EDUCATION GOES DIGITAL:

The Evolution of Online Learning and the Revolution in Higher Education

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Studying the transformation of education and its changing role in society.

Online learning is the latest in a long list of social technologies that have been introduced to improve distance learning by adding various augmentations, substitutions, or blending of new pedagogical approaches and technologies. Technologies utilized for distance and online learning include: correspondence courses, physical mail, and printed matter; telephone and/or audio recordings; television and/or video recordings; computer-assisted instruction; group communications (asynchronous and synchronous); the Web and multimedia materials; simulation and gaming; collaborative learning; asynchronous learning networks (ALN); collaborative knowledge systems; immersive simulations; and wireless and handheld devices. Most current distance courses have

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incorporated one or more of these technologies or methodologies. By 2004 at least two million higher-education students in the U.S. were engaged in distance education utilizing various ALN technologies where whole classes can engage in a continuous discourse and group project work independent of time, place, and synchronous constraints of participation [1]. In themselves the technologies have not radically changed the basic concepts of distance learning or university education in terms of the underlying societal structure of education. However, there is a substitution process occurring that will transform higher education.

In this article, we argue that the current evolutionary changes in educational technology and pedagogy will be seen, 50 years from now, as revolutionary changes in the nature of higher education as a process and as an institution. We are in the process of moving:

From: face-to-face courses using objectivist, teacher-centered pedagogy and offered by tens of thousands of local, regional, and national universities;

To: online and hybrid courses using digital technologies to support constructivist, collaborative, student-centered pedagogy, offered by a few hundred "mega-universities" that operate on a global scale.

Digital Learning as a Substitution Process

Online learning is a new social process that is beginning to act as a complete substitute for both distance learning and the traditional face-to-face class. This is because it also is a process that will infiltrate the ordinary face-to-face class and radically change the nature of what is thought of as the typical college course. Face-to-face courses skillfully blended with online learning technologies and methodologies are generally rated by students as significant improvements over traditional face-to-face (only) classes. What is already occurring is the same evolutionary substitution process illustrated by water-based paints having been almost completely substituted (over 95% of the market) for oil-based paints, or the substitution of synthetic rubber for natural rubber.

Substitution processes have sometimes been characterized as disruptive processes because they change the nature of the marketplace and the underlying institutions involved in supporting the infrastructure of the marketplace: providers, consumers, and regulatory agencies [4]. All substitution technologies in the past have been disruptive for the industries, markets, investors, and regulatory bodies they have affected. The term disruptive does not represent any new process but merely a negative characterization of technological progress and change, in making way for the new. Those who have invested heavily in the "old" technology may be damaged or destroyed if they do not adapt.

Blended Courses. The critical substitution process is the new phenomenon of "blended" or "hybrid" courses. On many campuses professors use asynchronous discussion systems to extend discussions beyond the classroom. Many who teach both distance and face-to-face sections of courses are blending the separate sections so that as far as the instructor is concerned there is no difference in the material, assignments, and participation for either type of student. This is seldom measured in most university settings, where the administration process still treats the two types of students differently.

For the purposes of defining a substitution analysis we take a normative view and define a "blended

course" in terms of what will bring about the greatest social and economic value to society as one in which:

There is no need for the instructor or student in a blended course to be concerned with which students attend the face-to-face class and which students participate online. All learning experiences that are available face-to-face are also available in a digital form that is at least equally effective.

This definition is entirely independent of the particulars of the technology or the learning methodologies employed. It focuses on the end result of blending face-to-face and online learning into one entity. Traditionally this is referred to as specifying the "normative goal" that people will agree is the likely outcome of the technological substitution process.

The Technology of Online Learning. We expect the specifics of course delivery will undergo rapid change with advances in the technology of online learning. Even the concept of what is a course can be expected to change. The inclusion of self-selection of the learning mode by students is not only the likely outcome but it is desirable since prior research indicates that 10%–20% of students always prefer the face-to-face environment and believe they learn best in that environment. Also, some students have negative reactions to the methodological approach of collaborative learning in small teams and prefer to work alone. However, this does not negate the learning benefits of classwide collaborative discussions where the technology can aid in encouraging equal participation [2].

The current generation of vendors for online course management systems have largely focused on administrative support rather than innovative tools for collaborative learning activities. Tools for the improvement of learning systems have been evolving from other efforts. Computer-mediated communications now incorporates Wikis, blogs, virtual marketplaces, and Dynamic Delphi systems [5]. All of these are examples of collaborative methodologies for improving the ability of large groups to meaningfully communicate about complex topics. This applies to active discourses in classes as well as to virtual teams, political lobbies, hobbyists, and other forms of online communities.

Underlying these methodologies is digital support for the techniques of voting, scaling, hypertext (relationship analysis), visualization, and the structuring of collaborative communication protocols (for example, Roberts Rules of Order), and the structuring, filtering, and organization of collaborative discourse content. These techniques may be used in the following manner:

- Voting to direct or focus the discussion on areas of group differences and to allow for dynamic (ongoing) changes in evaluation of contributed material;
- Scaling to promote collective understanding of the group's views, degrees of agreement, and shared meanings;
- Hypertext (the two-way linking and typing of both links and nodes) to allow the construction and expression of complex relationship structures and individual and collective cognitive maps;
- Visualization to develop the functional equivalent of the periodic table of the elements for all other fields of human endeavors;
- Communication protocol structuring to allow for equality of participation by type of communications structuring; and
- Content structuring to allow asynchronous contributions to be automatically categorized and organized and to facilitate individual problem solving within a group process.

Some examples of challenges for further R&D in computing to improve the learning processes and allow class and programwide contributions and collaboration include:

- Integration of the tools into more comprehensive computer-mediated communication systems in such a manner the users can directly design their communication processes tailored to the application and the nature of the group;
- Virtual markets better able than traditional stock commodity markets to integrate discourse structures, using scaling tools for the accumulation of knowledge by large groups and provision of evolutionary content systems for continuous learning by students and practitioners alike;
- Collaborative hypertext systems utilizing domain-specific typing of two-way links and nodes that can be agreed to and evolved (in a Dynamic Delphi-like manner) [3] by users and can be used to structure diagrams and cognitive maps by large groups as knowledge and discourse depositories; and
- The extension of recommender systems to proposed knowledge observations and the use of associated negotiation structures to encourage an intelligent content-oriented consensus on agree-

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ments about knowledge or on investigations to resolve disagreements.

Much of what we do as educators is devoted to conveying to the student the cognitive maps that we use for problem solving in a discipline. If we could express ours directly and see the maps that the students develop with an ability to analyze them comparatively, we could more easily perceive and understand our degree of success in our endeavors.

We need to be able to analyze and visualize the differences among hundreds of participants who all can have a voice in expressing the structure of a topic taught in a given class. The extension of the Web to provide true hypertext (semantic relationships) would result in the ability to create structural models as templates for collaborative content. The extension of recommender systems utilizing scaling and voting to show the degree of collective agreement and to stimulate a focused discourse is the other key component.

The Driving Societal Forces for Online Learning

Given that currently over 50% of U.S. students are returning to education after work or are working now, and often have families, there are benefits to the students, the organizations, and to the society, as well as more direct cost-benefit factors. The major driving forces for digital substitution processes include:

- The value to the student is the flexibility of being able to integrate education with the demands of work and family.
- Learning effectiveness in online (ALN) or blended courses is equal to or better than in entirely face-to-face courses (see [2] and www.alnresearch.org, an online community of researchers on ALN that includes a digital library collection of evaluation research).
- The value to the instructor is being able to treat all students equally, and to prepare and deliver the materials of the course as a single entity.
- The value to the organization is not having to duplicate any administrative or support function as a separate entity for distance learning.
- The growing competitive environment in higher education and the need to provide quality online instruction as a matter of long-term survival.

Of course, once most courses are available in digital formats as well as on campuses, geographic monopolies and barriers that have sustained thousands of different colleges and universities in the U.S. and around the world will weaken. In the structural change resulting from the elimination of geographical monopolies for higher education, colleges and universities must face the need to change, or risk extinction. They need to embrace the concept of blended courses and provide the infrastructure and incentives to allow faculty to make this transition as rapidly and as effectively as possible.

What we have today is a little bit like the early days of message systems in organizations when the technology was introduced by the technical people responsible for information systems development for their own benefit. It then spread by word of mouth to other professionals and managers who found it a beneficial technology to begin to use. There was no plan or management control, or even management understanding, of what was occurring. In fact, when management discovered what was taking place some were extremely upset because of the lack of control over the information flowing laterally in the organization. It was another new technology that was con-

sidered disruptive because it often affected or reduced administrative control over the flow of information in the organization and threatened some jobs that depended upon restricted information flow for their existence.

In the early days or first stage of any innovation, what creates a successful technology is the innovators, who always tend to produce an outstanding product that is molded by their understanding and an early focus on quality to convince people that what they have produced is better than anything that is currently available. This is what must occur to attract investment and trigger acceptance of a new social product over current alternatives.

In the second stage, there is a proliferation of many different vendors attempting to enter the marketplace and a wide diversity of products. Usually this diversity of products can be divided into five distinct types:

1. Products that emphasize quality so that more can be charged.
2. Products that emphasize low cost in the hope that lower quality levels will be acceptable and higher levels of sales will be obtained from the low cost.
3. Products that are in some way unique and not easily provided by anyone else.
4. Products requiring a heavy investment by the customer in maintenance and training, so a customer cannot switch cost-free to an alternative product or even a better one.
5. Repackaging of the old technology to make it appear to be the new technology.

Today we can easily see successful and unsuccessful examples of all these approaches that are occurring in what is currently the second and most chaotic phase of the innovation of online learning in higher education.

Consequences of Online Learning

In viewing the current and future impact of computing in higher education, we must assume the technology of online learning will produce learning systems of a blended nature that are far better than the prior "gold standard" of the face-to-face class. As a beneficial side effect, distinctions will blur between traditional learning and distance learning. Online learning is also starting to penetrate K–12, adult learning, and corporate training. Some higher-education institutions employ educators in other countries to teach courses. Some students are taking courses and earning degrees in other countries via the Web. Professionals in many fields are beginning to realize their long-term job survival depends on an atmosphere of lifelong learning.

Ultimately the public will educate itself on what are the most effective learning systems because it has become too expensive not to. The costs will drive the public to want more informed choices and lead to improved consumer-oriented evaluation services.

Most of the current regulatory processes serving higher education have been directed at administrators and managers. They have had very little direct impact on the consumers of higher education—the students and their supporting families. There is no equivalent in higher education of a "consumers union" or other non-profit oganization dedicated to providing unbiased information to the student at a level of assessing different degree programs and courses, much like a consumer can get details on the properties of a particular automobile. In this atmosphere of change and a growing number of alternatives the researchers in online learning have an ethical obligation to help consumers and the public understand the effectiveness of the alternatives that will be available.

What is happening in a time of transitional chaos between an early marketplace for an innovation and a mature marketplace is quite normal except that we are dealing with a highly regulated industry in higher education and the introduction of the Web is beginning to turn it into a deregulated industry. We have seen deregulation in other industries produce chaos and abuse as well as improvement. However, there are still fundamental questions as to whether higher education should be a right of the citizen as opposed to a privilege for those who can afford it, and what is in the best interests of society as a whole.

One hopes that professional societies, accreditation organizations, and universities and colleges will realize the need to provide impartial mechanisms to educate the consumer about their choices for higher education and the long-term differences among these choices. We predict that the surviving institutions will be those that increase their emphasis on providing a high-quality education using the best technology available, and ensure that permanent faculty play a major role in this process and are appropriately rewarded for excellence in this endeavor. Finally, the improvements in the technology to provide this level of quality will occur very quickly and organizations must be careful not to become dependent on their current technology and vendors.

As with other utility-type enterprises such as energy and communications, society seems to be moving toward increased deregulation of what

should be viewed as a scare resource: higher education. The diverse goals of institutions of higher education and the rapid advance of the technology have led to numerous innovative success and failures. This time of transition to global competition will continue for at least another decade. Whether U.S. institutions survive to offer quality affordable public education will depend on an aware public body and informed policy development by all the related regulatory and governmental bodies involved.

The pace of this change depends upon many social factors; it may take 10 years or it may take far longer. Countervailing forces might take the form of resistance (conservative backlash) or an entirely new conception of the role of education in society. Perhaps the most appropriate final note for the conclusion of this article is the comment of Charles Darwin on the evolution of life as it might be applied to universities:

"It's not the strongest of the species that survives, not the most intelligent, but the one most responsive to change."

—Charles Darwin, *Origin of Species*, 1859

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