermore, the growth came at a time of a severe economic downturn. (p. 10)

The ITU attributes Korea's connectivity success to several factors: growth of broadband services and competition in the broadband marketplace, growth of Korean web page hosting and content in the Korean language, Korea's dense urban population, government support[27], a manufacturing industry that concentrates heavily on computer and telecommunications *hardware*[28], and a "mentality" to adopt the Internet based on opportunities to try out the Internet through various public and private venues (Internet cafés and the like). In addition to the rationale offered by this report, there is also evidence that South Korea's success comes as a result of a combination of serendipity and synergy: serendipity because the growth of Korea's broadband industry and telecommunications reform happened to coincide with the advent of the Internet; synergy because the effects of a burgeoning economy, a sophisticated high-tech electronics sector, growth of educational opportunities, and a general resurgence of East Asia in the world economy are likely to all work together to promote the growth of each of these factors.

Another East Asian country that has had similar success in Internet connectivity is Singapore. Singapore contrasts with Korea in its smaller population, but in many other ways, Singapore's situation is similar to that of Korea – a dense urban, relatively young

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[27] The report identifies the following as significant government contributions to the diffusion of Internet and computer technologies: a national system for evaluating the success of IT projects, research and development expenditures, promotion of universal access, Internet and computer initiatives in the educational system, special initiatives for low-income families, and promotion of an environment for sharing lessons learned.

[28] In contrast to India and her South Asian neighbors, known worldwide for their *software* expertise, South Korea and some other Asian "Tiger" economies have chosen to focus more on the manufacturing of computer and telecommunications *hardware*. The ITU report offers the following rationale why this focus may have made Korea a more fertile environment for the diffusion of the Internet:

> ICT products account for a third of Korea's total exports. The large equipment industry and its export orientation have a strategic impact on Korea's ICT sector. It helps explain why Korea has been quick to exploit new ICT technologies. First, they create new domestic markets driving demand for telecommunication equipment to be produced by local manufacturers. Second, they can give Korea a strategic edge in high technology exports. Source: International Telecommunication Union. (2003). *Broadband Korea: Internet Case Study*. Geneva, Switzerland: International Telecommunication Union, p. 4.

population, a strong telecommunications infrastructure that has benefited from reform, an educational system that is first-rate and focused on high technology, and a growing economy with a focus on hardware. The ITU (2001a) reports that connectivity is high throughout the island, but that reasons for non-connectivity are largely due to factors other than infrastructure.

> The small size of the island coupled with widespread public Internet access at schools and community centres and a scattering of cybercafés suggests that no one is very far from the Internet if they [sic] need it…Awareness of the Internet is also high…Therefore problems with access to the Internet are not primarily infrastructural or economic…but more social and cultural. This includes convincing people that the Internet is relevant. For example, the 1999 IDA *Information Technology Household Survey* found that the main reasons homes did not have Internet access was there was no perceived need for it (47 per cent) compared to only 16 percent that found it too expensive. (pp. 25-26)

Singapore's neighbor, Malaysia, is a middle-income country that also stands out as being in excess of where it is predicted to be in Internet connectivity. One possible explanation for Malaysia's success was an early emphasis on reform and liberalization in the telecommunications sector. The ITU (2002f) reports that "Malaysia opened its market much earlier than most countries in Asia and today has one of the most competitive telecommunication markets of any developing nation." (p. 6) Malaysia also recognized that the *convergence* phenomenon dictated that the regulatory environment be harmonized for all players in the industry, and responded to this need with the passage of the Communications and Multimedia Act (CMA) of 1998.

> The Act establishes a regulatory framework in support of national policy objectives for the communications industry. Services regulated under the Act include traditional broadcasting and telecommunications, as well as computer networks, and content carried over those systems. The CMA seeks to provide a common set of regulatory provisions based on generic definitions of communications services. It is therefore suited to a converged environment where the same digital information can be transported over any electronic network. (p. 5)

Malaysia's experience also includes early experimentation with computer networks – the *Rangkaian Komputer Malaysia* (Malaysian Computer Network) was established in 1988 by the Malaysian Institute of Microelectronic Systems, a dial-up network that connected Malaysian university computers to the United States, Korea, the Netherlands, and Australia. (International Telecommunication Union, 2002f)

A final reason for Malaysia's success in Internet connectivity is due to pricing – the price of dial-up Internet access is the second-lowest in the region, excelled only by Singapore, which has no ISP charge – only telephone usage and rental fees. According to the ITU, this is due to Internet connections being regulated at a lower rate than voice transmissions. (International Telecommunication Union, 2002f)

Perhaps surprisingly, Iceland is another country that stands out as having greater connectivity than the variables would predict. According to Ratnathicam (2002) this is due to government promotion plus some unique cultural and geographic features of Iceland:

> [I]t is often forgotten that Iceland is one of the world's most technologically sophisticated societies. Citizens of Iceland have readily embraced ICTs as a natural complement to their communicative but geographically isolated culture, and the government has done much to advance ICTs as a tool to improve the country's internal services and economic connectivity to the rest of the world…The people of Iceland have adopted new ICT services almost as quickly as they are offered. Iceland boasts the highest level of Internet connectivity in the world and the second-highest level of mobile connectivity…The small, relatively concentrated population and high GDP per capita make infrastructure build-out less problematic…and adoption of consumer technology more financially accessible, than in many other nations. Iceland offers few barriers—legal, geographic, or economic—to the latest technological innovations, and is sometimes used as a test market for foreign companies. Advanced communications services have often reached Iceland before they are seen in most of the rest of the world. (p. 218)

Countries that have more Internet connectivity than would be predicted from the regression equation thus do so because of a combination of factors: effective and timely

government regulation and reform of the telecommunications sector, education about and opportunities to try the Internet, a focus on high-technology and promotion of exports of the same, and pricing of Internet services that make it possible for many to participate.

Outliers Below

Outliers showing a negative variance in Figure 28 above have less Internet connectivity than the regression equation would predict. These outliers are dominated by two groups of countries – Russia and former Soviet Union states of Central Asia, and older, more affluent Southern European nations such as Luxembourg, France, Switzerland, Portugal, and Greece. What factors explain these outliers?

In the case of Russia and the Central Asian republics, the proceedings of a conference on Internet connectivity in Russia (International Research and Exchanges Board, 2002) reported that:

> Computer penetration and Internet use in Russia are low, the pace of Internet infrastructure development is slow, and there are vast regions of Russia that have little to no access to the Internet; hence, the risk of an ever-widening digital divide…Currently, Internet access in Russia is available primarily in major cities and at rates that are prohibitive to average consumers. (pp. 1-2)

The report lists Russia's Internet connectivity challenges as being concentrated in two primary areas: "creating the technical, economic, and legal environment that supports the Internet, and creating a cultural environment that embraces this inherently transparent technology." (p.3) Participants in the conference recommended that Russia promote telecommunications reform and privatization as steps toward meeting the challenge of greater connectivity. Participants also agreed that Russia should focus on "establishing transparent government policies, good governance, and education in information technologies – in addition to developing infrastructure." (p. 4)

In the case of Southern Europe, countries such as Portugal, Spain, Belgium, France, Greece, Luxembourg, and Switzerland fall below where the would be expected in Internet connectivity. A recent report on world competitiveness (Porter, Sachs, Cornelius, McArthur, & Schwab, 2002) outlines some of the reasons these countries lag their Northern counterparts in the European Union. Of Switzerland, the report notes that the reasons for lower than expected adoption may be due to both government regulation and cultural reasons:

> Although the fixed-line market has been legally open to competition since 1998, Swisscom's refusal to unbundle the local loop has dampened the competitive dynamic within the telecommunications environment…The Swiss population's approach to technology adoption has been measured and thoughtful, even hesitant. Business and individual users alike have shown skepticism of the Internet's viability as a sales channel or retail outlet. (p. 288)

For Spain, slower telecommunications reform and the high cost of Internet service has led to the lowest Internet penetration in Western Europe.

> Spain is marked by dynamism in parts of its ICT sectors, but progress has been slowed by delayed benefits of fixed-line telecommunications liberalization. Internet penetration is a mere 13 percent, due in part to the combination of high access cost and an average of fourteen PCs per 100 inhabitants, less than half the EU average. When adjusted for purchasing power, Spain has among the highest Internet access costs in the EU, even though many ISPs offer free Internet service and draw their income from call charges and portal advertising instead. (p. 282)

Neighboring Portugal is substantially below the line, but its Internet penetration is 50 percent better than Spain. Greece is a paradox – Internet penetration is low, but cell phone use is high.

> The Greek ICT landscape is characterized by both delay and vibrancy. With only 12 percent of its population using the Internet, Greece lags behind the other EU nations, and ranks thirty-first overall in Readiness for the Networked World, just behind Hungary and Slovenia. Yet, the nation's cellular phone penetration is one of the highest in the EU—almost 60 percent. (p. 208)

Finally, for France, Bauer, Berne, and Maitland (2000) assert that "there is some kind of 'French specificity'" (p. 14) that has led to lower than expected adoption of the Internet. The reasons offered by the authors include slow telecommunications liberalization, concern about privacy issues, and the dearth of French language and content on the Internet.

Summary of the Analysis at the National Level

The factors influencing diffusion of the Internet at the national level are complex and imperfectly understood. Internet use is highly correlated with a number of national level variables, including national income and income distribution, political and civic freedoms, education, corruption, cultural factors, telecommunications infrastructure and regulatory environment, scientific and technical infrastructure, and usage of other electronic and traditional media. However, just a few national variables – teledensity, tertiary enrollment, and corruption indices – are sufficient to explain approximately 85% of the variance in national Internet use. The experience of outlier nations – South Korea, Singapore, and Malaysia on the positive side, Russia, Central Asia, and Southern Europe on the negative side – can provide additional illumination into what can be done to promote Internet use to a greater degree in low-to-middle income countries. From a national policy perspective, governments can promote greater Internet use by promoting effective and competitive telecommunications reform policies, upgrading telecommunications infrastructure, providing education about and opportunities to try the Internet, and by ensuring Internet use is priced affordably to consumers. Countries that are currently focused on high-technology manufacturing and exports, particularly in the

computer and telecommunications industry, will continue to have an advantage in Internet use for the foreseeable future.

Conclusions

Is the head start that high-income countries have in Internet use insurmountable – are low-income countries consigned to an enduring gap? No – since the correlation of GNP with Internet use becomes less significant with lower-income countries, there must be other factors to explain the success of some countries in this regard, and the failure of other countries to become "wired." The regression equation that was developed in this section attempts to explain which national level variables that have a significant influence on Internet use. Those national variables are few, and are the subject of intense effort to improve in some low-income countries.

The analysis showed that three national level variables had the most influence: the number of telephone lines per capita – the *teledensity*, the percentage of students enrolled in tertiary education, and the country's rating on a corruption perception index. These three variables were sufficient to explain approximately 85% of the variance in Internet use across countries. Though it is likely that at least two (if not all) of these variables are highly correlated with income, this does not permit us to conclude that low-to-middle income countries will always be at a disadvantage. The World Bank and other aid organizations are providing assistance to improve the telecommunications infrastructure in many low-to-middle income countries. New telecommunications technologies are making this easier. Focused aid to education and the increasing priority of education in many developing country Ministers' portfolios will enable improvements to be made on this front as well. Telecommunications reforms are

underway in a number of low-to-middle income countries. Those countries that are reluctant to adopt such reforms may do so in the future if they see their neighbors succeeding with such policies. Though many low- and middle-income countries are experiencing challenges with urban overcrowding, the urban environment does provide an efficient environment for becoming "wired." Internet connectivity could eventually be diffused from urban to more rural areas. This "urban to rural" diffusion replicates the pattern found in most high-income countries, but often takes place at an even slower pace than diffusion from high-income countries to low-to-middle income countries. Rural areas in developing countries will likely be at a technological disadvantage for some time. Urban areas will achieve parity much more rapidly.[29]

The conclusion of this national level analysis is that low-to-middle income countries *can* achieve long-term success in Internet connection and use through a combination of national policies and international aid. The model of the developing East Asian countries provides one model by which this may be done – focusing first on primary education, developing a manufacturing base by focusing on export of product and import of capabilities.

Internet use seems to fit into a complicated puzzle of national development that is less than perfectly understood, but the model in Figure 29 presents some of the national-level variables that are part of this puzzle.

[29] The Internet remains largely an urban phenomenon. Zook reported in 2001 that the world's five most populated cities were responsible for only 1.1% of the world's population, but had 17.5% of the world's Internet domains. The top 100 cities represented 6.7% of the world's population and 51.4% of the world's domain names. Source: Zook, Matthew, "Old Hierarchies or New Networks of Centrality? – The Global Geography of the Internet Content Market," *American Behavioral Scientist*, June, 2001, Vol. 44, No. 10.

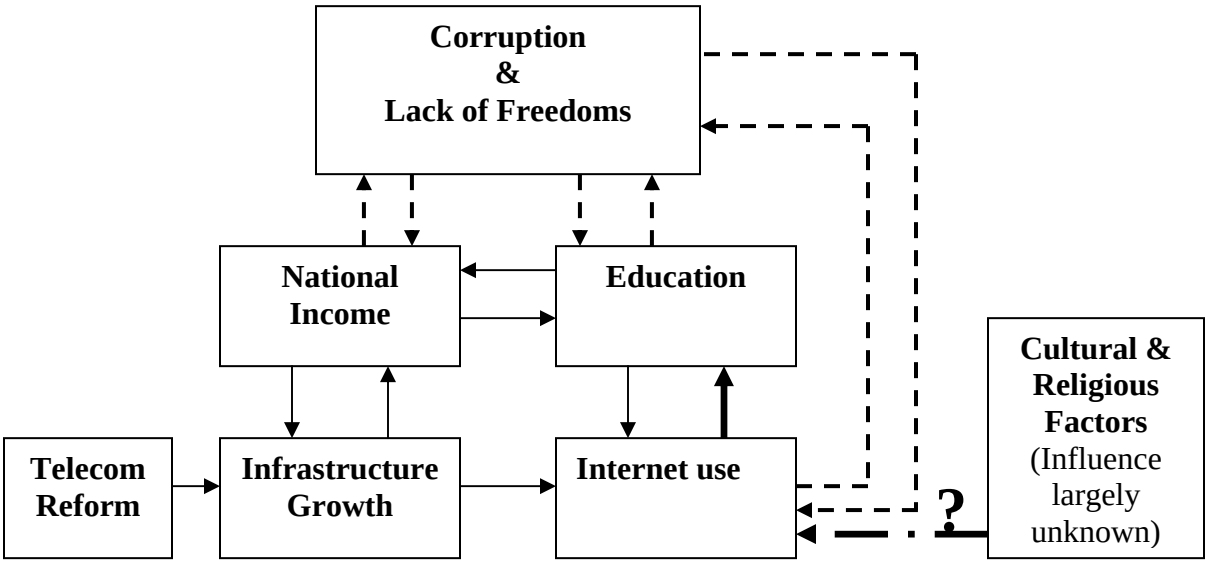

Figure 29: Internet Use and other National Level Variables

In Figure 29, solid lines indicate positive effects, dashed lines indicate negative effects. The bold solid line indicating the positive effect of Internet use on education is the subject of the following two sections – the analysis at the institutional and classroom level. The question mark on the arrow emerging from the box labeled "Cultural and Religious Factors" indicates the uncertain nature of the effect of these factors on Internet use. Much remains to be learned about the effect of this and other factors on Internet use.

The next chapter turns to the analysis of Internet diffusion and use at the institutional level, and the effects on *access* and *quality.*

CHAPTER VI

INSTITUTIONAL LEVEL ANALYSIS

Recently, while addressing The League for Innovation in the Community College, former University of Phoenix President Jorge Klor de Alva (1999) related a story about the Harvard University provost's reaction to competition from Internet-enabled distance education institutions like the University of Phoenix.

> For instance, Harvey Fineberg, Harvard's provost, reflecting on the cyber future of his institution recently spoke about the University of Phoenix model by making reference to Intel founder Andy Grove's anxious observation that the domestic steel industry of the U.S. is moribund today because it chose not to produce rebar—the steel used to reinforce concrete—and thereby permitted the Japanese to gain market share in the country. Nervous about the future of his venerable institution, he asked "Is the University of Phoenix our rebar?" And fearful of being left behind by the future UOP is helping to create, Fineberg concluded his interview in last month's Boston Globe with the observation, "I know that Harvard has to change. No institution remains at the forefront of its field if it does the same things in 20 years that it does today." (p. 6)

De Alva also reports the results of a survey of state governors, relating what these officials consider to be important initiatives for higher education in the 21st century.

> The contemporary disconnect between what traditional higher education provides, especially in research institutions and four-year colleges, and what that society wants can be gleaned in part through a 1998 poll of the fifty state governors. The aptly titled inquest, "Transforming Post-secondary Education for the 21st Century," reveals that the top four items perceived to be most important were (1) to encourage lifelong learning (97%), (2) to allow students to obtain education any time and any place via technology (83%), (3) to require postsecondary institutions to collaborate with business and industry in curriculum and program development (77%), and (4) to integrate applied or on-the-job experience into academic programs (66%). In contrast—and most tellingly—the bottom four items were: (1) maintain faculty authority for curriculum content, quality, and degree requirements (44%); (2) maintain the present balance of faculty research, teaching load, and community service (32%); (3) insure a campus-based experience for the majority of students (21%); and (4) in last place—enjoying the

> support of only one of the governors responding—maintain traditional faculty roles and tenure (3%). (p. 3)

Apparently, state governors have radically different ideas for where higher education should be headed than do certain tradition-bound higher education institutions. But, what are the assumptions underlying the governors' preferences? It appears that, in some ways, the governors equate technology-facilitated higher education with increased *access* and increased educational *quality*. The validity of these assumptions – that the increased use of technology, particularly Internet and computer technology, can increase higher education access and quality – will be examined in this and the following chapters. In this chapter, a mixed methodology is used to research the diffusion and impact of Internet and computer technology at the *institutional* level. Before proceeding to this investigation, the notion of institutional quality is examined.

World's Best Universities: The Elusive Notion of Institutional Quality

Institutional quality is an elusive concept. Yet, many observers have an intuitive understanding what it entails – it might be compared to the way former Supreme Court Justice Potter Stewart once defined pornography – "I may not be able to define it, but I know it when I see it." Even so, one certain way to attract controversy in academia is to assert that one university is in some way superior to its peer institutions. But this is precisely the controversy that the periodical *U.S. News and World Report* has courted every year, publishing its annual list of *America's Best Universities.* To no one's surprise, institutions such as Harvard, Columbia, Yale, Princeton, MIT, and Stanford appear at or near the top of this list every year. Likewise, there does appear to be some consensus even among academics that these institutions are among the best. But, beyond

the apparent consensus about the very top institutions comes great controversy about how other institutions fare under *U.S. News'* scrutiny.

The editors of *U.S. News* deflect this controversy somewhat by publishing the criteria used for selecting the top schools. Consequently, there is less disagreement about a school's position on the list and more disagreement about the appropriateness of the particular criteria chosen for judging an institution's quality. In its 2003 assessment of the top U.S. undergraduate institutions, *U.S. News* included the following nine criteria in its analysis

1. A peer assessment score
2. Student graduation and retention rates
3. Class sizes
4. Student faculty ratio
5. Faculty resources
6. % of faculty who are full time
7. Student performance on SAT/ACT tests and high school ranking
8. Institution financial resources
9. Alumni giving

The reader should note in the above that there is no category for use of technology in an institution, although it is possible that the usage of Internet and computer technology is embedded within some of the above categories, such as "Student/faculty ratio," "Class sizes," and "Peer assessment score." Since there is no category for it, there is therefore no *direct* influence of the use of Internet and computer technology at an institution and that institution's ranking on the *U.S. News* scale. So, as far as *U.S. News* is concerned, the effect of Internet and computer technology on institutional quality is, at best, of secondary importance.

U.S. News does, however, compile statistics on the computer and Internet availability to students at the universities chronicled in its annual list. One of the data listed is the number of library volumes available at each institution. In addition, the list

includes the number of computers available to students at the schools. What might be the relationship of these data to *U.S. News'* assessment of institutional quality? It might be expected that, as the number of library volumes and the number of computers available to students increases, the ranking of the school would also climb. One would therefore expect a *negative correlation*[30] between these variables and the institution's rank.

This is indeed the case with the *number of library volumes* and *volumes/student*. The strong negative correlations indicate that there is some relationship between the number of library holdings and an institution's place on the list. An even stronger correlation with *volumes/student* indicates that small-enrollment institutions with large library holdings are even more likely to be listed among the top schools.

Table 14:
Correlation of Institution Ranking with Library Volumes

Variable	Rank
Library Volumes	- 0.403
Volumes / Student	- 0.524

Correlations are significant at the .01 level.

However, a counterintuitive result is obtained when analyzing the correlation of the number of computers available to students and an institution's ranking.

Table 15:
Correlation of *U.S. News'* Institutional Ranking with Computers

Variable	Rank
Computers	0.110*
Computers / Student	0.182**

*Not statistically significant
**Significant at the .05 level.

[30] Since a smaller number denotes a higher ranking school.

Though the correlation is small, its direction is counterintuitive. It seems to imply that an institution may suffer a *penalty* in its ranking when the number of computers it provides to students is large. What can be the explanation for this puzzling result?

There are several possible explanations for this. One possible explanation is that the data compiled by *U.S. News* for institution-provided computers may be in error. Or, there may be ambiguous definitions about what constitutes a computer available for use by students at a university. Some universities may report all campus computers as part of the data, whereas others confine their reporting to formal computer laboratories. Notwithstanding such potential procedural errors on the part of *U.S. News'* researchers, some institutions may be much more likely to encourage computer ownership by students themselves, thus obviating the need for provision of computers by the institution. Consider, for example, that it is highly more likely for a matriculating student at the Massachusetts Institute of Technology to already own a computer than a student at a less technologically-oriented institution. Some universities even require students to own a computer.[31] Computer ownership is strongly correlated with family income, so a student attending an expensive private school might be more likely to own a computer than a student who attends a community college. No data is offered by the *U.S. News* data about the age, condition of repair, or Internet connectivity of the institution-provided computers. Finally, there may be a "chicken-and-egg" problem confounding the analysis. Some middle-range institutions, looking to move up the *U.S. News* list and fearing their rankings may fall if they don't implement bold technological solutions, may be finding

[31] According to the 2004 *U.S. News'* data, Top-100 institutions Dartmouth, UNC Chapel Hill, Georgia Tech, Penn State, Rensselaer Polytechnic, University of Florida, Stevens Institute, and the University of Denver all require computer ownership by students.

themselves in the role of technological pioneers, whereas some institutions near the top of the list may pursue a "technology follower" strategy,[32] waiting to see where the trend will go before committing fully. In conclusion, the answers to these conjectures are far from clear, but the *U.S. News'* data certainly do not support an unequivocal endorsement of the thesis that computer availability positively affects perceived institutional quality.

Neither do the variables *Internet Availability* and *e-mail Availability* provide any illumination about *differential* institutional quality, at least with respect to the *U.S. News'* listing. Of the top 125 schools that reported to the *U.S. News* survey on this question, *every* school reported providing Internet and email access to all students. Furthermore, for the U.S. Department of Education National Center for Education Statistics' list of 237 U.S. institutions of higher education with enrollment greater than 15,000 students, every single school had a website. Apparently, a school website, along with provision of Internet and email for students is considered to be an essential in U.S. higher education today. The institutional website is addressed in detail in the next section.

Institutional Website Content Analysis

U.S. Institutions

One face that a higher education institution presents to the community that provides some indication of its technological sophistication is the institution's website. It was noted above that there are 237 higher education institutions in the United States with an enrollment greater than 15,000 students – and every one of these institutions has an

[32] Benefits of pursuing a technology follower strategy are addressed in Christensen, C. (2000). *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. New York: Harper Business.

active website. It would therefore be possible to understand something about these institutions by looking in detail at these websites. In order to understand the kind of information available on these 237 U.S. higher education institution websites, and to use as a basis for comparison with low-to-middle income country institutional websites, a random sample of 147 of the above 237 institutions was chosen to ensure a 0.05 significance level, and the institutional websites were rated on the following five dimensions:

1. Does the website enable electronic access to research tools: the university library or electronic databases/journals?
2. Does the website offer online virtual learning or a Course Management portal such as *Blackboard*, *WebCT*, or *Prometheus*[33]?
3. Does the website provide basic administrative information about the institution? (where it is located, how to apply)
4. Does the website enable student email access?
5. Does the website provide detailed information about academic departments and course offerings at the institution?

The random sample of 147 websites was tested on these five dimensions, and a score of "0" (information is not present) or "1" (information is present) was given for each dimension of information. For the random sample of U.S. institutions, all websites were available when accessed via the Internet, and the percentage of each dimension of information is shown below:

[33] Though these "Course Management Systems" potentially provide a portal for online distance education, they are also often used as a supplement to classroom-based courses at many U.S. institutions.

Table 16
Random Sample of U.S. Institutional Websites Rated on Five Dimensions of Content
Source: 147 U.S. Institutions of Higher Education with >15,000 Enrollment

Dimension of Information	1 Library	2 Virtual Ed	3 Admin Info	4 Email	5 Course Info
Percentage of Websites Having Information	**100%**	**98.6%**	**100%**	**86.4%**	**100%**

The results of this sample are striking – every single institutional website in the sample had basic administrative information about the institution, detailed department and course information, and electronic access to the library. Almost all had a distance education portal or a Course Management system. Most provided institutional email access for the students[34], and those institutions that did not offer such institutional email access had apparently decided that there were many free email options available for students through services such as Hotmail, Yahoo, and the like, and therefore it was unnecessary for the institution to provide this service[35].

In addition to the five dimensions shown, there were a number of other services and information sources available at different institutional websites such as: access to grades and transcripts; tuition payments and financial aid; online writing and research help; personal web pages for faculty and students; staff, faculty, and student directories; housing, parking, and university police information; and even online advising, tutoring and video tours of the campus.

[34] Usually an email address with an institutional tag – such as ClarkCapshaw@vanderbilt.edu and the ability to access this account through the institutional website.

[35] This was confirmed both through interviews with higher education administrators and statements made by institutions on their websites - some websites directed students to these free email services through their "student services" option on the main page.

Low-to-Middle Income Country Institutions

A similar sample was taken from a list of low-to-middle income country institutional websites. The sample began with a list of almost 2500 Asian, African, Middle East, and Latin American higher education institutions compiled by Klaus Förster and listed at http://univ.cc/world.php. From the institutions listed on this website, all of the institutional links were tested in November-December 2005 to determine if the links were active. The table below shows the results of this investigation by region.

Table 17
Low-to-Middle Income Country Institutional Website Availability by Region

Region	Countries Represented	Institutions Listed	Active Sites	% Active / Total Institutions
Middle East	Bahrain, Jordan, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, UAE, Yemen	150	138	92.0%
Latin America	Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, El Salvador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay, Venezuela	771	583	75.6%
Caribbean	Antigua & Barbuda, Bahamas, Barbados, Belize, Bermuda, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Netherlands Antilles, Puerto Rico, St. Kitts & Nevis, Trinidad & Tobago, Virgin Islands	74	57	77.0%
Asia	Armenia, Azerbaijan, Bangladesh, Bhutan, Brunei, Cambodia, China, Fiji, French Polynesia, Georgia, Guam, India, Indonesia, Iran, Iraq, Kazakhstan, Kyrgyzstan, Laos, Malaysia, Mongolia, Niue Island, Pakistan, Papua New Guinea, Philippines, Sri Lanka, Thailand, Turkey, Turkmenistan, Uzbekistan, Vietnam, Western Samoa	1195	777	65.0%
Africa	Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Congo, Cote d'Ivoire, D.R. Congo, Eritrea, Ethiopia, Gabon, Ghana, Guinea, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Nigeria, Reunion Islands, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe	286	178	62.2%
TOTAL		2476	1733	70.0%

Of nearly 2500 low-to-medium-country higher education institutions listed by the *Universities Worldwide* website (http://univ.cc/world.php), 70% of them were active when accessed in November-December 2005. From these 1733 websites, a random sample of 314 was chosen to ensure a 0.05 significance level. Table 18 below shows a statistical comparison of the overall population of active websites and those chosen for the random sample.

Table 18
Summary Statistics
Low-to-Middle Income Country Institutional Website Random Sample

Population					
	LA/Carib.	**Asia**	**M. East**	**Africa**	**Total**
Number of Sites	640	777	138	178	**1733**
% of Total	36.9%	44.8%	8.0%	10.3%	100%
Sample					
	LA/Carib.	**Asia**	**M. East**	**Africa**	**Total**
Number of Sites	110	144	23	37	**314**
# of Total	35.0%	45.9%	7.3%	11.8%	100%

The 314 websites were analyzed for the same five dimensions of information as in the sample of 147 U.S. institutions, and Table 19 below shows the results. For these websites, even though all of them were available when accessed in December 2005, several were not available in January or February 2006 when tested for content – this occurrence and other evidence leads to the conclusion that low-to-middle income countries are sometimes only intermittently available. It is not known whether this is due to a problem with the national Internet infrastructure that inhibits access to websites at certain times, due to the institution itself making the website unavailable for a time, or

some other reason outside the country in question. In all, 288 websites from the sample of 314 were tested for content (91.7% of the sample).

Table 19 shows the percentages for the various regions offering the different dimensions of online content on their institutional websites. The Latin America/ Caribbean region score higher than other regions on almost all measures. Africa is ranked last on most measures. This disparity in information content corresponds with the differences in income for these regions.

Table 19
Random Sample of Low-to-Middle Income Country Institutional Websites Rated on Five Dimensions of Content

Dimension of Information	1 Library	2 Virtual Ed	3 Admin Info	4 Email	5 Course Info	Sites Not Available
Latin America and Caribbean	**61.9%**	**46.7%**	**99.0%**	**58.1%**	**84.8%**	**5**
Asia	**46.0%**	**24.6%**	**100.0%**	**55.6%**	**79.4%**	**18**
Middle East	**42.9%**	**28.6%**	**100.0%**	**52.4%**	**95.2%**	**2**
Africa	**38.9%**	**25.0%**	**100.0%**	**50.0%**	**66.7%**	**1**
All Countries	**50.5%**	**32.9%**	**99.7%**	**55.7%**	**81.0%**	**26**
PREVALENCE RANK	**4**	**5**	**1**	**3**	**2**	

At the bottom of the table is another ranking – that of the relative percentages of the types of information available on the websites. Note that almost all institutional websites give administrative information, many give detailed department or course information, and substantially fewer give email and electronic library access. Virtual

education and Course Management systems are the least prevalent at institutional websites in the developing world.

Relationship of National Connectivity Levels to Institutional Website Information

From the data for the 288 available websites, an average score was calculated for each country represented. For example, if a particular institutional website offered all five dimensions of website content, then that website was given an overall score of five. If a country had two institutions with websites, and if one website rated 5 and the other 3, then the average score for institutional websites in that country was 4. Average scores for 64 countries were then correlated with each country's Internet connectivity level in 2004 and projected connectivity levels in 2009. This correlation analysis was conducted to determine if there was any relationship between *national Internet connectivity levels* and *institutional website sophistication* in low-to-middle income countries. When this was done, a low correlation coefficient was obtained, providing little evidence to support a hypothesis that national-level Internet connectivity is strongly connected to institutional website content. Correlation levels improved slightly when 22 countries having only one website were removed from the tabulation[36], on the assumption that such countries having only one data point might skew the averages. Even with this modification, the connection between national levels of connectivity and institutional website content is weak. This is most likely due to the fact that higher education in most low-to-middle income countries is largely an elite, urban phenomenon.

[36] Countries that were removed: Armenia, Benin, Cambodia, Cameroon, Congo (Democratic Republic), Ethiopia, Georgia, Ghana, Honduras, Indonesia, Iraq, Jamaica, Kyrgyzstan, Martinique, Mauritania, Mongolia, Mozambique, Namibia, Panama, Papua New Guinea, Sudan, and Trinidad/Tobago – leaving 42 countries for the modified correlation analysis.

Table 20
Correlations between National Internet Connectivity Levels and Institutional Website Content

# of Countries	Correlated with		
		2004 Levels	Projected 2009 Levels
64	Website Content Average	0.289	0.206
42		0.352	0.347

Interpretation and Extension of the Results of the Website Analysis

The author knows of no longitudinal studies that report the results of long-term website development at U.S. institutions – what kinds of information were introduced first, and the evolution of the information and services available through such websites – but the model in Figure 30 was developed based on the study of institutional websites in the U.S. and in developing countries, and the results of interviews with higher education administrators and faculty at several U.S. institutions who have had first-hand experience with the development of such tools over time.

Most institutions begin the development of the institutional website by providing very basic administrative information – the location/address of the school and admission procedures being the information that is deemed to be the most essential. Therefore, it is highly likely that if a website exists, it contains administrative information of this type at a minimum. In Figure 30 below, this represents the first level of website development.

The process of such website development may follow a multitude of models, but one such model that is likely to be prevalent today in some low-to-middle income country institutions is the following one: a graduate student or even an undergraduate student who is technologically adept plays a strong role in the initial development of the school's

website. He or she is limited in this effort in several respects: by the information provided by the institution for inclusion in the website, by the hardware and software that he/she uses to initially develop the website, by the bandwidth limitations due to the country or institution's infrastructure, by his/her own knowledge and ability, and by his/her eventual departure from the institution through graduation or transfer, often leaving no one to maintain the website. (J. Sierra, personal interview, March 20, 2006).

As institutions continue to develop their websites, often the next step is to introduce more detailed departmental or course information, along with a parallel effort to develop more sophisticated administrative information: online applications, messages from institutional officials, and information for prospective students. Along with this effort may be an initial attempt to connect to the institution's library – although more often than not, these connections offer only rudimentary information about the library: location, hours, and, occasionally, electronic card catalogs of library holdings. In this instance, a student would still have to physically visit the library to gain access to most of the resources. This level of website sophistication represents the second level from the top in Figure 30, below. Level 3 in the diagram represents yet another iteration of sophistication – some institutions provide online admissions applications, detailed course listings and catalogs, student email accounts, and more library access. As indicated by the data from the website analysis, many of the low-to-middle income country institutional websites are reaching this level of sophistication, but all U.S. institutions have already passed this level of sophistication. All U.S. institutions that were analyzed are already at Level 4 in the diagram – offering a variety of administrative information and services, detailed departmental and course information, multiple student services often available from a sign-in service, multiple electronic journal and database access

through the library, and Course Management systems and sophisticated means to deliver course content electronically at a distance for e-learning. But, the evolution of low-to-middle income country institutional websites is seen to be developing along the same lines, and quite a few institutions are already offering sophisticated information and services through their websites that rival that of the U.S. institutions. In short, it is the same phenomenon that was noted with national Internet connectivity – these countries lagged behind at the start, but are catching up. Simultaneously, they are learning lessons from the experience of institutions in high-income countries. The question is, will their overall long-term progress be limited, and if so, to what extent?

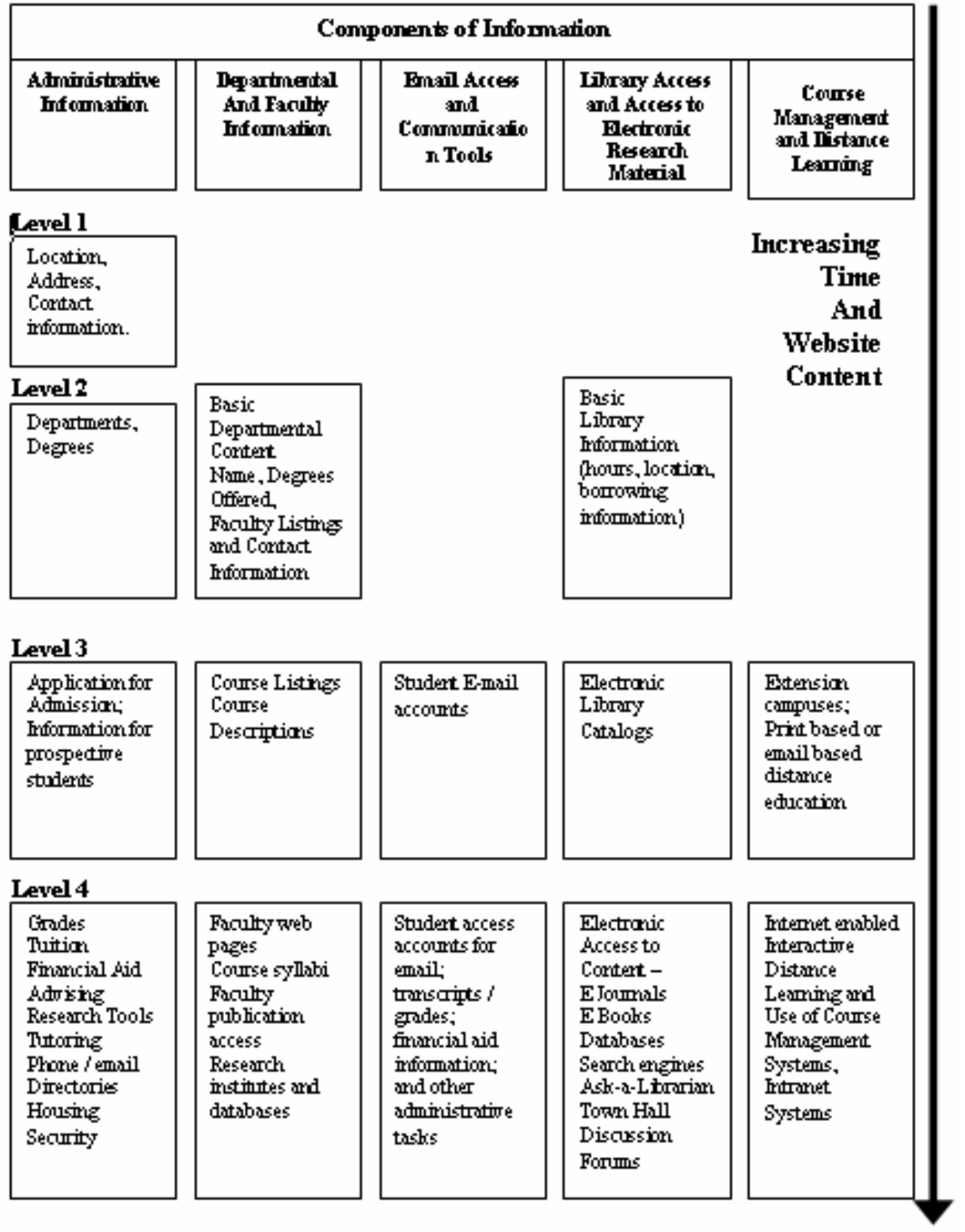

Figure 30: The Evolution of Information Content of an Institutional Website

Institutional Website Development and the Impact on Institutional Quality

The analysis above has provided some indication of the relative sophistication of the kinds of information and services available through the website of the higher education institutions – both in the U.S. and in low-to-middle income countries. But, as yet there are at least two problems that impede our ability to make conclusions about the impact of such technological sophistication on institutional quality: first, the elements of institutional quality have not been enumerated, and second, the connection between the availability of such information resources and institutional quality is at best tenuous.

Comparison of Worldwide Institutional Rankings

What Does Being World-Class Mean?

Before proceeding to a discussion of the elements of institutional quality, let us first backtrack to the controversy introduced at the outset of this chapter – the enumeration of the "best" universities and other higher-education institutions. Because "Best Of" lists such as that published by *U.S. News* are so controversial, it begs the question as to how much consensus there is among such lists that purport to rank institutional quality.

In addition to *U.S. News*, a number of other sources have developed lists of the best universities, all based on different criteria for their rankings. One particularly interesting list was compiled by Shanghai Jiao Tong University[37]. Below are the criteria used by the Jiao Tong University study to compile the list of the Top 500 Worldwide

[37] This list will be referred to hereinafter as the *Jiao Tong* list. The complete list of the Top 500 World Universities can be found at the Shanghai Jiao Tong University website: http://ed.sjtu.edu.cn/ranking.htm.

Universities. The list contains five independent variables, each weighted by 20%, and the reader should note that they are quite different criteria from those used by *U.S. News.*

Table 21:
***Jiao Tong* List Criteria**

Indicator	Criteria	Weight
Nobel	Nobel laureates in physics, chemistry, medicine, and economics	20%
HiCi	Highly cited researchers in 21 broad subject categories	20%
N&S	Articles published in Nature and Science	20%
SCI	Articles in Science Citation Index - expanded and Social Science Citation Index	20%
Performance per faculty	Academic Performance per faculty	20%
Total		100%

The reader should again note that the *Jiao Tong* list also contains no direct independent variable for Internet and computer technology in its ranking of universities worldwide.

Another worldwide list, compiled by Gourman (1996) uses 18 criteria, listed below in Table 22. Note that, in this case, there *are* technological variables that are directly related to the institutional ranking, specifically factors 14, 15 and 16.

Table 22
Gourman Report Rating Criteria
Source: Gourman, Jack, The Gourman Report: A Rating of Undergraduate Programs in American and International Universities, 9th Ed., Los Angeles, CA: National Education Standards, 1996, pp. 2-3)

1. Auspices, control, and organization of the institution;
2. Total educational programs offered and degrees conferred (with additional attention to "subfields" available to students within a particular discipline);
3. Age (experience level) of the institution and of the individual discipline or program and division;
4. Faculty, including qualifications, experience, intellectual interests, attainments, and professional productivity (including research);
5. Students, including quality of scholastic work and records of graduates bot5h in graduate study and in practice;
6. Basis of and requirements for admission of students (overall and by individual discipline);
7. Number of students enrolled (overall and for each discipline);
8. Curriculum and curricular content of the program or discipline and division;
9. Standards and quality of instruction (including teaching loads);
10. Quality of administration, including attitudes and policy toward teaching, research and scholarly production in each discipline, and administration research;
11. Quality and availability of non-departmental areas such as counseling and career placement services;
12. Quality of physical plant devoted to undergraduate, graduate and professional levels;
13. Finances, including budgets, investments, expenditures and sources of income for both public and private institutions;
14. Library, including number of volumes, appropriateness of materials to individual disciplines, and accessibility of materials;
15. Computer facility sufficient to support current research activities for both faculty and students;
16. Sufficient funding for research equipment and infrastructure;
17. Number of teaching and research assistantships;
18. Academic-athletic balance.

Another ranking that includes Internet-related independent variables that are *directly* related to that institution's position on the list is *Webometrics Ranking of World Universities.* (http://www.webometrics.info) This list is compiled by rating a university's presence on the web according to three criteria: size, visibility, and the number of rich files available. These criteria are defined in detail in Table 23 below.

Table 23
Webometrics Ranking of World Universities: Methodology
Source: http://www.webometrics.info/methodology.html

Size: Number of pages is calculated using four engines: Google, Yahoo, MSN and Teoma. For each engine, results are normalized to 1 for the highest value. Then for each domain, maximum and minimum results are excluded and every institution is assigned a rank according to the combined sum.

Visibility: The total number of unique external links received (inlinks) by a site can be only confidently obtained from Yahoo and MSN only. For each engine, results are normalized to 1 for the highest value and then combined to generate the rank.

Rich Files: After evaluation the "academic" relevance and the volume of different file formats we considering for our purposes the following 'rich files':

EXTENSION	FILE
.pdf	Adobe Acrobat PDF
.ps	Adobe Postscript
.doc	Microsoft Word
.ppt	Microsoft Powerpoint

These data were extracted using Google and merging the results for each file type after normalizing them in the same way as described before. The three ranks were combined according to a formula where each one has a different weight:

Webometrics Rank (Position) = 2 * Rank(Size) + 4 * Rank(Visibility) + 1 * Rank(Rich Files)

WR=2S+4V+R

In 2005, the *London Times Higher Education Supplement* published a list of top universities based on ranking criteria closely related to the *U.S. News'* criteria. Table 24 shows the criteria chosen for the *Times Higher Education Supplement* list.

Table 24
***Times Higher Education Supplement* Ranking Criteria**
Source: http://www.thes.co.uk

- Peer Review Score 40%
- Recruiter Review 10%
- International Faculty Score 5%
- International Student Score 5%
- Faculty/Student Score 20%
- Citations/Faculty Score 20%

Correlation coefficients for the five lists – *U.S. News,* Jiao Tong University, Gourman, *Webometrics*, and *The Times Higher Education Supplement* – were calculated for the entire number of schools in common on each list: the Top 100 schools, Top 50, Top 20, and Top 10 schools. Not all lists had more than 50 schools in common, thus it was impossible to calculate a correlation coefficient for this item. The results of these correlation calculations are shown below:

Table 25
Correlation of Rankings of Worldwide Universities on 5 Lists
Source: Calculated from *U.S. News*, Jiao Tong, Gourman, *Webometrics*, and *Times Higher Education Supplement* Listings

	Webometrics					Jiao Tong				
	All	Top 100	Top 50	Top 20	Top 10	All	Top 100	Top 50	Top 20	Top 10
Webometrics										
Jiao Tong	0.472	0.281	0.292	**0.485**	0.359					
Times	0.229	0.319	0.260	0.136	**0.560**	0.385	0.379	0.324	0.179	**0.529**
US News	0.376	0.344	0.322	0.592	**0.610**	0.516	0.516	0.354	0.563	**0.663**
Gourman	0.422		0.422	**0.624**	**-0.359**	0.487		**0.487**	0.472	0.432

	Times Higher Education					US News				
	All	Top 100	Top 50	Top 20	Top 10	All	Top 100	Top 50	Top 20	Top 10
Webometrics										
Jiao Tong										
Times										
US News	0.381		0.368	0.220	**0.425**					
Gourman	0.638			0.518	**0.549**	0.707			0.084	**0.713**

What conclusions, if any, can be drawn from this information? One thing that is easily seen is that the correlation coefficients are almost always higher for the Top 10 or 20 schools than for the Top 50, Top 100, or all schools. This evidence confirms the intuition that there is a general consensus that schools like Harvard, Yale, and Stanford (and, internationally, Cambridge, Oxford, the Swiss Federal Institute of Technology, France's *Ecole Polytechnique*, and Tokyo University) are deserving of high ranking on any list of worldwide universities. However, the apparent consensus about institutional quality tends to disappear after about the first 20 schools.[38]

[38] Interestingly, the Gourman listing and the *Webometrics* listing differ enough on the Top 10 schools to create a *negative* correlation coefficient, the only one in all of the comparisons that is negative. However, this could happen if the same schools were listed in the Top 10, but their orders were reversed – for example if Harvard is listed as #1 on one list, and as #10 on the other list. Thus, the *absolute value* of the correlation gives more information about the consensus of the Top 10 than their specific positions.

Institutional Quality and the Role of Outcome Measures

If such institutional rankings indicate an apparent consensus about the Top 20 or so worldwide universities, but indicate increased controversy about institutional quality beyond those institutions, the question becomes, what measures might be used as a reliable indication of institutional quality? Many discussions of institutional quality devolve to *outcome measures* – i.e., what have students gained from their experience at the institution. But, as yet there is presently no universally applied instrument to obtain student outcome measures.

Measuring Institutional Quality with University Exit Exams – Differing Views

This lack of clarity about the ability to measure student learning and institutional quality has led some to call for metrics to determine the knowledge and skill gained by graduates (and, by extension, measure the ability of the institution to impart that knowledge). The following extended excerpt speaks to this very issue, and indicates that the higher education community is far from a consensus on its value:

> The nerve wracking parlor game of choice for many people in higher education these days is trying to predict where the Secretary of Education's Commission on the Future of Higher Education is heading. But one thing has become clear: The panel, or at least its chairman, Charles Miller, believes that colleges must better measure the skills and knowledge they impart to students, and openly share that information with the public.
>
> In its simplest form, Miller is advocating 'testing' of what students learn while in college. Details – on what measures to use, how to present the information and, perhaps most importantly, whether the testing would be encouraged or mandated – are few at this point, though Miller pointed the way in a memo he sent last month to commission members and in some of his public comments.
>
> The bottom line: He believes that effective tools for measuring student learning now exist, and that instituting an accountability system that measures and reports student learning is essential, for higher education and for society…

> …Support for the idea tends to fall apart, however, at the notion of creating a national – or certainly a federal – standard that would apply similarly to all colleges, and that, in the worst case, might eventually be used as a basis for rating or even rewarding or punishing colleges…College officials fear an overly simplified, one-size-fits-all approach that can't possibly capture the differences in the missions and student bodies of major research universities and community colleges, liberal arts colleges filled with 18- to 22-year-olds and adult-focused for-profit institutions...
>
> 'Higher education has deflected the idea for the past quarter century by arguing that the kinds of things we want undergraduate education to teach are not really measurable,' says Patrick Callan, president of the National Center for Public Policy and Higher Education…
>
> The situation is changing in two ways. First, the pressure on higher education to prove itself is mounting, driven most significantly by perceptions that America's economic competitiveness is slipping as other countries invest more heavily in higher education….The other significant change in the climate is that years of research into assessment have, by most accounts, greatly improved the tools available to measure what students learn. From the National Survey of Student Engagement to a slew of institutionally developed exams to the Collegiate Learning Assessment — which is emerging as a favored test in several state and national efforts to measure student learning — 'the assessment business has become hugely more sophisticated,' says Callan. 'It has now been demonstrated that it is possible to measure what students learn, and we can no longer rest our case on the argument that it's impossible,' he adds. http://www.insidehighered.com/news/2006/02/15/testing

The previous extended passage speaks to several issues in the debate about higher education quality. Though its focus is on the experience of the United States, the questions it asks have application to universities everywhere:

- When a student attends a higher education institution, how does the institution know that the student has learned something from the experience, and is this learning measurable?
- Given the multitude of missions that higher education is called upon to accomplish, is it possible to believe that a consensus might be reached on what the outcome of a university education ought to be?

- What tools exist to promote the measurement of the outcome of a university education, and are such tools a reliable measure of institutional quality?

These are quite controversial questions, and it is into this very controversy that no less a luminary than Harvard University President-Emeritus Derek Bok has chosen to enter, presenting his ideas in a recent article in *Forbes Online.* Bok's comments also provide illumination into the very questions of this dissertation, because they address the potential of technology to improve higher education quality. Portions of the excerpted passage directly relating to technology's role in increasing quality or in enabling the measurement of the output of a university education are highlighted in italics.

> For all their success…American universities have one major weakness. *The quality of education they provide is not all that it should be.* According to a large body of research accumulated over the past 30 years, students do make progress in attaining the knowledge and skills they need, but the progress is typically modest. For example, college freshmen with critical thinking skills at the 50th percentile of their entering class only improve to a level equivalent to the 69th percentile by the time they graduate. Many students who major in science and engineering leave writing English no better than they did when they entered. Conversely, seniors majoring in the humanities often graduate without the improvement in quantitative skills needed to understand simple statistics or compare different options for financing their home. Fewer than ten percent of college seniors believe that they have made substantial progress in mastering a foreign language. According to one former college president, the rest 'know enough to read a menu, but not enough to compliment the chef.'
>
> *These modest accomplishments result in large part from antiquated methods of teaching that do not reflect what cognitive scientists tell us about how students learn. Teaching methods change very slowly. Apart from a few technological flourishes, they are very much like the methods used 50 years ago*. As a result, no one can confidently assert that colleges today are helping students to *write better, speak more eloquently, think more rigorously, or reason quantitatively more proficiently* than they did in the 1950s.
>
> Unfortunately, universities lack the incentives that many other institutions have to constantly improve their performance. Although they often compete fiercely for better students, such rivalry does not spur increases in quality. *The reason is that applicants to universities have no way of knowing how much they will learn at the college or professional school they are considering, let alone comparing it to how*

much they might learn at some other institution. Unlike most businesses, therefore, universities do not feel much pressure to work at improving their 'product.'

Most of the popular remedies one reads about in the press, such as abolishing tenure or giving presidents the powers of a corporate CEO, are simplistic and will probably do little good. Getting buckets of additional cash from the government won't help much either. Such proposals are either self-serving or reflect little practical knowledge of how universities function. *Distance learning via the Internet offers more intriguing possibilities that could lower costs and increase access, but there is little evidence that such instruction will improve student achievement, or that it can convey such subtler values as learning to live and work together with a diverse set of classmates.*

Other reforms would be welcome if only someone could figure out how to achieve them. It would be wonderful if colleges could strictly limit the time undergraduates spend with their iPods, computer games and television sets, and thereby halt the seductive distractions that are gradually eroding the quality and quantity of time spent preparing for classes. It would be a blessing if American high school seniors could graduate with academic skills that were at least equal to the average levels in other industrialized nations. But these reforms, however valuable, are beyond the reach of universities.

My utopian wish is far different. It is deceptively simple but could have far-reaching effects. What I would wish for is a set of reliable, universally accepted measures for evaluating and comparing student progress toward all the educational goals appropriate to every college and professional school.

If measures of this kind were available, results would soon be published in *U.S. News & World Report* and other well-known guides. Before long, students would gradually move to universities with the most effective educational programs. Presidents and trustees at less successful institutions would quickly notice that their ratings were deteriorating. Professors would realize that the best students were choosing to go elsewhere. Soon, pressure would build to improve the quality of teaching. Instructors who were demonstrably effective in the classroom would start to be rewarded with handsome pay increases and attractive job offers from rival institutions. Faculties everywhere would begin working harder to find new and better ways of helping students learn.

Although reliable, universally applicable tests do not exist, and though some educational outcomes cannot be measured at all, *tools are already available that can help campuses assess such important competencies as critical thinking, writing, quantitative reasoning and proficiency in foreign languages.* These measures may not be perfect, but they are a big improvement over knowing little or nothing about student progress. Many institutions use such instruments already. Others participate in national surveys to determine where they stand in making use of the most effective methods of teaching and learning.

> What most campuses still lack is a comprehensive effort that begins by assessing student progress and goes on to identify weaknesses, experiment with possible remedies, and adopt those innovations that work well while discarding those that don't. Thus, universities have not yet become 'learning organizations' – at least not in the sense that the term is used in other well-run institutions. (www.forbes.com/2006/04/15 , Italics added.)

Note that Bok feels that technology will likely have more immediate impact on higher education *access* than *quality*. Also embedded within Bok's comments can be found a reasonable definition for a outcome quality measure for higher education - namely, the ability to teach students to "…write better, speak more eloquently, think more rigorously, or reason quantitatively more proficiently." Though there may be many more outcomes that an institution might wish for its students, these four factors are certainly fundamental to any notion of education. They are the higher education equivalent of the "Three R's." Bok seems to think that these kinds of outcomes can be measured, and that technology can assist not only in helping students attain these skills and knowledge, but can also assist in their measurement. As I discovered through interviews with higher education administrators at a variety of Washington, DC-area institutions, his ideas are not unique.

The Administrator's Perspective on Internet and Computer Technologies

The Importance of the Administrator's Perspective

Bok's ideas, along with those of Duderstadt (The University of Michigan's President Emeritus) and other institutional leaders who have been quoted earlier in this work, provide an important perspective that has not yet been explored in depth.

- What role does the administration of the institution play in promoting or inhibiting the diffusion of technology?

- What are the beliefs and attitudes of college and university administrators in regard to the adoption of technology for use in higher education?
- What is the administrator's perspective on the potential for Internet and computer technologies to affect *access to* and the *quality of* higher education?
- Are there tradeoffs that limit the impact that such technology can have in the institutional environment?

It was with these questions in mind that I began qualitative interviews of institutional administrators and professors at five higher education institutions in the Northern Virginia/Washington DC area, in order to gain insight into the institutional diffusion of Internet and computer technologies, and to probe the administrators' beliefs and assumptions about the ability of the technologies to impact institutional *quality* and *access*.

Institutional Models

Institutions where interviews were conducted fell into five different models of higher education institution: a state university, a community college, a private university, and a corporate university; the community college also had an adjunct institution which focused on Internet-enabled distance education. These different institutional models were chosen in order that the results obtained might provide some indication about the diffusion and its effects on institutions with differing resources, and so that the results might be generalized to institutions in other countries.

The results of interviews with institutional administrators are presented in this chapter, and interview results with classroom faculty are presented in Chapter 7. Some interviewees provided both perspectives – as administrator and faculty – since they had

performed in both roles. Table 26 below shows the pseudonyms for the institutions and persons interviewed at the four institutions, for the institutional and classroom perspectives.

Table 26
Institutions, Institutional Models, and Interviewees

Institutional Model	Institution				
	Coastal Community College (CCC)	Coastal Community College Online Learning Institute (CCC OLI)	James Monroe University (JMU)	Federal Institute of Military Contracting (FIMC)	Midas University (MU)
	Community College	Distance / Online Education	State University	Corporate University	Private University
Administrators	Katrina Bart	Katrina Bart	Elizabeth Ryan	Will Huron	Donna Wayne
	January 24, 2006	January 24, 2006	March 20, 2006	January 13, 2006	July 18, 2006
	Robert Goodyear		Jane Lockheed		
	January 31, 2006	January 31, 2006	May 2, 2006		
	Maureen Brock 24	Maureen Brock	John Sierra		
	January 24, 2006	January 24, 2006	March 20, 2006		
	Samuel Garvey				
	November 10, 2005				
Professors	Angela Nimorata	Angela Nimorata	Jane Lockheed	Robert Dovins	Greg Zhang
	March 13, 2006	March 13, 2006	May 2, 2006	March 31, 2006	July 18, 2006
	Katrina Bart	Katrina Bart	John Sierra	Richard Seaylin	Nolan Atkins
	January 24, 2006	January 24, 2006	March 20, 2006	April 4, 2006	July 19, 2006
	Don Globus	Don Globus	Stan Gehrig		Donna Wayne
	February 1, 2006	February 1, 2006	June 26, 2006		July 18, 2006
	Robert Goodyear				
	January 31, 2006				
	Maureen Brock	Maureen Brock			
	January 24, 2006	January 24, 2006			
	Nora Foley	Nora Foley			
	March 31, 2006	March 31, 2006			
	Samuel Garvey				
	November 10, 2005				
Total	7	5	4	3	3

Note: All interviewee names and institution names have been modified

Interview Results: Five Categories

Although an interview protocol was used (See Appendices B and C), interviews were informal and conversational; accordingly, the interviews touched on a wide variety

of subjects related to the institutional diffusion of Internet and computer technologies and the effects on institutional quality and access. Interviews were audio-taped and transcribed shortly after completion of the interviews. Administrator comments were classified into the five categories shown below:

1. Information Literacy
2. Training and Competence Issues
3. Buildings and Physical Infrastructure
4. Technological Infrastructure and Hardware and Software Issues
5. Enrollment and Access Issues

Although the categories above appear as discrete elements, they are not, in fact, discrete. Every conversation flowed seamlessly between and among all categories above. But, the breakout into the five categories is of use in analyzing the comments of the institutional administrators and faculty and the diffusion and impact of Internet and computer technologies at both the institutional and classroom levels.

The Bell Curve of Adoption as Applied to the Five Categories

Before looking at the specific ideas and comments in each category, there are some overarching ideas that seemed to touch on every category. The first idea that had universal relevance was the notion of the bell curve of adoption. This curve was first presented in footnote number five, above, and is reprised below. Note that the curve divides technology adopters into five categories: innovators, early adopters, early majority, late majority, and laggards.

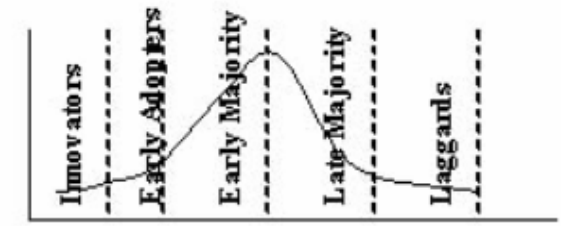

Figure 31: The Technology Adoption Bell Curve

It quickly became clear in all interviews that, just like there is no idealized "average" student in the real world, there are also no "average" teachers, administrators, or university staffers. On all dimensions relating to this question, there is a bell-curve like distribution. Some administrators are immediately comfortable with technologies, and hence become advocates for their wider use. These administrators belong in the "innovator" category for this dimension. However, it is entirely possible that an administrator who is gifted in this dimension is not equally gifted in communicating his/her vision to others, gaining allies in order to build momentum, building institutional consensus, or providing for training of those who are not equally as gifted. A technology advocate may see the benefits of the increased use of technology in the academy, while ignoring the costs. He or she may be comfortable with breaking academic tradition when others in similar positions of power are not. All of these things put some limits or "brakes" on the capacity of such innovators to bring about change.

But, another point that emerged from the interviews is that the "bell curve" for technology has shifted to the right – at least in the United States. Even technology laggards are adopting technology to some degree. It is extremely rare to find an administrator or professor who does not use email as a communications medium. One

interviewee even noted that such technology “laggards” gain negative reputations among students.

> Because most faculty are using e-mail, and now…it's not all – and it's amazing – if the instructor doesn't use e-mail, the students find out – and they're reluctant to take that professor’s class. So that is a real indication that the e-mail, threaded discussions, and chat…are the most important dimensions. (J. Sierra, personal interview, March 20, 2006)

Another interviewee hinted at some of the dynamics within the institution that are encouraging faculty to focus on becoming more technologically proficient. The forces are often a combination of top-down and bottom up pressures:

> We are bringing people and who have newer, more contemporary ideas. Obviously, we had circumstances where we had people resisting adopting the technology. The top-down initiative in the late 1990s was quite different in that we started telling faculty members things like, “you'll use e-mail, you will use resources that we have here, and you will incorporate them in your instruction, you will have a web page" – well, initially people were evaluated on whether they did this or not, but the real trick is incorporating that is a real part of the faculty evaluation. And I think that his varied from division to division, based on the personality, the nature of the person that has been in charge, the dean of the division. I think some divisions have been more receptive than others, based upon that. To be quite honest, there were folks who were resistant to the technology, but were excellent lecturers. So they should leave them alone. They know what they're doing. They're going to retire, and we will replace them with someone who will come in...we've done that, I think, very effectively because the people that we tend to attract now are folks who have had the experiences...the levels of comfort with technology is a lot higher than it used to be. It's just an accepted standard. Particularly when you look at students that are coming to us...the students have been very accepting and in many cases have pushed the faculty...”are we going to have the service or, you know, are you going to reply to us by e-mail at two o'clock in the morning?” You know, there is a lot of preparation that goes into preparing for classes using the technology, but people are becoming more comfortable with it by and large. (R. Goodyear, personal interview, January 31, 2006)

One factor that can accelerate diffusion throughout the institution is senior institutional leadership that is both technologically proficient and skilled at communicating its vision to the rest of the institution.

> Our president is a computer scientist, so he is continually challenging us to do more…I mentioned [the] Dean…[who is] the senior associate dean for liberal arts…there is tremendous leadership there. (J. Lockheed, personal interview, May 2, 2006)

The Crucial Role of Senior Insitutional Leadership

Thus, the second universal idea that emerged from the institutional administration interviews was the notion that senior institutional leadership was key in providing the right physical, financial, and psychological environment at the institution for the effective diffusion of Internet and computer technologies. Sometimes this required bold steps, such as purchasing a computer for every administrator and faculty member, and other times the steps were more subtle. The following interview passages illustrate this point.

> It really does start at the top. Certainly at this institution and the entire system of [this state's] community colleges, it does start with the administration. And I think that is because it is such a large, it is such a huge resource. Without having a computer on everybody's desk, we couldn't even talk about it. We couldn't make the faculty learn how to do something, and we couldn't tell them this is the wave of the future and this is what your students are going to expect, this is what all employers expect if you don't give them the tools. So, it came with some of the faculty who were some of the early adopters who had a computer at home and were doing it, but the majority came from the administration. Put it out there, put it on everybody's desk, and then it was up to the institution again to teach people how to use the tools. And you do it with different levels of success, and it has become very much a part of everybody's life now but it was 1997 when we first put computers on everybody's desk…I think it needs to be everyone, but it certainly needs to be the leaders, starting with the President. The President has to be sufficiently conversant and knowledgeable in using the tools, for example. (M. Brock, personal interview, January 24, 2006)

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> I'm looking at what occurred at this campus. We had a tremendous period of growth in a very short period of time. Up until probably the mid-90s, our IT infrastructure was Big Blue. It was mainframe-based, and the college was pouring its resources into older technology - which was being replaced by the Microsoft's and whatnot, and the PC. The impetus really came from the Virginia community college system itself – centrally. Okay, this is what we're going to do – within a given period of time we are going to put a computer on every desk. We are going to be hooked up to a network, and you are going to have all of the prime network/applications software on your computer. And you're going to have e-

> mail, and everyone is going to use all the resources that we have. That took place at this college pretty much within one year. It was an unbelievable time, in that, with all of the wiring that had to be done. The buildings, and all of the infrastructure that had to be done – getting new computers and then the training to allow people to use those resources, and encouraging them to do that. On company time, be paid, and getting training in pretty much anything you wanted to do. That took place, as I recall, in 1997 or 1998. There was a big push at that time. And, believe it or not it all happened it all took place. (R. Goodyear, personal interview, January 31, 2006)

A new computer on everyone's desk where it had not been the day before is an explicit signal of change from the senior leadership, but another interviewee noted that even subtle cues are noticed by the junior administration and the professoriate:

> They will take their cue from a senior administrator. And so if the senior administrator is negative, they will be negative. If the senior administrator is positive, they will be more positive. Whether it's something that…it doesn't have to be a formal thing…it can be very informal. It can be when they make a presentation. It can be a funny remark. Our student information system, when it got in trouble earlier, it became the butt of a joke at every presentation. That's exactly the wrong thing, because in some cases it is actually outperforming our old system. It was new, it had new problems, and so everyone begins to pick up that "well it doesn't work." Of course it works. But, if the only thing they hear is when the President stands up and he comments the two days it didn't work…We had a steering committee for a major project. One of the senior administrators was on that steering committee, and she was told, "well, it's not important to go there, it's more important to go to some truly less important event." It sends a message. Senior administrators play a really important role. But they often don't know what to push for. They don't know. They want to get down in the weeds. But they also don't know what it is that our institution ought to be doing. (S. Garvey, personal interview, November 10, 2005)

Developing an Institutional Technology Strategy

The previously quoted passage hints at another universal idea encountered throughout the interviews – the notion that there should be some degree of knowledge among the institutional leadership as to the technological options available to them, and some strategy for proceeding forward, even if there are many unknowns along the path forward. All institutions where interviews were conducted had developed technological

strategic plans, and were constantly reviewing these plans and progress toward accomplishing the institutions technological goals. But, as one interviewee noted, senior administrators often saw the genesis of the technology initiatives occurring from the actions of innovators at lower levels in the organization. Smart administrators know how to pick up on these lower level initiatives and to keep the momentum going.

> I think that for an institution to move forward, there are a couple of things that have to happen. You've got to support the innovators. That doesn't necessarily mean financially, but somebody's got to get out of their way. You've got to make sure they know they are appreciated, and not make them go somewhere else to innovate. Because the innovators and those at the leading edge are not going to sit around if they feel that they can produce, they will do fine…for the early adopters you need support mechanisms as they move forward because they are not always going to be able to do it on their own. And so, it doesn't always have to be heavy support – you don't have to pay them, but they're going to need help. They are not going to be self-motivated. That's the innovators. So, they are going to need some kind of support, some kind of help, something…[because] you really want to get to that majority and then especially the later adopters. You are going to have to start mandating some things. You are going to have to have a very strong push from the administration and the academic leaders. You need leaders speaking out, you need mandates. I know that a lot of administrators really don't want to do it, but that's the only way it happens. You can't mandate it too early. But there comes a time where they really have to have a website. And then you can make it easy, but if you don't move them along and get the inertia going, you can just train them, you can't just show them, but you actually have to make it happen…And then, sometimes, you have to create *guerrilla organizations* [because] the existing committees, the existing structures are almost impossible to change. So sometimes you have to create something, like we did with our Extended Learning Institute. It's a different culture, different rules, and you can just get things done, so that you are not tied up trying to nit-pick everything to death to make it fit within your existing structure. (S. Garvey, personal interview, November 10, 2005)

One senior technology administrator spoke of her efforts to encourage diffusion of technology at her institution by providing new technologies to a focus group of core individuals whom she trusted to give her honest feedback, and whom she also trusted to be strong advocates for the technology if they were convinced of its utility.

> When I wanted to roll it out to the faculty, I would give it to my core group – some are high end technology people. I would give it to them and look for their

> feedback, let them play with it first, for a period of time, then pull them back in and say what did you like about it; and the folks that really grabbed on to it, I'll ask them if they'll teach the small group. So, that level of listening and peer instruction is better than anything I could have done. I could have – on the first day – presented my techies and they would say "it can do this and this and this." It'll enhance your curriculum, etc., but when it comes from a colleague it means more. I've done it now three times very successfully…That core group helped me solve these problems. (D. Wayne, personal interview, July 18, 2006)

This theme of building technology initiatives from the ground up was a notion that was found in other interviews as well:

> I think for promoting technology, you have to have some ground up. You have to start at the grassroots, and then the administration has to endorse it. I have seen the administration say, "Everybody has to have a professional web site." And you get some, and some you don't, even if you say everyone has to have it. It has to come both ways. I tell you when I put together [an online] literature course, I ended up doing it with four other people and for other locations in Virginia. And we had to all go to [another] community college campus, because there was nobody else here who could help us, because it was the beginning. Now, of course, my office helps, and we have all kinds of help. So it was like you had a group getting started, and then the administration saw the vision. But if you don't have both...what can happen? (K. Bart, personal interview, January 24, 2006)

Thus, the overarching themes that were encountered in all of the interviews with senior technology administrators were (1) the crucial role of senior administrative leadership, (2) the need to engage the innovators at various levels of the institution through technology focus groups, lead users, grassroots movements, or *guerrilla* strategies, (3) a shared recognition that there are different levels of technological proficiency and technological comfort in the institution, and (4) the necessity of building of a strategic technology plan that recognizes all of the above and that gets communicated throughout the entire institution.

Below are comments and synthesis from specific concerns and observations about the potential for Internet and computer technology to affect the *quality of* and *access to* higher education by category.

Concerns about Information Literacy

Many interviewees noted that today's educational environment is characterized by a profusion of knowledge sources, some reliable, but many of doubtful quality or reliability. The notion that an undergraduate student might compose an entire research paper based entirely upon information gained using the *Google* search engine was a cause of much consternation among both technology administrators and faculty members. As a consequence, most institutions are now placing increased emphasis on "information literacy." For administrators, there is a growing recognition that helping students develop the ability to discriminate among the cacophony of various sources should be one of the chief goals of the institution.

> How does technology fit into this – for example, if we're talking about something like information literacy…Instead of requiring students to have general IT skills, what we want is communication, collaboration, visual literacy, information literacy, analytical skills and qualitative and quantitative analytical skills – those kinds of things; and in each department, because we are going to concentrate on majors, rather than individual professors. We're looking at ways to create efforts on the part of faculty to actually collaborate – on their curricula – and we're providing support to that. (E. Ryan, personal interview, March 20, 2006)

Information literacy has always been a need in higher education, but the wealth of new information sources brought about by the advent of the Internet has made it an even more important priority today. In response to a question on this subject, one interviewee noted that discriminating among web-based sources that have no peer review process is quite challenging, even for those at higher levels of academia who have been trained to analyze sources of information for their credibility.

> Well, I'd take that one step further and say that a lot of online information is made to look better than it really is. You can go online to such and such a journal, and they just made up a title, and they try to make it sound like it is a scientific inquiry, much like lobbyists do. They make it look like what they are not. They will have something very biased, something that will support their own company

> or whatever, and they try to make it sound very scientific and reliable. The deception is hard for the public to know[39]. A good example of that – we are trying to buy and extended warranty for our automobile, and there is a website that looks like an auto warranty consumer-digest-like magazine, but once you dive into it, no matter where you go, you get linked to their company. They are the only benefactor of this thing. There are a lot of this type of thing going on on the Internet for even an educated consumer to decide what is real, what is good data, what is not.[40] The academy will continue to rely upon peer reviewed journals for the time to come. What I have seen a lot of recently is better preparing of students for distance education. We have done a lot of work in this area. (N. Atkins, personal interview, July 19, 2006)

The need for additional training in information literacy is only one of several training and competency issues that both administrators and professors identified as being crucial in order to take advantage of the opportunities offered by the Internet and computer technologies in higher education.

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[39] Confirming these comments, a consortium of research organizations recently issued a report entitled "How Do People Evaluate a Web Site's Credibility?" The overall conclusion was that consumers, even sophisticated ones, evaluate a web site's credibility more on the basis of superficial aspects such as layout and visual appeal rather than the website content's authorship, affiliations, customer services, privacy policies, or peer review. Source: Fogg, B.J., Soohoo, C., Danielson, D., Marable, L., Stanford, J., & Tauber, E. (2002) *How Do People Evaluate a Web Site's Credibility?* Palo Alto, CA: Stanford University Persuasive Technology Lab.

[40] This phenomenon, the ability of the Internet as *medium* to trump the *message*, was encountered by *The New York Times'* correspondent Thomas Friedman in a much more chilling context – the case of some Muslim students trusting Internet sites regarding a vicious Internet rumor about a Jewish conspiracy in the September 11, 2001 terrorist attacks. – "And the place I saw that most profoundly is with the lie that 4,000 Jews were warned not to go to work on September 11. That lie is believed by the vast majority of the Muslim world today. And when I would meet young Muslims and old Muslims, and Muslim leaders, even, I'm afraid, and they would repeat this lie, I would say, 'Young man, just stop and think for a second. Who could have had the names of everyone working in the two Twin Towers? Who then could have figured out which ones exactly were Jews? Who then would have had all of their home phone numbers? Who then could have called them all on the night before September 11? And by the way, could you name just one person who was called?' And then they would look at me and say the saddest thing, 'But Mr. Friedman, I read it on the internet.' You see, because it comes wrapped in this patina of technology, people believe it even more. They have no idea that on a good day, the internet is an open sewer of untreated, unfiltered information - that on the good days it's an electronic version of the National Inquirer. They don't know that. 'But Mr. Friedman, I read it on the internet.' That is really sad, but it is really true." Source: http://yaleglobal.yale.edu/display.article?id=913&page=4

Training and Competency Issues

Interviews revealed that not only students, but also faculty, middle-level administrators, and even senior institutional leadership all needed to be better prepared and better trained to take advantage of the new technologies.

> You know, students think they are a lot better at technology than they actually are. Their self reporting is less accurate than having some instrument do it and say, "Yes, the student can do this or that." (E. Ryan, personal interview, March 20, 2006)
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> We also give reassignment time to a faculty member on each of the campuses who can act as a mentor to other faculty on the campus. The other thing that has happened in higher education is you have the people who started early – they are way out there now and you have the people who never started and the gap is widening. (K. Bart, personal interview, January 24, 2006)
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> If I were to try to pick out anyone in the institution who was the least knowledgeable and the least adept with the technology it would be those middle managers – the department heads and division chiefs and so forth who are no longer teaching – most of them have come out of teaching, but just as they became department heads this is coming in, so they didn't get the experience, and yes, they use it for communications and it depends on them and their understanding and their becoming the leadership of the institution making them understand how important it is for employers. (M. Brock, personal interview, January 24, 2006)
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> No, they [senior institutional leadership] are not [familiar with the technologies]. A few are, but more are not. And so for them, it's a challenge. That's why we've got to package it and try to make it very simple and straightforward…for many of them it is a challenge. (S. Garvey, personal interview, November 10, 2005)

In summary, great potential exists with these technologies at all levels. There are innovators and early adopters at each level – but there are also laggards. The key to successful diffusion is finding the right type and amount of training, and providing the resources (funding, release time, adjustment of priorities) to make it happen. Of equal

importance with technical training is the physical and technological infrastructure to enable the change.

Infrastructure: Physical and Technological

During the interviews with institutional administrators, there were many comments about infrastructure – physical infrastructure such as buildings, campuses, computer hardware, and also software and telecommunications infrastructure – that were crucial to the institution's ability to absorb the technologies and use them to increase access and quality. Interviewees acknowledged that technology was expensive, but that physical buildings and infrastructure were equally or more expensive, and often took longer to accomplish, given the bureaucratic nature of the approval process for physical facilities.

> Yes, because we have for example, not only people, but another key element is facilities…brick and mortar, are also extremely expensive. Land is extremely expensive. Buildings – a new building, when you reach capacity – I don't know what it is in other institutions, but by the time you've proved that you need it and by the time that you get the permission and money from your legislature which is what we have to do – you've lost your momentum. And what you've lost, it's tremendous. With technology, we can use technology to, for example, something we're doing right now in trying to make the best of both worlds and reducing the need for face-to-face time by offering more and more hybrid and blended courses where students will get the same contact time in the materials or instructor time but won't all have to be in a classroom where you have 25 bodies – something like that…And so, for us, that is something that we want to manage for increasing our enrollment and without having to build new facilities. (M. Brock, personal interview, January 24, 2006)

Addressing the idea of hybrid classes, another administrator noted that technology was enabling his institution to do more with less, to be more efficient in the use of the physical infrastructure and classroom space.

> From the standpoint of sharing rooms for example; hybrid classes for example – one course meets there on Tuesday, and one course meets there on Thursday, they

> can alternate the use of the room as far as that's concerned. So, that is just one example. (R. Goodyear, personal interview, January 31, 2006)

Perhaps more revealing is a comment from an administrator/faculty member at the Federal Institute of Military Contracting (FIMC), a self-described "corporate university" that provides mandatory training to individuals working in the military contracting field, about how technology can lower costs, particularly when used to deliver a *standard* curriculum to students who would otherwise have to incur travel costs and would have to occupy physical buildings or classrooms for the training.

> I'm surveying faculty who are taking my online courses and even they say they would prefer to have the courses classroom based. But that doesn't fit the business model. The business model says, if I can get you online I don't have to pay travel, *per diem* – and so the business model wins – so that is why I would suggest that there's not much resistance [by faculty and administration to delivery content online]. Some people don't like the online courses, but they're not going to resist them because that is the way that it is going. That sounds pretty harsh, but it's not quite that bad. (R. Dovins, personal interview, March 31, 2006)

Midas University, a private institution, is challenged not only by the costs and bureaucratic burden of constructing new buildings and infrastructure, but also by the fact that it would be physically impossible to erect additional building contiguous to the main campus, given that the institution is located in the heart of Washington DC. This has caused leaders at this institution to look at ways to use technology to maximize the use of the classroom space, and also to look at programs that can be efficiently and effectively delivered via distance technology.

> We are so landlocked here. Our classes start at 8:00 A.M. but people are in the class as early as 7:30 up until 10:30 at night. (D. Wayne, personal interview, July 18, 2006)

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> At [this institution], we deliver some of our advanced research methods courses only by distance, and that has been quite controversial among faculty and students. The reason why we do it is that we not only have students at this campus here, but we have a smaller campus out in Loudon, Virginia and we teach

> Doctoral programs in Alexandria, Virginia and Hampton, Virginia which is 90 miles away, and we wanted students to be able to take whatever methodology course would be appropriate for their eventual dissertation, and we didn't have enough students at any one of these centers to teach 5 advanced methods courses – so we did it out of necessity. And I think there is an interesting lesson there, and it could be a parallel to developing countries where they don't have enough students to teach a certain course…but there would be enough students if they pooled several universities. (G. Zhang, personal interview, July 18, 2006)

Stated briefly, administrators were largely convinced of the efficacy of Internet and computer technology to accomplish at least two things: (1) to relieve some of the pressure on the physical infrastructure of the institution, and (2) to widen *access* to the institution by providing an alternate avenue to instruction. Access issues are addressed in the next section.

Internet and Computer Technology as a Means to Increase Enrollment and Access

One administrator spoke optimistically of the potential for both online and hybrid classes to help increase enrollment at the community college level. For her, one of the keys to success in that endeavor would be controlling the quality of the online content.

> I think the key thing for us is student access and student success. You know, we are having ever-increasing numbers -- so in order to meet those ever-increasing numbers. You have to keep up with building -- and community colleges are the poor children of the universe. They don't have endowments…So, we are always asked to 10 times more with 10 times less. I do believe that the completely distance course, we have to be able to offer. We have to be able to offer it for the people who can't come here. We have to be able to offer it so we can offer more courses. And we have to offer it as another means of delivery for the student that excels in that. And we have to promote the hybrid courses, because where you used to have one class in one room you can now have two classes in one room. Again, you increase access – but you have to be very careful about student success. So you want to be sure that the development of these hybrid courses is done well. (K. Bart, personal interview, January 24, 2006)

An administrator at the Federal Institute of Military Contracting noted that classroom instruction had not declined as a result of the advent of online content delivery at his institution. What had occurred, he noted, was that the content was now being

offered to a much wider audience online, while classroom instruction remained about the same as before.

> We still deliver the same amount of classroom instruction than we did before we started delivering online instruction. Online instruction has allowed us to reach additional people within the [Acquisition] workforce...We have accomplished this within the same budget via recapitalizing from student travel cost avoidance. It has worked for us. Each organization will be different and should take a good look at what they want to accomplish. What works for [us] may not work for another organization. (R. Seaylin, personal communication, April 4, 2006)

At state universities, increasing enrollment is also a concern, and offering online and hybrid classes as a supplement had enabled James Monroe University to meet increasing enrollment numbers.

> We have tremendous increasing enrollment here and in the last year we have added as many students as study at Mary Washington College. We added 7,000 students (J. Lockheed, personal interview, May 2, 2006)

An administrator at Coastal Community College noted that the enrollment at his institution had not grown in the last few years, perhaps due to competition from online institutions such as The University of Phoenix and Strayer University. What he did note about enrollments was that online learning and technology enabled learning had made it possible for his institution to open its doors to a wider demographic of students. He and other administrators at this institution repeatedly mentioned those students who would be challenged by the traditional classroom delivery mode – specifically single mothers, students with extremely constraining work schedules and shifts, and students in remote locations.

> To be quite honest with you, we've had pretty flat enrollments for the past two or three years. In fact, 10 years ago, the college had higher enrollment than it does now…[but] I think we are attracting people we would not have five years ago, using technology for placement testing, through hybrid courses, or distance learning. (R. Goodyear, personal interview, January 31, 2006)

Conclusions from the Interviews

Diffusion of technology at an institution is both a top-down and a bottom-up phenomenon – recognizing this dual nature is key to enable the institution to get the most from technology, and ultimately to impact both *access* and *quality* at the institution. It is top-down because institutional leadership really does make a difference in the broad adoption/non-adoption of the technologies in question, and the ability of such technologies to transform the institution in different ways. But, it is also bottom up because many of the innovators reside at the lower levels of the institution, willing to try new things, and looking for signals from above that such experimentation will not only be tolerated, but that the institutional leadership is willing to actively promote technologies that have proven their utility.

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Institutional Senior Administration and the Benefits of Top-Down Initiatives

Top-down initiatives work because, even though the higher education model is very different from that of the standard hierarchical business model (with the exception of newly emerging proprietary, for-profit institutions), there *is* a hierarchy in higher education institutions, no matter how informal that hierarchy might be. When the president of an institution issues a "Strategic Plan," the contents of that plan *do* make a difference in how middle-and-lower level administrators do their jobs and assign their priorities, and it likewise makes a difference in how faculty and students conduct themselves. Senior administration is most effective when it involves the other levels of the institution in the development of such plans. Ways in which an institution might maximize this dynamic are:

- Chartering focus teams and committees to develop strategies on technology policies;

- Working to build technological consensus instead of operating from an authoritarian position;
- Taking steps to recognize technological excellence through promotion, tenure, and recognition;
- Working through university consortia or with community leaders to ensure that graduates from the institution are technologically proficient, and that the institution is on par with technological improvements in local industry and government organizations; and
- Using the "bully pulpit" of their positions to advance technology at the institution, speaking often of the institution's initiatives, and informing the other institutional actors of the high priority such initiatives have within the institution.

Institutional Middle-Managers: A Strategic Linchpin

Middle-level administrators are a strategic linchpin because their actions have effects both in a top-down and bottom-up mode. Working to implement the details of a strategic plan developed by senior institutional leadership, middle-level administrators are operating in top-down fashion. But, through the role of communicating the needs, desires, and opportunities identified by technology innovators they can also be important catalysts for bottom-up initiatives. One administrator's example about using "lead user" groups, or focus groups of faculty and staff to try new technologies is a significant example of bottom up initiatives at work. When such focus groups find the technology to be useful, the road is already paved for its smooth diffusion throughout the institution.

Bottom-Up Initiatives, and the Role of Junior Faculty, Administrators, and Students

In any organization, many of the innovators are found within a particular demographic category. The technological innovators, or early adopters, in a university or other higher education institution are likely to be junior faculty, administrators, or students. The reason for this is twofold: their technical knowledge is often more current, and newer employees or students are less likely to be deterred by institutional paradigms. If they find a technology to be promising and useful, they will recruit their own allies through their enthusiasm. In the words of one faculty interviewee,

> In my experience, it has been mostly enthusiastic early adopters who say, 'look at this, isn't it cool'…and they said this to groups of people who said "Yes, I would like to be able to do that too.' In my experience, that is what caused all of us to get involved…I don't think the upper administration of the college was all that involved. Many of them were not computer literate at all…I don't think it happened despite them, but without their active participation. (A. Nimorata, personal interview, March 13, 2006)

Senior Faculty and Department Heads

As the previous section argued, many of the innovators or early adopters in higher education are found at the lower levels – junior administrators and junior faculty members. But, none of this innovation activity will succeed without the support of senior faculty, who are the "gatekeepers" at the institution. They control the gate through faculty teaching and research assignments, committee assignments, and most importantly, tenure review. Senior faculty are also more tuned in to the culture of the institution. They know what will work and what is unlikely to succeed at the institution. Their network of contacts in administration, institutional leadership, and other faculty outside the institution make it unlikely that technological solutions which proceed without their review or assent will be successful over the long term.

Institutional Perspective: Conclusions

From the quantitative analyses, the results were often surprising. Data from *U.S. News and World Report's* led to the result that more library volumes were strongly correlated with an institution's ranking on the list, but the number of computers provided by the institution was correlated in the opposite direction, indicating that institutions with more computers per student actually suffered lower rankings. It was this kind of puzzling result that begged for deeper understanding of the diffusion of such technology at the institutional level, and the perspective of the administrator. Furthermore, a comparison of several "best of" lists that purport to indicate the highest quality institutions around the world failed to show that there was any consensus on what constitutes a "quality" higher education institution, at least once the top 20 or so worldwide universities had been enumerated. A great number of "middle tier" institutions are in that class for reasons that are not quite quantifiable.

Quantitative methods were also used to analyze, classify, and grade institutional websites both in the United States and in low-to-middle income country institutions. The result of this analysis is that (1) institutional websites *do* provide some indication of an institution's level of diffusion of Internet and computer technology, and these websites follow an evolutionary path that leads to more and more information and services being offered through the institutional website over time; (2) U.S. institutions are at or near 100% on all dimensions used to analyze institutional website sophistication; (3) institutions in low-to-middle income countries are developing institutional websites along the lines of institutional websites in the United States, and some countries and institutions are surprisingly far along in this process. Website content provides administrative content, course information, electronic mail, library and database access, and virtual

education portals. Institutional website availability and content is correlated with national income and with national telecommunication connectivity levels, but the correlation is not particularly strong. Some other variable, as yet unidentified, is likely to be more strongly related to the development of institutional websites and the diffusion of this technology at the institutional level in the low-to-middle income countries studied herein.

Qualitative interviews provided more "thick descriptions" of the phenomenon of diffusion of Internet and computer technology at the institutional level. Interviews revealed that such diffusion is simultaneously a top-down and a bottom-up phenomenon. Institutional leaders' technology "strategic plans" matter, and both administrators and faculty pay attention to these plans, even if they sometimes view them with skepticism. Skilled administrators know how to read the signals of the leadership, and also how to plumb the innovative nature of the institution's "early adopters." Technology laggards are being increasingly marginalized in the academy, at least in the U.S. Institutional administrators and leaders are responding to the challenge of the Internet and computer technology, and view this challenge as a means to increase *access to* higher education, particularly due to its ability to enable institutions to do more with limited physical space and buildings. Consensus among administrators about the effect on *quality* is much more elusive. Administrators, faculty, and senior institutional leadership all agree that these technologies have created a necessity to focus on information literacy, and to provide training and release time for faculty to become more proficient in the use of these new tools.

Finally, success or failure in improving *access* and *quality* are dependent upon decisions that institutional leaders and administrators make. Such decisions *must* be

made in a fashion that welcomes and encourages the input and participation of the institution's faculty. The faculty's perspective is the subject of the next chapter.

CHAPTER VII

CLASSROOM LEVEL ANALYSIS

Aldrich (2004) verbalizes what many educators have thought when considering the potential offered by computer technology and education.

> Who hasn't watched a computer game and thought about education? As we watch our kids play a game, or get into one ourselves, thoughts like these go through all of our heads:
> - Look at how much is going on.
> - Look at how fluidly he or she has (or I have) learned how to use this.
> - There has got to be some substantial learning going on.
> - Why does all of this seem so vacuous? Who cares about shooting villains or racing a car?
> - There has to be an opportunity here. What if there were valuable content presented this way?
> - Why can't learning be more like this? (p. 7)

But, although many educators have probably thought this way, many remain skeptical, suspicious, or disappointed about technology's ability to truly revolutionize the educational experience.

This chapter presents the results of interviews with faculty members who have had the opportunity to use, interact with, and experience the Internet and computer technologies as a part of higher education at the classroom level. The aim of this chapter is to analyze and understand the perceptions of professors and other institutional faculty about enhancements or detriments to the quality of higher education through the use of technology; specifically of interest is the perception of the contribution of *content delivery, visualization, artificial intelligence, enhanced communications, and electronic access* to increasing the *quality* of higher education.

Of the potential for Internet and computer technology (ICT) to enhance the *quality* of education, one researcher notes that the answer to such a question is quite complicated, and requires more than one caveat before answering in the affirmative. Note that this author has also used video games as an example in his analysis of the ICT-enhanced learning environment.

> [O]ne may ask: Is ICT-assisted education better or worse than traditional education? The answer is, probably both. ICT does not suit all students, all subjects, or all phases of learning equally well. There are already considerable differences say, between the offerings in mathematics and history compared to those in music and physical education. Much depends on how ICT-assisted learning is done, and, as in traditional teaching, there are no fast formulas. Discovering and developing the potential of ICT will surely take time, and what we find may not be valid for all time because the context surely will change. Technology in itself is not a panacea; uploading Web content in different subjects does not in itself result in quality teaching or effective use. Teachers have to be trained and need to feel knowledgeable and skilled – not always easy in an environment where young students are often quicker than their teachers to learn new technologies. On the other hand, the lack of willingness to mobilize the young to learn from one another – in the same way as they learn the tricks of new video games – is not only old-fashioned but even counterproductive. Educational planners can focus no longer just on how to secure implementation; they need to arrange for continuous experimentation and innovation to learn by doing in an ever-changing environment where even what is being learned and done is changing. (Hernes, 2002. p. 26)

Interviews of Higher Education Faculty

To research the classroom perspective, faculty members from the same five Northern Virginia/Washington DC-area institutions were interviewed using a protocol (see Appendix C) aimed at determining in what ways Internet and computer technologies are being or could be used in the classroom to enhance quality. Interviews with faculty elicited the same caution as in the passage cited above about drawing any broad conclusions about the effects of these technologies. Internet and computer technologies

have much to offer higher education. They can be a means to increased quality if offered in partnership with trained and motivated faculty members, but they are not a panacea.

From the interviews, comments were classified into the five categories shown below. The first category, Information Literacy, was also addressed at the institutional level in the preceding chapter.

1. Information Literacy
2. Course Management Systems
3. Learning Objects and Open Source Material
4. Hybrid Classes as an Alternative to Campus-Based vs. Distance Classes
5. Pedagogical Concerns, Learning Styles, and Educational Quality

In addition to these five areas, faculty were asked which ways offered the most promise for enhancing educational quality, among the following five cateories: *enhanced content delivery, visualization, artificial intelligence, enhanced communications,* and *electronic access to library and research materials.*

Information Literacy

Faculty members who were interviewed exhibited the same anxiety about students using information obtained from unreliable sources on the Internet as did institutional administrators. However, it became apparent that the information explosion that enables a student to search *Google* and get one million hits on almost any subject that a professor might assign for a research paper is less of a problem created by the Internet than one that has been revealed by it. This notion of critical thinking – in particular the necessity of teaching students to critique sources for reliability – has always been a need, but the information explosion has raised its priority such that many institutions have

begun designing courses specifically for this purpose. The following interview passages illustrate this point.

> We've always had that problem. Students go online, and they say, well, I got this online – and you have to say well, what was the source. That part of the education system – that can start in the first grade. That's like when we had to help people determine the reliability of what's in the newspaper and television... [The Internet is just] another medium, but the problem is really about the same. The principle is having the ability to analyze and criticize information. (K. Bart, personal interview, January 24, 2006)
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> We're very concerned and focused a lot on information literacy. We actually have a couple of courses that we offer that are intended to help students to assess the quality of the resources they find. Going back in time, students used to go to the card catalog, and the microfiche, and now it's online. Let's go to Google and see what we can find that that's what we need...then students have to figure out is this really valid material. We provide instruction…showing them how to do the citations correctly, and how to really verify that the information source at the time is really a reliable one from that standpoint. So that's really a role that we have. (R. Goodyear, personal interview, January 31, 2006)
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> One of the skills that we develop as part of the TAC [Technology Across the Curriculum] program is information literacy, and we've also put an emphasis on courses that use software like EndNote to students to use the bibliographic references so the students know that you are not just supposed to be just taking a paper and importing it, but you are supposed to be building a paper from information resources. (J. Lockheed, personal interview, May 2, 2006)

Therefore, the problem of student research using questionable sources is one that the academy has recognized as a critical need, and is doing something about it. It is designing and adding courses on critical thinking. It is promoting information and visual literacy. It is supplementing or altering the curriculum to enable students to be more discriminating in their choice of sources, and to give them the ability to critically analyze the sources they use. This situation, therefore, instead of being a problem created by the profusion of Internet sources, is rather a true opportunity to achieve one of the true goals of higher education. It hearkens back to the comments quoted earlier from Harvard

President-Emeritus Bok, who opined that universities ought to measure themselves on their ability to teach students to "write better, speak more eloquently, think more rigorously, or reason quantitatively more proficiently" than before.

Course Management Systems

In response to the problems posed by the profusion of Internet sources, some faculty members prefer to exert closer control over the content of the academic material that students use in their classes. This might be no more than a professor passing out a syllabus with an approved source list, but the Internet and computer technologies do offer some tools that can make this task much easier, and can provide additional capabilities as well. These tools are known as Course Management Systems, and there have been a number of them developed in the past few years – *Prometheus*, *Blackboard*, and *WebCT* being perhaps the most well known of these products. Course Management Systems not only enable faculty to post lectures, readings, and syllabi on-line, but many often provide a portal for class discussion, for test administration and grading, and can supplement the course materials with video demonstrations and/or animation. Such systems can enable on-line courses, but are often used as an element of classroom-based courses as well.

Several interviewees noted that some Course Management systems were even available through open-source – that is, for free, as long as the institution had a computer platform on which to run the open-source software.

> One of the things that's happening in course development, and in many of these dimensions is that there are programs out there that are available basically for free, as long as you pay someone who knows how to run the system, on the Linux or whatever it happens to be on. And at the same time, the proprietary systems are increasingly costly…If you take a system like *Sakai* which says we think every institution should have access to no cost or low-cost Course Management tools, I think, one interesting question you could look at between developing nations – which are often, not always, but often resource poor – is whether or not they're

> opting to look at open source applications or whether they're going proprietary and just paying *WebCT*'s annual license. It depends on the size of your institution, but that is what it cost us. So, to me, that is an interesting question. As you are responding to the needs of clients: students, faculty and staff, you have resource drains particularly as you choose between proprietary stuff and more open source stuff. (J. Sierra, personal interview, March 20, 2006)

Other institutions have experimented with different options for Course Management, and some institutions have even written their own software.

> *Town Hall* is a kind of…it is a Web Crossing product. That was so faculty could have folders that they could start a threaded discussion. They can design and put assignments and syllabi up, and so on. And of course the product evolved, but we offer it because – we have several reasons – but here is *WebCT*. *WebCT* is huge. We have 14,000 seats a semester for *WebCT*. That's 700 courses and over 500 faculty. So it is really big. Our license for *WebCT* requires us to authenticate our global database. But no one can get into *WebCT* unless they are on our database. So that's what Town Hall does that *WebCT* doesn't – with *Town Hall*, you can self register. And the faculty member has the option when he or she sets up a folder of allowing guests in. But the real reason we offer it is because of these Course Management tools, and then it is a love-hate relationship. Either you really love it, or you really, really hate it. So for the faculty who hate *WebCT*, we say we have an alternative for you. It is a little bit less techie, a little bit less complicated and it allows you to do some focus group work if you want to invite faculty or speakers into a chat or a threaded discussion. You can do that without having to move heaven and earth to get them into a global database (J. Sierra, personal interview, March 20, 2006)

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> …then I started teaching composition, and we used *Daedalus* software…It's a Course Management software mostly for English people. Then another friend of mine who is now at UVA developed a cold-fusion driven Course Management program. That is, in fact, what he did his dissertation on, and he helped four of us. So we used that and commented on it, and he wrote his dissertation on how that helped to teach English composition. I really liked it. I continued to use it as long as I was there. [The advantage of this program over other Course Management programs for teaching English was because] it had a place where you could park papers and students could comment on them. It gave you a place where you could post a paper, and then a place where you could comment on the paper. I did a lot of group work with it, where students would read the papers, comment on the papers, peer-review, that sort of thing. I also used the chat feature to stimulate discussion on the topic. I had a lot of second language students in the class who are taking the class for their English, and they seemed to be more comfortable typing and speaking because of their accents, and so that worked out quite well…What I mostly used it for was for commenting on rough drafts and having students comment on rough drafts for peer-review. And then I did the

> same thing using the e-folio software that my friend designed for us, and it was specifically designed for us, because he had taught here for a while, and knew the problems we were having. We gave him ideas on how we wanted it designed and was very useful from that standpoint. I loved that software. They were able to upload their papers from home, so it was moving toward a paperless society. I kept records of all their papers, their drafts. (A. Nimorata, personal interview, March 13, 2006)

This profusion of different Course Management software options is driven by multiple factors: cost to the institution, institutional fit, faculty familiarity, and the fit of the tool with the course subject matter (as in the *Daedalus* example above). When such software, whether for course management or for supplementary or instructional materials, can be chosen among multiple options – especially when it is available for free – it is highly likely that the effect will be positive. The next section addresses such open-source options.

Learning Objects and Open Source Material

The next passage relates how these technologies build upon one another. Even if a school decides to spend the money to buy a license for a commercial Course Management System like *Blackboard*, there are a myriad of open-source options available for "learning objects" – individual lectures, presentations, and visual aids that have been developed through open source, are peer reviewed, and are available to be used by faculty members anywhere to supplement their classroom materials. *Merlot*[41] is one of many learning object repositories available on the Internet that faculty could use as potential course content resources.

> We really focus on two things – *Merlot* and its collection, and Dogwood, which is an internal little *Merlot* – learning object collection. So, we are bringing faculty in to help them use these kinds of tools in their *Blackboard* courses…*Merlot* is a national open source type of repository. So, if I see a site out there with a learning

[41] **M**ultimedia **E**ducational **R**esource for **L**earning and **O**nline **T**eaching, online at www.merlot.org.

> object in it that I think is really good, I can contact *Merlot* and I'd like to add to the collection now. The collection doesn't take that object. The objects stay at all the institutions where they were developed. All this does is do the metadata…It gets teams of faculty across the United States and Canada to peer review, to score them. So, what it's doing is – you know you talked about visualization – faculty don't have time to use one of the visualization tools, or there's nobody to help. You come to *Merlot* and there's already a visualization piece, it's already done. And you figure out how that'll work in your course for what you are trying to do. So, you build the lesson around the learning object...Everybody that puts everything in there has agreed that everybody can share it. There are thousands and thousands and thousands of learning objects. (K. Bart, personal interview, January 24, 2006)

Though much material is available for free via open sources like *Merlot, Sakai* (www.sakaiproject.org), and the *Wisconsin Online Resource Center* (www.wisc-online.com), faculty who have experience working in the on-line and technology enhanced environment caution that training and release time for faculty will be crucial to truly take advantage of these kinds of open-source materials.

> I feel very strongly that people use and who are using the Web for instruction need to know how Web page works and how to design one. *Blackboard*, for example, dumps everything into little boxes into all the junk code that Microsoft puts it – it is just paper on the screen – it's not designed for the Web, it's not written for the Web, it's not redesigned for the Web. I think that a lot of people are doing it without taking the time to learn the technology and how to do it well. They depend upon instructional designers – and we have very good ones – but instructional designers use a template, and that template may not be useful for what you are trying to do or for what you are trying to teach. You need to be comfortable enough while you're in classroom to go online and show them something. You need to understand it yourself and be able to use it yourself in order to use it properly. I think that is a real problem because it requires an investment of time and energy. (A. Nimorata, personal interview, March 13, 2006)

Hybrid Classes as an Alternative to Campus-Based vs. Distance Classes

As noted above, tools such as Course Management Systems and On-line Learning Objects can be a great boon to on-line education, but can also be used in the traditional classroom. Thus, materials and methods of instruction for on-line and classroom-based

instruction are merging. This is paving the way for what are called "hybrid" classes, which usually take the form of a blend of some classroom instruction and some on-line instruction. In theory, such hybrid classes can retain the advantages of face-to-face instruction while freeing up classroom space and enabling students and faculty to save commuting time for at least a portion of the clases.

Interviewees comments were almost uniformly positive about the potential for hybrid classes to make the best of both learning modalities – classroom and online – and some form of hybrid classes were being used at every institution where interviews were conducted.

> Right now we are in the process of providing all of our courses through technology of some sort. Technology hybrids and what we call a technology, organic conference. And organic is where we'll do online shared distance learning with asynchronous online and then if they have to do a performance or practical exercise that we have a certified organic at each campus… we're just starting to develop [our school's] first technology hybrid... where students are going to take a lesson on line using the electronic page turner and then they have to go for a week of facilitated online. (R. Dovins, personal interview, March 31, 2006)

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> We have to promote the hybrid courses, because where you used to have one class in one room you can now have two classes in one room. Again, you increase access – but you have to be very careful about student success. So you want to be sure that the development of these hybrid courses is done well. You kind of have to look at: what are your objectives, what are your goals…So, moving content online starts with someone just putting their home page up, putting their office hours or link to a syllabus. The next step is moving to put content online. So, from content, then it's communications. And then from communications, you need to go full-blown distance, full-blown hybrid. But I think many courses start as classroom face-to-face, with Web enhancers, and then from there they moved to hybrid and distance courses. And I don't think they all evolve that way ever…but there are very few courses now that don't have some Web element to them. (K. Bart, personal interview, January 24, 2006)

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> The biggest change that are seen in the last two or three years has been the faculty involvement in hybrid courses – from the standpoint of say, class meeting, one day a week of the classroom, and then perhaps being online, or doing other all off-campus kinds of things at people's home or office or whatever. And we found

> that that draws students for two purposes: first, we find students who have difficult schedules, who have to balance work and home responsibilities – single parents, things along those lines. And they can pick and choose their academic experiences, based upon their availability...So they can go online to do things. Second, I think it's helped us because the difficulty we have here is managing classroom facilities…It sort of maximizes your room utilization. (R. Goodyear, personal interview, January 31, 2006)

One other option is a "virtual hybrid" class, where two meetings were held on-line at the same time – synchronously – in this case using an on-line net meeting product called *Centra*, and the remaining classes are held in asynchronous fashion. Such combinations of on-line synchronous and on-line asynchronous classes enable the institution to widen access even more – reaching out to students separated by geography or other reasons.

> This year I've got two classes which are called *virtual hybrids* where we meet online at a specific time, two times a week – the rest is asynchronous. So in that case, I can give real-time help for the students, and we can also use what is called AppShare, where a student can actually in put things on my computer. So if I have a student who says I couldn't find a symbol for set intersection, I say, "Watch," or I say, "Here, you do it." "Toolbar, or click here, or move your cursor to the right." So they're able to get real-time feedback, real-time help through the software, which is something I couldn't do before. I can send them information, but I couldn't watch them do it. Now I can do in real time, and they can get real-time help…One of my present virtual hybrid students is now in Yugoslavia, and she is attending a net meeting from there. So, for a student, I don't care where he is as long as he has a good Internet connection. (D. Globus, personal interview, February 1, 2006)

With Internet and computer technologies changing not only access to information, but also the modalities of learning, what will be the impact on pedagogy, and educational quality in higher education? That is the subject of the next section.

Pedagogical Concerns, Learning Styles, and Educational Quality

Why are some educators convinced that the Internet and computer technologies offer the possibility for quantum-leap improvements in educational quality when other

technologies such as Instructional Television (ITV) have had such limited success? The answer is given in the following passage:

> Computers provide, for the first time in history, a key ingredient that was lacking in all the previous tools that raised high expectations when introduced in the educational system: **individualized interactivity**. From blackboard to television, the previous tools were presentation tools only. Computers, however, can not only present information with all the audio-visual expressive possibilities of television or film, but also can receive information from the user, and can adapt the presentation to the user needs, preferences or requests. (Osin, 1998. p. 3, Emphasis in the original)

This notion of *individualized interactivity* was understood by all faculty members interviewed, but not all interviewees were equally optimistic that this potential would be realized. Some faculty noted that their institutions had started slowly and improved in quality, other faculty reasoned that there were other forces at work which might be limiting the quality of higher education instruction using Internet and computer technologies. Some of the reasons offered were (1) the push for increasing enrollment numbers limited the effects that such technologies had on quality, either by increasing the class size or requiring instructors to teach more sections to keep up with the increasing numbers, (2) the increased use of adjunct or part-time faculty versus full-time faculty had an adverse effect on quality, and (3) the awkward nature of online conversations were a poor substitute for classroom discussions.

> I think it can offer a quality alternative to traditional classroom instruction. I think my students come out well. What is missing is the collaborative work. The opportunity for discussion is less. The weakest part is assuring quality, and one of the countervailing forces is that desire for higher enrollment numbers. I think one of the biggest problems is people who are not visual – who are auditory or tactile learners…it is easier in the classroom…and I am not sure that in many 3rd world countries that people are more visual, and that could be a problem in providing access and reaching those people. (N. Foley, personal interview, March 31, 2006)

> Every time I look at it the volume distance learning, one could say it is low quality – low quality in the sense that the vast number of professors are adjunct faculty. And there you are making the assumption – and perhaps it is an incorrect assumption – that full-time instructors are better than part-time instructors. That is a fascinating question in itself. All the high volume is in the tier four or lower tier of these schools, so that is one element of the class system. (S. Gehrig, personal interview, June 26, 2006)

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> I will tell you that my experience having taught an introductory graduate course in Education Policy by distance and by face-to-face for at least 3 years simultaneously – I taught it at least 3 years before – and the last 2 years I didn't teach it by distance…and my impression is that the only way in which the course was inferior by distance was by discussions. We used discussion boards, we posted topics. It took a huge amount of time for the professor to go in and be involved in those discussions…If you aren't in there all the time, they tend to go astray, they get off the topic, which …and they can reach conclusions that are wrong; [whereas] in a classroom session, if they start to get to something wrong, I'll ask some probing questions fairly quickly to get them back on track. (G. Zhang, personal interview, July 18, 2006)

The bottom line is that higher-education faculty are far from a consensus on the notion of whether these technologies increase quality. There is fairly consistent agreement among both faculty and administrators that these technologies will enable greater *access* to higher education, but an answer to the question on quality remains elusive. There are too many variable to consider, and furthermore the very definition of quality is often in dispute. One interviewee, however, believes that the burden to disprove this proposition should be on the shoulders of those who propose a return to less technological methods. He also notes that the changing character of education and the distribution of both good and bad professors make reliable quality measurements difficult, if not impossible.

> It would be hard to argue that technology isn't improving the quality of education, but it is hard to compare because education has changed so much in the last 20 to 30 years. Specialization has deepened, there is such a broad amount of information that students now have to know. It's just not "apples to apples" to compare a 1976 education to a 2006 education. So it is difficult to say whether or not the quality has improved, but since education has changed, technology has

> helped to support it in a very significant way; students get a high quality education with technology. (N. Atkins, personal interview, July 19, 2006)

Five Areas for Quality Improvement

Accepting the notion that technology *can* improve higher education quality, interviews also focused on determining which of five different areas would be most crucial in enhancing quality: content delivery, visualization, artificial intelligence, electronic communications, and electronic access to library and research materials. Interviewees were asked to rate the contribution of each of these elements to enhancing quality in their own classroom experience, and were asked to give additional detail about how they had made a difference.

Enhancing Content Delivery

Most faculty interviewees put *enhancing content delivery* at or near the top of the priority list for the impact of Internet and computer technologies in the classroom. Interviewees noted that this could mean anything from posting a syllabus on-line to extremely sophisticated methods of content delivery using simulations or interactivity.

> Enhancing content delivery is absolutely central, especially due to the fact that like many universities we are running out of space here, and we have no choice but to move to distance learning. There is an expectation that it will not just be "as good" but it will be better than what is done in the classroom. I think that puts an extra burden on us. I would hate to have as my goal to be "as good" as my colleagues teach in the classroom, or as I teach in the classroom. My goal is to be better than I ever would have been in the classroom. There is really no reason not to.…I think that with the Internet and all the other online resources, you can make use of those and make it a more rich and broad experience, versus the classroom where my feeling is that here is a book from this and such country. Now you can send them and they can read anything they want to about it, and they can interact with it in a lot of different ways…all of the resources that you can never bring into a classroom no matter how hard you try…One of our primary objectives is to enhance content delivery. (N. Atkins, personal interview, July 19, 2006)

The previous passage speaks to the "paradigm breaking" aspects of the technology. The very presence of such a new technology poses a challenge to those who use it to try to go beyond present boundaries. Those who recognize this and accept the challenge are more likely to find ways to use the technology to improve quality. Of course, faculty can always go out and find additional resources and ways to enhance their courses, but technology enhanced content delivery gives them an additional means to do so that is new, fairly easy to use, and, with the open sources now available, such resources are more often than not free of charge.

An interview at the Federal Institute for Military Contracting, a federal government training institution self-described as a "corporate university," revealed that electronic content delivery can enable an institution to do more within its resource constraints, particularly when teaching a standard or near-standard curriculum is the institution's goal.

> Enhancing Content Delivery – In particular for [this institution], since it is a corporate university, this is absolutely critical. And you indicated you had looked at our Annual Report. What you see in there is our ability to meet a growing demand of students, of need, basically with a constant budget. It's only been possible through an online environment. There is no way in the world that we could have done similar work with a constant budget and have increased resident course work. What we have focused on doing is refining our approach, and I think what our mission or goal is as a corporate university is different from what an academic university would be, particularly in this area. Our focus is in a couple of things: You see us talking about learning at the point of need. In a corporate environment that is, I think the major focus of the corporate environment…So our focus in the corporate environment is much narrower than what you have in the university environment. With that, we have found, and this is not shocking – learning decay…So, if I can give them that learning, that material, just prior to their need, I can give it in a very focused way – they can demonstrate it and with that demonstration, I believe they will increase the duration of the learning. So the utility of the learning and the duration is increased the closer I can give it to the point of need – just in time learning, as you have said. I can do that with a distance environment. I can't do that as nearly as effectively in a resident environment...So, in terms of content delivery, the

> distance environment is optimal for a corporate university – absolutely optimal for a corporate university. (B. Huron, personal interview, January 13, 2006)

Finally, electronic content delivery is often the entryway for most faculty into the use of the Internet and computer technologies for the classroom. The first step is usually posting the class syllabus on a web-site or a Course Management System. This has already become an expectation of most students in any course, classroom or otherwise.

> The first thing that I put on the Web was content delivery – providing the syllabus to students through the Web – and I thought that was great, because I thought it was so practical. Especially in this area where more than 80 to 95% of students have access to the web... that was five years ago with Web access wasn't as common as it is now – now I think the percentage is probably around 100%. So I think it is very easy for them to get the material that way to get access that way – so I think it is wonderful. (A. Nimorata, personal interview, March 13, 2006)

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> I think enhancing content delivery is the way most people get started. Looking at ways of helping students learn their content more effectively. (K. Bart, personal interview, January 24, 2006)

Visualization and Artificial Intelligence

Most interviewees felt that visualization and artificial intelligence belonged as subsets of *content delivery*. These two areas were deemed to be among the most advanced uses of technology, and were, accordingly, the least used to date. Of the two, visualization was more prevalent, being used in some cases to promote understanding of highly visual subject matter – science, engineering, and the arts – and learning objects were being made available through *Merlot* and other repositories to fulfill these needs. But, these two categories were not considered to be contributing a great deal to the improvement of quality in higher education, according to the faculty interviews.

> For example, you talk about visualization. If you're going to be teaching any of the sciences, allied health, where you need to get a three-dimensional look at something that's moving etc.... you don't have time to make models yourself. But you could do it on the Web. Mathematics – you could do all kinds of formulas.

> You could use the *Centra* product where the teacher is doing it and everybody's watching it no matter where they are, and interact. History – with history, you can do all kinds of case studies. You can go and hear Martin Luther King doing speeches...and the Web removes you from being the only expert, for courses done well. You're sending the students out to hear the voices of other experts. And then having to figure out what their voice is on the subject. (K. Bart, personal interview, January 24, 2006)
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> The 'enhancing the visualization' of academic material – in a few fields, you know, particularly in the sciences and some of the math might be taking advantage of that…learning that it can, finding the material and incorporating it into their courses…but I'm not sure that's a big piece of it...I think more and more faculty are learning how to do that and how to integrate – a much deeper place to go for the material, particularly the online courses that we develop, and the faculty who use the internet to supplement their courses, to enhance their courses. They will do that; they will use very good material and take students way beyond what they could do just with the textbook. (M. Brock, personal interview, January 24, 2006)

For uses of artificial intelligence, interviewees thought that it would require a lot of cost and effort before it was useful in a substantial way. Standard, high volume curricula would derive the benefit before other types of classes.

> No one is really screaming for artificial intelligence at this point…Instructors are still your best intelligence…I don't see that as a primary objective. You'll see a lot more of it in training before it comes to higher education. Business can afford it. Businesses have the repetition that will make it useful. The military will probably have it first and foremost. But again they have the repetition that we don't have in higher education. (N. Atkins, personal interview, July 19, 2006)

Enhanced Electronic Communications

Most faculty rated electronic communications as an important facet of improving the quality of their courses, often placing it second or occasionally third in priority behind electronic content delivery and electronic access to libraries and databases. But, the use of email by faculty was almost a given in many situations. Quoted earlier was a passage that spoke to student expectations that faculty would be users and responders to student email. If a certain faculty member was known to be lagging in this aspect, it would result

in fewer students wanting to take his or her class. But, another interviewee pointed to both positive and negative aspects of the frequent use of email as a communications medium with students.

> I think clearly faculty members love and hate email. You can do things with it you couldn't do before, but before you limited your office hours to certain hours, and whoever got to your door then made use of the time. Now everyone expects office hours to be 24/7. On the other hand, if a student asks me a good question by email, I'll copy the question and my response to everybody in the class. And it is a wonderful way of sharing what otherwise would have been – I would have to write that down and cover it in the next session of the class, and sometimes I would, sometimes I wouldn't…There is that factor, particularly in a graduate program where our graduate students don't live on campus, they are all scattered, and nowadays most graduate programs are part time with students working, so I think it facilitates communications with them. (G. Zhang, personal interview, July 18, 2006)

One faculty member related how she used email as a means to keep the development of a student's research paper in two distinct categories – formal and informal – while enabling her to establish quality control gateways during the student's writing process.

> In my Comp 2 class I have a lot of students commenting on each others work. They do a couple of *listserv*s, then they have to email me a thesis, and they can't proceed until I've commented and approved. And then they write a draft…and they can't publish until I've commented. So the only grade they get is on the final. [Interviewer question: "So you have gateways along the way for quality control?"]…Yes, and that prepares them for the writing process and what they are going to do. The informal part is kept informal, and the formal part is kept formal. (N. Foley, personal interview, March 31, 2006)

This creative use of electronic communications is the kind of thing that can make a big difference in the quality of higher education for students who are lucky enough to be in a classroom with a skilled faculty member who knows how to use the tools very well and is committed to excellence in teaching. But, not all faculty members are equally skilled or equally committed, as one interviewee points out. The ability to effectively use

the tools available is heavily dependent upon the skill and commitment of the individual faculty member.

> At every university you're going to have a few bad professors, a few bad courses, people who chose the wrong profession to go into teaching, and should not be there. And these people will show up online too. They are not concerned, they are not there for the students, they are there for some other reason, and it's probably about the same number on line than it is on campus. If it is 10% of our campus faculty it is probably 10% of our distance faculty at the university that should not be there. (N. Atkins, personal interview, July 19, 2006)

Electronic Access to Libraries and Databases

Returning to the notion of the profusion of sources available for research – one way in which quality of sources is assured is by the use of peer reviewed journals and databases. In the past, this meant a search through bound periodicals at the campus library, perhaps aided in the search by a periodical index, but no longer; all U.S. universities researched as part of this dissertation have electronic access to libraries, electronic journals, and electronic databases. As noted in the previous chapter, a surprising number of institutions in low and middle income countries are also gaining such access. Since the cost for such electronic subscription services can be high, the decision to make such electronic databases and journals a part of a low-to-middle income country institution's budget is a strategic step in the direction of greater technology use. Is such a step warranted? Will access to electronic journals and databases improve the institution's quality and create more well-educated graduates? The consensus of faculty interviewed for this dissertation was a resounding "Yes!" Faculty felt that the use of such resources would enhance the quality of student research, in contrast to students using a commercial search engine, where the quality of the resources encountered was doubtful.

> Library and research materials: I love it. It has totally changed the way I teach how to use library. I ask students to research using subscription databases all the

> time. I think it is very unfortunate that most students don't use databases. What they usually do is go to Google or Yahoo. And I do that too, but I do go to the databases to get more refined stuff. Also, because a lot of students are not very good at figuring out which web sites are worth looking at. (A. Nimorata, personal interview, March 13, 2006)
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> Another resource we have is called LRC online – it's a real-time reference tool. Students log into a web site, and you have an actual librarian who's logged in at the other side who is able to answer questions for them. So, that really enhances access to the library and research materials. (R. Goodyear, personal interview, January 31, 2006)
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> Access to library and research materials – yeah, I think that will continue to be a primary objective. As far as where people are putting their resources, for a lot of journals it is more expensive to put on line than it is to get the paper. Libraries that are already short on budget are struggling to find out how they are going to manage this. Students are relying upon it more and more. I saw a survey a few years ago; it said 80% of students are using online sources instead of going to the library. (N. Atkins, personal interview, July 19, 2006)
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> I think that, to me, the number one is probably "E." [electronic access to libraries] Now, interestingly enough, the community college is interesting because that's the world people live in, and it's a high priority. But I'm not sure how good a job we do at training our students to do that. But we do provide a lot of access – electronic access to materials. (S. Garvey, personal interview, November 10, 2005)

Classroom Perspective: Conclusions

Lessons from the Evolution of Internet and Computer Technology in the Classroom

It became clear through the interviews that there was an evolution unfolding in the experience of higher education faculty at U.S. institutions. Figure 32 illustrates this evolution. In each category listed at the top of the diagram, from "Course Content Delivery" at the top left to "Access to Library and Research Materials" at top right, there was a progression that took place from simple to more complex applications of Internet and computer technologies.

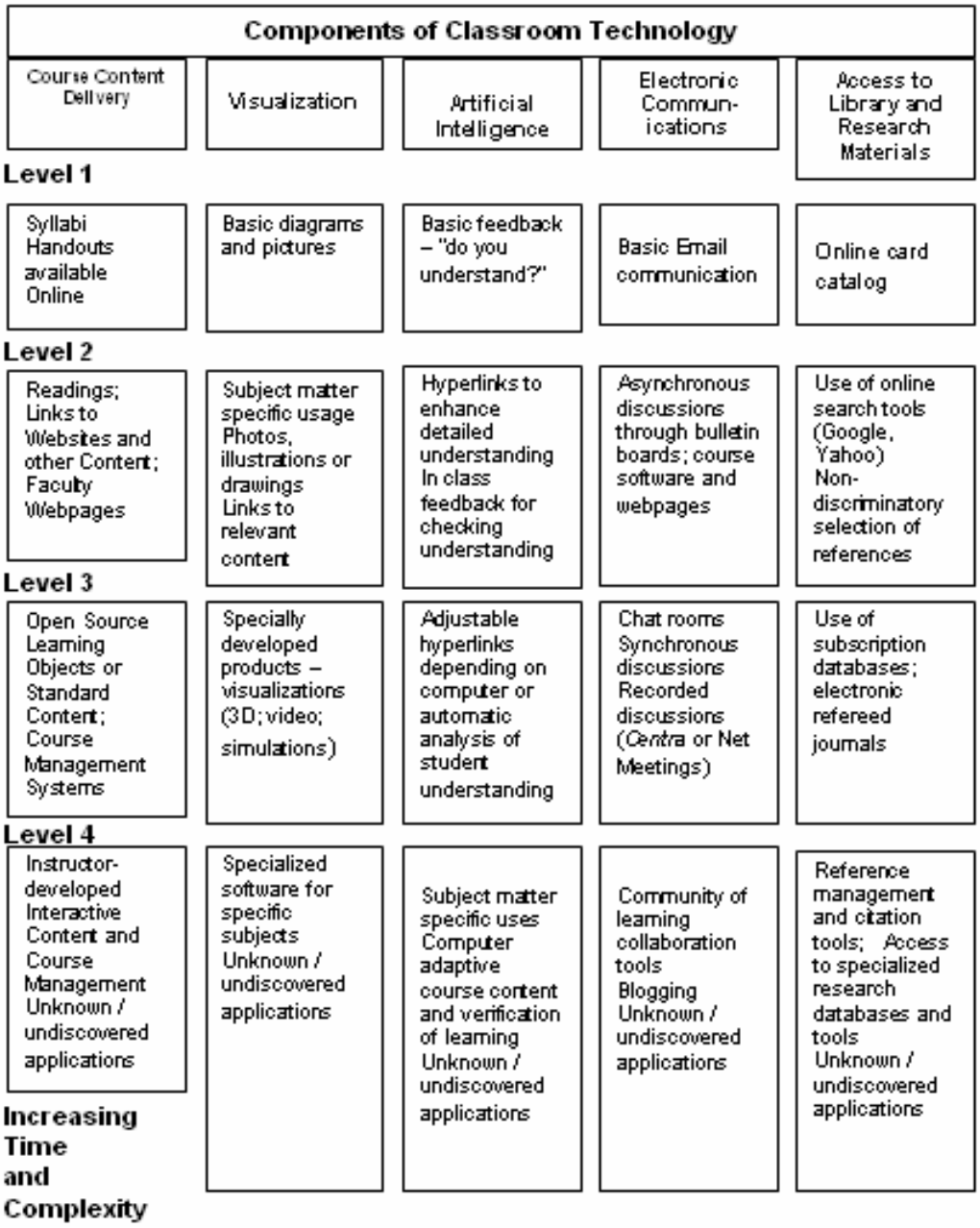

Figure 32: Evolution of Internet and Computer Technology in the Classroom

Interviews elicited that most faculty had begun enhancing classroom content by simply putting their course syllabus on-line. Now, faculty at many U.S. higher education institutions are becoming comfortable using course management systems, visualization-based learning objects, student-to-instructor email communications, electronic classroom

discussions, and research using on-line databases such as *ProQuest* and *EBSCOhost*. Faculty at institutions in low-to-middle income countries are likely to follow a similar evolution in technology at the classroom level, with one major difference – they can learn from the experience of faculty in high-income countries who have already experienced this evolution. To the extent that higher education faculty members in low-to-middle income countries are able to apply such lessons, they will be more successful in enhancing quality.

Differences and Similarities Among the Different Institutions

Table 27, below, illustrates that the institutions where interviews were conducted are similar on some dimensions, but are quite different from one another in many ways – in the use/non-use of a standard curriculum, in student demographics, in admissions policies, whether *quality* or increased *access* is the primary criterion by which the institution measures itself, the presence/absence of an explicit institutional hierarchy, and the number and type of institutional competitors. Since the institutions are so diverse on these measures, they represent a good cross-section of institutional models, and thus provide some foundation for a conclusion that the results could be generalized to institutions in other countries. For example, as noted in the comments earlier, *all* institutions agreed that *electronic content delivery*, *electronic communication*s, and *electronic library and database access* were contributing positively to increases in quality at the classroom level – and the figure above (Figure 32) shows that there is an evolution taking place in which more and more is being done in each of these areas in all institutions.

Table 27
Characteristics of Internet and Computer Technology at Five Different Institutions

Institution and Institutional Model			Institution				
			Coastal Community College (CCC)	Coastal Community College Online Learning Institute (OLI)	James Monroe University (JMU)	Federal Institute of Military Contracting (FIMC)	Midas University (MU)
			Community College	Internet Institution	State University	Corporate University	Private University
	1	Standard Curriculum	No	Yes	No	Yes	No
	2	Geographically Dispersed	Yes	Yes	Yes	Yes	Yes
	3	Large Student Population	Yes	Yes	Yes	Yes	No
	4	Hierarchical	Yes	Yes	Somewhat	Yes	No
	5	Quality of Incoming Students	Open enrollment	Open enrollment	Yes	Yes	Yes
	6	Diffusion is Mandated from Above	No	Yes	No	Yes	No
	7	Diffusion is a Partnership	Yes	No	Yes	No	Yes
	8	Increased Access is Primary	Yes	Yes	?	?	No
	9	Qualilty is Primary	No	No	?	?	Yes
	10	Competitors in Delivering Content	Many	Many	Many	Limited	Limited
	11	Professors Accept Technology Diffusion	Yes, due to mission need and student population	Yes, by design	Depends on the Professor	Yes, by design	Depends on the Professor
	12	Responsibility for Learning	Shared (student/faculty)	Student	Shared (student/faculty)	Student	Shared (student/faculty)
5 Dimensions of Internet/Computer Technology	13	a. Electronic Content Delivery	Yes	Yes	Yes	Yes	Yes
		b. Visualization	No	Yes	No	Yes	No
		c. Artificial Intelligence	No	No	No	No	No
		d. Electronic Communications	Yes	Yes	Yes	Yes	Yes
		e. Electronic Access to Libraries	Yes	Yes	Yes	Yes	Yes
	14	% of classes online / total classes	20-40%	≈ 100%	Some (5-10%)	>50%	Some (5-10%)
	15	Types of content delivered	Syllabus, Lecture, Course Management System, Quizzes, Discussions, Readings	Syllabus, Lecture, Course Management System, Quizzes, Discussions, Readings, Links, Case Studies, Simulators	Syllabus, Lecture, Course Management System, Quizzes, Discussions, Readings	Readings, Visual Information, Quizzes, Custom Course Management, Certificates, Case Studies	Syllabus, Lecture, Course Management System, Quizzes, Discussions, Readings
	16	Synchronous or Asynchronous	Asynchronous	Synchronous or Asynchronous	Asynchronous	Synchronous and Asynchronous	Asynchronous

CHAPTER VIII

CONCLUSIONS

General Conclusions

The central question of this research, whether use of Internet and computer technologies will enable higher education institutions in low-to-middle income countries to close the *access* and *quality* gaps with higher education institutions in high-income countries, is not one that can be answered without some degree of equivocation, since much depends on decisions that must be made in order to maximize the potential of these technologies. Notwithstanding these "what ifs" and caveats, the following general conclusions are offered from the weight of the evidence uncovered:

Harvard is Harvard, and will remain Harvard. What this means is that it will be very difficult, if not impossible, for institutions of higher education in low-to-middle income countries to ride the wave that Internet and computer technologies offer, and hence break into the club of the truly elite institutions. There are many, many aspects that have not been covered in this dissertation that contribute to the making of such institutions: historical factors, Nobel-laureate faculty, generous alumni giving and large endowments, world-class research facilities, connections to government and large corporations, and students who are chosen from the highest levels of achievement in high school. However, through judicious use of such technologies, application of lessons learned from other institutions, and crucial enabling steps at all three of the levels of the analysis in this dissertation – national, institutional, and classroom – it will be possible for lower tier institutions in low-to-middle income countries to move up and become

truly competitive middle-tier institutions. These institutions will also be able to meet the needs for greater *access* from a growing number of higher-education aspirants in these countries.

This dissertation examined the question at three different levels – national, institutional, and classroom. Success or failure depends on what is done at each of these levels. The decisions that governments, institutional leaders, and professors make will ultimately decide whether these technologies can make a difference in *access* and *quality.* At the national level, leaders must do the most they can to promote greater Internet availability and use. In some cases this means telecommunications deregulation and privatization, in other cases, it means focused aid to the telecommunication sector or promotion of local Internet centers. In still other cases, it may mean promotion of an export oriented economy focused on high technology, and education of the national workforce for such an economy. At the institutional level, it means leadership that supports the institutional innovators, and that has ways of catalyzing institutional diffusion of these technologies. This requires experimentation and a toleration of missteps along the pathway, while remaining focused on the overall goal of using technology to improve the institution. Experimentation and a willingness to try new things will also be necessary at the classroom level.

Access is easier to affect via these technologies than is institutional *quality*. First, access is easier to measure, and second, there seems to be little controversy about what constitutes access. Quality, however, is a different story. There is no universally accepted definition of quality in higher education. University *outcome measures* are being debated, but are not yet a reality. The learning gained from one's experience at a university remains an elusive variable. On some metrics that purport to measure

institutional quality (e.g. use of full time vs. adjunct professors, amount of class time spent in classroom discussions, amount of time the professor is personally available to students, both in and out of class) the emergence of Internet and computer technologies may actually be causing quality to decline. Conclusions about the effect of these technologies on higher education quality are therefore highly dependent on which metrics are accepted to be the most reliable indicators of institutional quality. But, as shown in the discussion of institutional websites and the comparisons of institutional rankings, the use of technology is being viewed more and more as a criterion for institutional quality. The more successes that are demonstrated through the use of these technologies, the more likely will be their acceptance as indicators of higher-education quality. Students (and faculty) will begin to flock to those schools that advertise their robust use of technology through their institutional websites.

To achieve these goals, effort makes a difference. The results of interviews with administrators and professors emphasized and underscored this point clearly. A good, committed teacher armed with a toolkit of technologies to work with can become a better, or even a great teacher. A mediocre teacher may remain mediocre, or worse. Strong leadership also makes a difference. This is true at every level. National leaders who resist corruption, and who promote competition in the telecommunications marketplace, prepare their countries for the technological advances that will prepare their societies for success. University presidents set the tone and the direction for the institutional community. Their leadership is collegial, so it cannot be effective without the cooperation of the institutional administration and the professoriate. In the classroom, outstanding teachers set the bar for others to follow. If they can productively use

technological tools, and can demonstrate to their colleagues that such use can lead to higher efficiency and effectiveness, then they will be effective leaders as well.

Technologies are *tools* – and, in the case of some of the tools addressed in this dissertation – they may be available for free or at a minimal cost. But, like all tools, they are most effective when used properly, and when properly maintained. Lack of training in their use will also degrade their effectiveness. This is a big challenge in the low-to-middle income country environment. Merely adding equipment without training and maintenance is a prescription for failure. The early enthusiasm which accompanied many projects in low- to middle-income countries has given way to skepticism. Such skepticism is productive if it leads to better planning, but is unproductive if it results in throwing the baby out with the bathwater.

But nothing is a foregone conclusion. The countries of South Korea and Ghana had approximately the same economic performance in the early 1960s. One country followed a path that led to economic dynamism, and the other followed a more stagnant path. The choices that a country makes, that an institution makes, and that an individual faculty member makes all have an impact on the ultimate utility of these technologies for higher education.

Application of the Research to Low-to-Middle Income Countries

One of the conclusions above noted that a number of "development" projects in low-to-middle income countries were embraced initially with enthusiasm, but the lack of quantifiable results later led to skepticism. Some of the fault of such projects may be due to the inappropriateness of the technologies or techniques used – which may have worked in developed countries, but which ignored the different conditions and cultures of

developing countries. This makes it important to ask if the results from this study would be applicable to apply to low-to-middle income countries.

For the institutional and classroom levels, all of the interview research was conducted at institutions in the United States – at five institutions in the Northern Virginia/Washington DC area. It was noted in the previous chapter that, even though these institutions were quite diverse in their mission, governance, faculty, and student bodies, interviewee responses were consistent in relation to an evaluation of the ability of Internet and computer technologies to lead to increases in higher education quality through *enhanced content delivery*, *enhanced electronic communications,* and *electronic access to libraries and databases.* This consistency of response, even under very different institutional models, lends weight to the argument that the lessons would also be applicable to institutions in other countries.

Some interviewees also had experience in assessing the transfer of technologies to developing countries, and were able to offer their comments about the transferrability of the lessons learned by institutions in high-income countries.

Leapfrogging

Development theory includes a concept called "leapfrogging" – this idea is meant to indicate that it is possible for technological lessons to be learned and applied more readily in developing countries and may enable those countries to outperform the countries where the technologies were invented. This is possible when two conditions exist: (1) there is opportunity for the developing countries to apply lessons learned from early applications in early-adopter countries, to follow highly productive paths, and to avoid the mistakes made by the early adopters, and (2) when *infrastructure* is part of the

technological solution, those countries which have little or no infrastructure may be at an advantage because resources can be spent to acquire the most modern infrastructure rather than using old or outmoded infrastructure, which may be the case in other countries. Interviewee comments confirmed these observations and noted that there are things that low-to-middle income countries can do to maximize the impact of these technologies.

> My overall comment, or impression – not impression – research, in terms of a lot of developing countries is that they are skipping over a lot of development…and going straight forward. And one of the benefits is they don't have a lot of baggage. They can go straight at the thing; they can take advantage of it. They can link the Internet of whatever to the biggest libraries and the biggest university systems anywhere. They have access to that. And therefore they are not having to spend their time or their energy or their resources on building libraries. That is one example. (M. Brock, personal interview, January 24, 2006)

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> In terms of national infrastructure, it hasn't been a problem. Maybe there have been some limitations in terms of high bandwidth delivery of videos, but we were even doing audio delivery pretty effectively five years ago. In other countries, some of them seem to leapfrog us – some of them are already on high speed, but some of them are still on low speed modems. My understanding in developing countries is that at least low speed modems are ubiquitous where you have telephone lines, which may be in part of a developing country, usually in the cities. (G. Zhang, personal interview, July 18, 2006)

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> I was in Panama in January, and the entire country was wireless – there was basically nowhere I could go that I couldn't use my computer. Isn't that amazing? On the other hand, I was in Guatemala a few years ago, and the teachers were trying to strike, and the government was intercepting their cell phone calls anytime they tried to organize a strike. It turned out that very few teachers knew how to use the Internet and very few teachers had access to the Internet. And that was true in Honduras too. I was in Honduras last summer, and the phone system has never been good and all they have is dialup for internet access, and it is not reliable. So it is a mess. Then you go to Panama and you say "Wow!" [Interviewer question: What did they do right that the others didn't do?] They would say a number of things: good roads, drinkable water everywhere in the country, and then once they had the canal and the free trade zone, they have

> the income stream for the country that can support the infrastructure. (N. Foley, personal interview, March 31, 2006)

Low to Middle Income Countries: Some Unique Challenges

Another unique aspect of low-to-middle income countries' higher education is the prevailing use of the rote learning model. Over the long term, such pedagogical models would need to be modified in order to improve higher education quality, but as one interviewee noted, *access* to higher education would be easy to achieve using this model.

> So, we see when international students come to the US, they are intimidated by the US style of graduate education, where they are expected to ask questions. They are expected, sometimes even challenged. Probably 70 or 80 percent of my students have been international students, and they adapt pretty quickly, but what I want to say is that is not the norm for education either in the US or other countries – the norm is "stand and deliver." And that is really easy to do on the web. You don't even have to have the video, you can do it with written materials. I've seen people who have 20 page lectures for every class meeting, and when I've used it, I've had about a two page lecture that sort of supplements the reading materials – books are essentially a lecture, too, and they are a one way media just like a lecture hall is. [Interviewer question: "That solves the access problem…what about quality?"] I don't think you lose much quality doing "stand and deliver" by web. (N. Atkins, personal interview, July 19, 2006)

Another interviewee reasoned that preparation for critical thinking-type teaching using Internet and computer technologies needs to start much earlier than higher education. Lessons learned in high-income countries at the K-12 level will also need to be transitioned to low-to-middle income countries to maximize the impact of Internet and computer technologies in higher education.

> This is a growing trend, where we've seen the shift in education, but the students are coming to us for help – the classroom environment at the K-12 level. They know how to sit at their desks and take notes; they don't necessarily know how to be independent learners in an online environment…We are definitely putting a lot of effort into becoming better instructors in an online environment. Now it is time to help students to come up with strategies…We are making a lot of progress in understanding how students learn in an online environment. And hopefully what we learn here will transfer over to developing countries so they don't have to go through the same process. (N. Atkins, personal interview, July 19, 2006)

The result of both faculty and staff interviews is that the lessons learned from the technology applications in high-income countries do have some applicability to institutions in low-to-middle income countries, but that every institution will have to make its own assessment of the ultimate applicability of those lessons. Given that both high-income country institutions and low-to-middle income country institutions are struggling with many of the same problems – accommodating greater enrollment and access, teaching students to be critical thinkers and to evaluate sources for reliability and credibility, learning to present materials using the most efficient and effective media, and encouraging more effective communications between students and faculty – the lessons learned by institutions in high-income countries will be valuable to institutions in other countries who are faced with these same challenges.

More than any other group, the professoriate controls the *quality* of the institution. Accordingly, the professoriate should involve itself in the application of Internet and computer technologies at the classroom level to ensure quality in instruction is achieved. Faculty at institutions in low-to-middle income countries can do this in the following ways: (1) by seeking to learn lessons from their faculty counterparts in high-income countries, (2) by actively promoting *critical thinking* and *information literacy* skills in the institution, and (3) by learning to use the technology in the most effective ways to meet their own particular teaching style. All of the above require an investment of time and energy. All can be improved by enabling cross-fertilization efforts of faculty in high-income countries and those in low-to-middle income countries. All should become factors in how faculty members are recruited, hired, evaluated, and promoted.

Limitations of this Study and Further Research

All predictive studies suffer from the same limitation – the results all depend upon decisions that are made by people whose actions influence the ultimate results. Since predicting human behavior is among the most intractable of problems, the results offered in this dissertation are limited in that respect. This dissertation is also limited in its assessment of the technologies in question – Internet and computer technologies. Since these technologies are among the fastest growing ever devised by man, it is unknown if some future development will be discovered that will render all the predictions of this dissertation moot.

In addition to these limitations, in this dissertation there are some questions that have begun to be explored but which remain unanswered, some of which might be fertile ground for further research, such as:

- What are the main predictors of successful integration of Internet and computer technologies at an institution?
- What is the correlation between the type of pedagogy and success/failure of the use of these technologies?
- What is the optimum mix of classroom time versus on-line time for hybrid courses?
- What differences in Internet and computer technology use are necessary for standard-curriculum type courses versus seminar or discussion-based courses?
- How can the quality of discussion be enhanced by these technologies for seminar and graduate-level courses?
- What are most appropriate metrics that might be used to assess the quality of instruction when using these technologies?

A Final Word

In the Bible, the first chapter of Ecclesiastes states, “There is nothing new under the sun.” Is there indeed nothing new about Internet and computer technologies? At the core, the answer is “no” because anything that is being done via Internet and computer technologies can be and has been done in different, less technological ways – lectures, blackboards, discussions, writing assignments, and through laboratory or practical exercises. Perhaps the first pioneer in the field of pedagogy, Socrates, taught his students just by sitting with them and dissecting their assertions – challenging them to be better thinkers. Though Socrates was able to do this in an austere environment, does this mean that similar results could be obtained today? Probably not, considering that today’s student has so many more expectations about higher education than those students who learned at Socrates’ feet. But, the lessons of Socrates are equally valid for this dissertation, and perhaps more so. Among the most resounding themes encountered during interviews with higher education administrators and faculty was the need for an increased emphasis on *critical thinking* and *information literacy* as part of higher education. Socrates taught this through his dialectical methodology. The academy must do so by giving students (and faculty and institutional leaders) the ability to discriminate among the profusion of sources available today, mostly brought about by the very technologies that are the subject of this dissertation. More information does not necessarily mean more learning. But, through leadership and scholarship, it can lead to that result, and can offer an opportunity for a quality higher education to many more students than was possible in the past, even in the poorest parts of the world. Such a result would truly be progress.

APPENDIX A

Results of Regression Equation
Internet Users / 10000 Population
Predicted vs. Actual

Country	Predicted	Actual	Actual - Predicted
Albania	172	35	-137
Angola	-452	33	485
Argentina	1085	1,120	35
Australia	4660	4,985	325
Austria	3922	4,123	202
Azerbaijan	206	375	169
Bangladesh	-584	16	600
Belarus	2137	793	-1,344
Belgium	3782	3,333	-448
Bolivia	192	333	141
Botswana	1598	313	-1,286
Brazil	1245	851	-394
Bulgaria	2026	768	-1,258
Cameroon	-231	41	272
Canada	5330	5,265	-66
Chile	2737	2,383	-354
China	795	473	-322
Colombia	1006	482	-524
Costa Rica	1752	2,222	470
Cote d'Ivoire	9	61	52
Croatia	1996	1,753	-243
Czech Republic	1710	2,524	815
Denmark	5195	5,200	5
Dominican Rep	793	357	-436
Ecuador	324	434	110
Egypt	400	304	-95
El Salvador	689	484	-205
Estonia	2548	3,171	623
Ethiopia	210	8	-202
Finland	4993	5,096	103
France	3680	3,167	-514
Georgia	634	134	-501
Germany	4246	4,146	-100
Ghana	382	90	-292
Greece	2557	1,624	-934
Guatemala	136	360	224
Haiti	-235	103	338
Honduras	168	268	99
Hong Kong	4091	4,230	139
Country	**Predicted**	**Actual**	**Actual - Predicted**

Country	Predicted	Actual	Actual - Predicted
Hungary	2171	1,584	-587
Iceland	4939	6,736	1,797
India	96	166	70
Indonesia	-166	386	552
Ireland	3547	2,878	-668
Italy	2869	3,455	586
Jamaica	1022	2,308	1,286
Japan	3830	4,518	688
Kazakhstan	539	162	-376
Kenya	-353	133	486
Korea	2759	5,613	2,855
Latvia	1549	1,292	-257
Lithuania	1874	1,351	-523
Luxembourg	4909	3,819	-1,090
Madagascar	-449	36	485
Malawi	-6	25	31
Malaysia	1456	3,454	1,998
Mauritius	1531	1,026	-506
Mexico	874	1,030	156
Moldova	478	349	-129
Morocco	504	248	-255
Namibia	1298	294	-1,004
Netherlands	4818	5,190	372
New Zealand	4535	5,021	486
Nicaragua	52	184	132
Nigeria	-457	34	490
Norway	5134	5,084	-50
Pakistan	-34	111	146
Panama	736	429	-307
Paraguay	-204	185	389
Peru	929	992	63
Philippines	320	456	136
Poland	1629	2,295	666
Portugal	3032	2,000	-1,032
Romania	698	800	102
Russia	1160	410	-750
Senegal	141	113	-28
Singapore	4245	6,563	2,317
Slovak Republic	1373	1,598	225
Slovenia	3161	3,750	589
South Africa	1205	736	-469
Spain	3744	1,614	-2,130
Sri Lanka	466	105	-361
Sweden	5290	5,758	468
Switzerland	4880	3,600	-1,280
Tanzania	-87	24	112
Thailand	642	778	136
Country	**Predicted**	**Actual**	**Actual - Predicted**

Country	Predicted	Actual	Actual - Predicted
Tunisia	1197	532	-665
Turkey	1210	761	-449
Uganda	-306	47	353
Ukraine	962	180	-781
United Kingdom	4628	4,230	-398
United States	4786	5,826	1,041
Uruguay	2016	1,212	-804
Uzbekistan	569	112	-456
Venezuela	476	538	62
Zambia	-90	53	143
Zimbabwe	35	420	385

APPENDIX B

Interview Protocol: Institutional Administrators

1. What are the major technology initiatives at the university today?

2. For technology initiatives related to academic objectives, how would you rate the importance of the following objectives?

    a. Enhancing content delivery
    b. Providing for Visualization of Academic Material
    c. Use of Artificial Intelligence to Gauge and Enhance Learning
    d. Enhanced Communications through Email, Chat, and other Electronic Communications
    e. Access to Library and Research Materials

3. From what level do you find the most support or impetus for the introduction of these technologies? How does it manifest itself?

    a. University administration and leadership
    b. The professoriate
    c. Individual departments
    d. Students and alumni
    e. Potential Employers
    f. Competing Schools

4. From what level do you find the most resistance or skepticism about the use of such technologies? How does it manifest itself?

    a. University leadership
    b. The professoriate
    c. Individual departments
    d. Students and alumni
    e. Potential Employers
    f. Competing Schools

5. For academic institutions that are challenged by increasing enrollments and level or declining budgets, do you see technology as an ameliorating influence or one which will not be able to alleviate this pressure?

APPENDIX C

Interview Protocol: Faculty

1. Are you presently using Internet or computer technology in any way with your classes or research? Describe.

2. From your experience as an instructor, how would you rate the importance of the following objectives for Internet and computer technology on higher education quality:

    a. Enhancing content delivery
    b. Providing for Visualization of Academic Material
    c. Use of Artificial Intelligence to Gauge and Enhance Learning
    d. Enhanced Communications through Email, Chat, and other Electronic Communications
    e. Access to Library and Research Materials

3. From what level do you find the most support or impetus for the introduction of these technologies? How does it manifest itself?

    a. University administration and leadership
    b. The professoriate
    c. The departmental administration
    d. Students and alumni
    e. Potential Employers
    f. Competing Schools

4. From what level do you find the most resistance or skepticism about the use of such technologies? How does it manifest itself?

    a. University leadership
    b. The professoriate
    c. The departmental administration
    d. Students and alumni
    e. Potential Employers
    f. Competing Schools

5. Do you believe that Internet and computer technologies are able to lead to improvements in higher education quality? Describe the mechanisms by which this might take place. What are the limitations?

6. Do you believe that technology mediated instruction such as Internet distance education can offer a quality alternative to traditional classroom instruction? What concerns do you have about such kinds of classes? What methods exist for assuring quality?

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