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Tutorial: Distance learning strategies that make sense, part 1: a micro analysis

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There are many conflicting reports on the economic implications of distance learning. On the one hand, it has been advocated as a tool for reducing costs—to leverage scarce faculty or facilities [9]. On the other hand, many faculty participants report that distance learning requires time commitments far higher than those of traditional courses [3]. With such a broad range of reported outcomes, faculty members who are considering engaging in distance learning have a right to be suspicious. Such suspicions should not be shrugged off as a form of generic resistance to technology, as they are sometimes presented [2]. They are better viewed as the reaction of a rational agent to an "opportunity" to innovate that could easily lead to uncompensated higher work loads.

The objective of this article is to present a framework for better understanding the apparent economic paradoxes of distance learning from the faculty member's perspective. This framework is derived inductively from three case studies of actual distance learning courses that are presented. These cases are analyzed with respect to their economic and pedagogical implications in order to synthesize a framework for characterizing distance learning courses. Finally, the implications of course design—from the faculty member's perspective—are examined using the framework.

Definitions of Distance Learning

For the purposes of this article, distance learning is defined as being present any time an instructional technique reduces the need for spatial or temporal proximity in the education process. This is only one of many possible definitions, and is considerably broader than some [8]. Under this definition, then, many non-telecommunication based techniques (e.g., placing video tapes of lectures on reserve in a library) represent a rudimentary form of distance learning. Technology enabled (T-enabled) distance learning is used to refer specifically to situations where technology is utilized to accomplish distance learning (e.g., broadcasting lectures, distributing lectures as Macromedia Flash on a CD). Internet enabled (I-enabled) distance learning can be used to identify techniques involving communications over the Internet (e.g., providing Webcast lectures in the form of streaming video).

Three Distance Learning Case Studies

As a starting point for developing a microeconomic framework of distance learning approaches, we look at three actual courses, all of which employed distance learning and all of which were successful in meeting some important educational objectives. Included with each description is a brief synopsis of its economics.

1. *The broadcast course: Economics U$A*. Over the past two decades, uncounted thousands (likely millions) of students have taken—either formally or informally—a course titled "Economics U$A." The course, available on tape or broadcast by local public television stations, has been offered for credit by high schools, community colleges, and universities. Nearly twenty years after its creation, the course's 28 half-hour segments are still broadcast in a number of markets sprinkled across the U.S.

   "Economics U$A" was developed by the Annenberg/CPB Foundation in the early 1980s. The course, which cost several million dollars to develop, featured two hosts: a journalist and an economist (a former instructor of Harvard's "Economics 1" course). A typical course segment consisted of video clips, interviews with important figures of the day (e.g., the Fed's Paul Volker), discussions of economic concepts and animated graphics. Some segments were updated in 1989, 1992, and 2003.

   When offered formally at the high school or college level, an instructor was normally assigned to lead a discussion of each segment and to create/grade appropriate assignments. To offer the course for credit, institutions paid a fee ranging from $200.00 to $300.00 a semester. A textbook specifically written for the course was also available.

2. *The hybrid course: Introduction to C++ Programming*. A required introductory programming course offered for undergraduate MIS majors, students chose between attending live lectures, taped lectures, and lectures specially prepared for distribution of over the Internet. In addition, the course textbook provided 17 hours of multimedia content on an accompanying CD, complementing the weekly lecture time.

   The course emphasized seven assignments, with all testing being specifically directed towards validating assignment completion. Testing techniques included computer generated multiple-choice tests—administered online—to validate pencil-and-paper assignments (e.g., numbering systems), proficiency tests in the lab, and oral examinations to validate programming assignments. For distance learning students, these exams could also be administered using a combination of telephone and remote terminal access (e.g., GoToMyPC).

   Because the assignment validation process verified that students understood the material they handed in, collaboration between students taking the course was strongly encouraged. Online discussion forums were also set up for each

assignment. These could be quite active, with 200 or more postings for a single assignment being common. Teaching assistants for the course were recruited exclusively from the ranks of undergraduates who had recently taken the course. Their activities included providing formal and informal support in the labs, helping respond to student questions in online discussion groups, assisting students with assignments during office hours, grading assignments and conducting preliminary oral examinations. These collaborative and peer-oriented elements of the course design were consistently the most highly rated aspects of the course in end-of-semester surveys. Some of the key survey results are presented in Table 1.

The course evolved into its hybrid format over a three-year time span. During that period, substantial development effort took place to enhance the course content. For example, online discussion support was introduced in early 2002, along with a sophisticated tool that allowed students to move from flowcharts to C++ code. In late 2002, an instructor-developed textbook draft was added to the course, incorporating embedded video segments. In early 2003, online lectures were developed to parallel in-class lectures, and automated test generators—covering about 15 percent of course content—were created. By late 2003, the amount of material covered in the course had been expanded by roughly 30 percent, without increasing the student attrition rate.

During the period when the course was evolving rapidly, the time demands on the instructor—who was also the principal content developer—were far higher than those of a traditional course. Once the content stabilized, however, the economics of offering the course proved to be quite comparable, even favorable, to those of a traditional classroom lecture course. This was a result of the use of teaching assistants for many support tasks and the reuse of much Internet content.

3. *The discussion course: Introduction to MIS*. Offered as part of a Virtual MBA (VMBA) program, students in the course had no personal contact with the instructor. The course employed the "case method," an approach normally used in a classroom setting. To adapt the technique for online discussion, the instructor developed a protocol differing from the classroom approach in a number of ways. First, rather than calling upon a single student to "open" the case, four to five students were each assigned questions to discuss and were told to open a discussion thread. Second, discussions were conducted over a period of roughly one week, rather than being limited to a single classroom block. Finally, students were divided into random, numbered groups towards the end of each discussion; each group then prepared a summary of recommendations and lessons learned. The instructor then posted both the summaries (anonymously, specifying only group numbers) and his detailed comments on each summary to conclude the discussion.

In parallel with the development of the VMBA course, the instructor experimented with different mixes of classroom and online case discussions for other sections of the same class. Four different treatments were used:

- all classroom discussions (classroom)
- primarily classroom discussions supplemented by some online discussions (light online)
- primarily online discussions supplemented by some classroom discussions (heavy online)
- pure online discussions (VMBA)

A comparison between these treatments, based on end-of-course surveys, is presented in Table 2. The results of two tests of learning—simple identification and concept recognition—showed online learners did at least as well as their in class counterparts. Student perceptions of the value of the course also appeared to be relatively independent of approach. Significant patterns did emerge in area of learning process, however. As the percentage of online cases went up so did the both desire for more instructor intervention and the perception that they were learning more from their peers

than from the instructor. Interestingly, emphasis on peer-oriented learning is often presented as a critical factor in effective case method instruction [1]. On this dimension, then, the online discussions could even be viewed as an enhancement when contrasted with the in-class version.

The economics of the VMBA class differed markedly from the previous examples. The preparation required for an online discussion proved to be substantially less than that required for a first time class discussion of a case. The reason: When a case was discussed online (asynchronously), the instructor could look up facts from the case if he or she did not recall them; during in-class discussions, the instructor needed to have full command of case facts. The demands of moderating an online discussion were much greater, however. To review and discuss a previously used case in class might take three hours; the same discussion conducted online might take eight hours—spent reading and responding to student posts, formulating the opening questions, writing extensive comments on student summaries, and grading each individual student posting. When case studies were reused in later semesters, an hour or so might be saved as a result of reuse (e.g., using the same opening questions in subsequent semesters), but the remaining time demands changed little.

Economic Analysis

In contrasting the economics of the three examples we have considered, a useful starting point is to think in terms of setup costs versus delivery costs (fixed versus variable costs, in economic parlance). As illustrated in Figure 1, the broadcast course had the highest setup and lowest delivery costs. The discussion course, in contrast, had minimal setup costs but was very expensive to conduct on a per student basis owing to the high level of instructor involvement required. The hybrid course fell between the two extremes; both setup and delivery costs proved to be in the intermediate range.

It is reasonable to expect that these profiles will change somewhat over the coming decades, as a consequence of both changing technologies and the evolution of the publishing industry. On the technology side, evolving software tools and hardware (e.g., the Tablet PC, digital camcorders, animation software, screen recorders) will make it easier to create quality multimedia content, reducing setup costs for most types of courses.

On the commercial side, publishers—facing diminished profits as a result of the used-book market—are already considering changes to their business models to develop more renewable revenue sources. In an early example of this, McGraw Hill has partnered with eInstruction to sell classroom response pads that must be reactivated every semester. Publishers are also currently providing Web-based course delivery infrastructures to faculty adopting their textbooks and have begun offering substantial multimedia content with some of their textbooks—such as the textbook developed to support the hybrid case example [6], which incorporated 15 hours of multimedia content on an accompanying CD. It seems only a matter of time before these trends converge. A plausible outcome of such convergence would be publishers selling semester-long subscriptions to online multimedia content while drastically reducing the price of the physical textbook at the same time. From the publisher's perspective, such a model would not only reduce the damage caused by sales lost to the used book market, it would also deal a serious blow to the textbook resale industry itself—whose profitability is heavily dependent on the high cost of new books.

Taken together, these technology and industry trends seem most likely to reduce total setup costs for courses over time. Their potential to reduce the delivery costs of labor-intensive discussion courses is more limited, however. The net result will be that the economics of (formerly) high startup cost course offerings should grow increasingly attractive compared with those of high interaction offerings.

Types of Content

Examining the three case studies, it is, possible to induce four distinct categories of distance learning content that have distinct implications with respect to the demands they place on the instructor:

I. *Prepared content:* Materials, such as taped lectures (Economics U$A) and Internet lectures (hybrid course)—along with other materials such as assignments, lecture notes, syllabi—that are incorporated into the course as part of its design and require no further instructor intervention once deployed.

II. *Evolving content:* Materials designed and introduced into the course while it is in progress (e.g., content introduced while the hybrid course was evolving), often in response to identified deficiencies in existing content or opportunities to enhance teaching effectiveness. Where courses are repeated, such evolving content often becomes Type I (prepared) content in subsequent offerings.

III. *Support content*: Activities or materials specifically produced in response to requests or queries from students. Responding to e-mail questions and the use of online discussion groups fall into this category.

IV. *Participative content*: Activities where the principal focus is on the interaction between students and evaluation is based primarily on the quality of that interaction and participation. The obvious example here is the online case discussions in the VMBA example.

It should be self-evident that none of these techniques are limited to distance learning—each has its traditional classroom equivalents. Furthermore, even in the T & I-enabled learning area, there are two distinct subclasses of techniques—those which serve as substitutes for traditional activities (e.g., a taped lecture versus a live lecture) and those which represent a novel form of content that is technology enabled (e.g., an online discussion group, a computer simulation exercise). Some common examples of content and delivery techniques are presented in Table 3, along with examples of enabling technologies used to supply substitute or novel content.

Using this framework, it is possible to characterize the three examples that were previously presented. The Economics U$A example, shown in Figure 2, is simplest because its sole use of technology is as a substitute for live lectures. Given this content profile, it is reasonable to suppose the high production values of the course were necessary in order to make up for the higher level of interactivity that would be present in a live lecture. This suggests a plausible rule of thumb for "Class A" content in general: If it is not to be viewed as a poor substitute for its classroom equivalent, it needs to offer the student clear benefits not found in the classroom.

The hybrid course presented as the second example has a very different profile, illustrated in Figure 3. In its final version (shown), prepared substitutes (e.g., online lectures, electronic versions of syllabi and assignments), novel prepared content (e.g., practice tests, course-specific interactive software) and novel support content (e.g., the online discussion groups) were all central to the course design. Other forms of T-enabled support (e.g., email) were also available, as was some participative credit (e.g., TAs were often selected based on discussion group participation), although these were not central to the course design. Some evolving content continued to be developed even after the course was "finalized"—whereas during its rapid development phases such content was central.

The final example, the VMBA course, is summarized in Figure 4. It employed bits and pieces of every content category (e.g., online lectures, password-protected video of actual case participants for some online cases that could be viewed once discussions were complete, multimedia presentation development exercises, online video chat sessions), but its central focus was clearly on class participation in the online discussions.

↑ Economic Implications of Content Type

Using the breakdown of courses by content type, it is possible to present an economic framework for analyzing course costs that is somewhat more useful than the fixed-cost/variable-cost view presented earlier in Figure 1. The framework is based on an analytical presentation approach often used in analyzing potential projects. It involves using the dimensions of present benefits and future potential.

To apply this approach to content type, we need to make a number of assumptions:

- Reduction of instructional time is viewed as an economic benefit. This assumption is derived from the fact that economic rewards of academia are normally far greater for research output than for teaching [4], and that reduction in teaching time will result in greater research output.
- Prepared content is a "sunk" cost. This "assumption" is largely a matter of definition, given how prepared content was specified. Most critically, it assumes the costs of using such content will not be incurred by the instructor.
- The course is to be given on a recurring basis by the instructor. Absent this assumption, the notion of future benefits—in the form of reduced instructional time—is meaningless.
- That support content activities can be delegated where it makes economic sense to do so. Stated simply, it means that teaching assistants will be used to leverage instructor presence—e.g., for grading, labs, review sessions—as the number of students assigned to the instructor grows. Not only is this common practice in traditional courses, it was also demonstrated to be quite effective pedagogically in the hybrid course.
- Participative content follows the asynchronous model presented in the VMBA example. As noted, it was the asynchronous nature of the VMBA discussions that made them particularly demanding for the instructor (and students). Had discussions been done as synchronous chat, the ability to time-constrain discussions might have changed the economics considerably. This assumption seems reasonably in line with the preference for asynchronous discussions reported by a number of experienced distance learning educators [3].

Given these assumptions, we find that the four content types fall roughly into four quadrants of the grid presented in Figure 5.

The axes of the graph reflect the current time required of the instructor (viewed as a cost) and the degree to which the content is deemed to be reusable, viewed as a benefit. Under this profile, the clear "winner" is prepared content, such as that provided by "Economics U$A." Evolving content places high time demands now, but offers the promise of future benefits. Support content can be delegated but, for the most part, cannot be reused. The clear "loser" in this analysis is asynchronous participative content, placing high time demands on the instructor now and in the foreseeable future. The most obvious way to make such a pedagogy comparable to the others in its demands is to reduce class size drastically, which will tend to reduce discussion sizes and the challenge of grading. Alternatively, the demanding role of e-Moderator [7] could be separated from the instructor role, substantially increasing course delivery cost to the institution but reducing instructor demands.

Discussion

Prior to concluding, it is useful to consider factors that could change the Figure 5 grid. One interesting exercise is to consider what happens as some of the assumptions are relaxed. Without recurring use of the course, benefits of reuse go to zero and the top row moves to the bottom row, placing I & III together, as well as II & IV. If support content cannot be delegated—based on lack of resources or the nature of the subject matter—then the current demands of support activities increase and III moves to the right, towards IV. If participative content is more synchronous (e.g., chat, conference calls), then the time required for moderating discussions could be substantially reduced, causing IV move leftwards, joining III.

The perceived nature of the grid will also be impacted by external factors. The experienced content developer, for example, may see the demands associated with evolving content as less extreme. The evolution of content development tools will also increase productivity in content development, as already noted. Similarly, the evolution of Internet technologies may also alter the quadrants. Synchronous participative content, for example, may become far more attractive when high quality multi-person video conferencing over IP is more accessible to students from their homes. (As an

example of what is already freely available, the reader is encouraged to visit http://www.paltalk.com/).

Perhaps the most important set of factors that could impact the nature of the grid are organizational in nature. Consider, for example, institutional policies such as:

- Immediately increasing teaching assignments for faculty members whose Type II courses have matured to the Type I stage.
- Asserting intellectual property ownership of Type I content prepared by the instructor, then making that content available to other instructors.
- Using a strict formula to assign resources (e.g., teaching assistants, credits for course preparation) to distance learning courses that is independent of content type.
- Viewing distance learning sections of courses as being "unlimited" in enrollment since they are not constrained by classroom size and availability.

Such policies could dramatically impact the grid. Typically, their effect will either be to discourage certain types of content (e.g., Type II, type IV) or to encourage faculty to drag their feet whenever the subject of distance learning is mentioned. In the author's opinion, such policies are more likely to stem from a misunderstanding of the nature of distance learning than from any malevolence on the part of administrators. Regardless of their original motivation, however, their outcome may be results that are inconsistent with the long term interests of the institution.

Conclusions

If distance learning is to take place, three conditions must exist: our students must demand it, our faculty must be willing to engage in it, and our institutions must enable it. Throughout this piece, the first condition has been assumed. This assumption seems reasonable, for two reasons. First, the convenience offered by effective distance learning is indisputable. Second, the generation that is coming of age is one that has grown up with computer games, e-mail, and instant messenger as principal forms of recreation. Why should they resist pedagogically sound uses of these same technologies in their education?

The issue of what will make faculty willing to engage in distance learning has been the central focus of this article. The approach taken has been to view a faculty member as a rational agent, meaning that his or her behavior can be predicted based on self interest. To determine what would constitute "self interest," a framework has been developed for analyzing a distance learning course based upon the types of pedagogical content it employs. Using that content breakdown, it is then possible to assess whether or not teaching the course is in the instructor's short term or long term best interest. Potential factors that can influence that breakdown—such as technologies, the nature of the course and institutional policies—have also been explored.

The final prerequisite for distance learning, enabling by institutions, has only been briefly touched upon in this article. It is, however, the central focus of a companion piece [5] that analyzes distance learning at the "macro" level. The central theme of that article is that institutional distance learning policies—with respect to allocation of resources and workload—need to be formulated so that they are consistent with the institution's overall strategy.

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Figures

F1 Figure 1: Setup vs. Delivery Costs for Courses

F2 Figure 2: Economics U$A Profile

F3 Figure 3: Hybrid Course Profile

F4 Figure 4: VMBA Course Profile

F5 Figure 5: Economic Profile of Content Types

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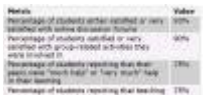

Table 1. Selected metrics from student surveys of hybrid course

Table 2. Selected responses from end-of-class questionnaires

Table 3. Taxonomy of Induced Types