# Blended Instruction: Adapting Conventional Instruction for Large Classes

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**Abstract**

This article provides a discussion of issues confronting institutions of higher education in their efforts to reduce costs and improve the quality of instruction for large classes. Blended learning is described with examples of technology applications referenced to existing courses at various universities. A discussion of cost reduction strategies is included. The article concludes with a summary of the types of adaptations and alternatives that instructors may use in teaching large classes, consideration of reusable course content, and the relationship of technology to instructional costs.

## Introduction

There is a financial crisis in higher education forcing cuts in programs and pricing some students out of post-secondary education. Tuition has increased at an annual average of 5.5 to 7.7 percent at four-year institutions (College Board, 2001), and for the 2003-2004 academic year, state colleges had the biggest tuition hike in three decades with a 14% rise over the previous year. According to the U.S. Department of Education, student debt on college loans in the United States topped $178 billion in 1999 (Dieterle, 2002). The greatest cost for most institutions is due to salaries and benefits because higher education is labor intensive, meaning that labor costs are greater than capital costs. Per-student costs are mainly a function of four variables:

faculty and staff salaries, including benefits ; faculty work assignments, mainly class size and course loads; costs of support staff; related facilities costs (e.g., classrooms, libraries, laboratories, equipment, maintenance)

A marginal increase in average salaries is a significant cost to an institution, and aging "baby-boomers" on college faculties drive up medical expenses that are borne by institutional insurance programs. Many corporations have achieved significant cost savings by means of increased productivity or greater output per worker. This is often accomplished by increased use of technology and automation in place of labor. Similar "capital for labor" methods are more difficult in higher education, so institutions use early retirement programs to free up slots for a younger faculty with lower salaries and resort to greater use of adjunct professors.

Another way that universities reduce costs is by warehousing students. The largest lecture class in 20 years was taught this year at Harvard with 300 students enrolled in an introductory economics course. The world's largest lecture class was reported to be 1,600 students in introductory psychology at Cornell (Leff, 2002). Many campuses commonly crowd 200 or more students into a lecture hall. Although large classes are cost effective for the institution, there is widespread concern about the quality of instruction. Graham Gibbs, of Open University, vividly describes the problems in a brief streaming video about teaching large classes. Felder (1997) related the sense of despair many college instructors feel when confronted with a large class:

When we find ourselves teaching a mob, it's easy to throw up our hands, conclude that there's no chance of getting any responsiveness out of 150 or 300 students in an auditorium, and spend 45 hours showing transparencies to the listless 60% who bother to show up from day to day. We can generate some interest by bringing demonstrations to class, but there are only so many hydrogen balloons we can explode and even they lose their impact after a while (para 1).

There are two basic strategies for improving learning in large classes: (a) placing greater responsibility on students, including recommendations for study skills (see a web page at Michigan State University), and (b) better lecture presentations (e.g., Penn State and University of Maryland). A more direct approach is a capital-intensive strategy or course redesign based on supplanting personnel with technology. Called "blended learning" or a "hybrid model," face-to-face (F2F) and distance education delivery methods and resources are merged. As Young (2002) said, "Hybrid models appear less controversial among faculty members than fully online courses have been, though some professors worry about any move away from an educational system that has worked for centuries" (para 10). A group at UCLA defined this concept as blended instruction:

Blended instruction is a term for the delivery of instruction based on the integration of face-based instruction and computer-based instruction. In blended instruction, a significant amount of student learning is achieved through online instruction, resulting in changes to course structure and how/where students allocate their time in mastery of the course content. Blended instruction can be an important vehicle to begin to exploit the potential of technology to improve the quality of instruction, to increase access, to increase the amount of learning, and to maintain or reduce costs (Instructional Technology Planning Board, 2003, para 1).

**Cost Reductions and Technology**

There has been little research about the uses of blended instruction as an alternative to conventional instruction. The exception is the Pew Grant "Program in Course Redesign" (Twigg, 2003) that has supported 30 institutions in non-competitive grants to demonstrate how colleges and universities can redesign their instructional approaches in large classes using technology to achieve cost savings and quality enhancements. The projects focuses on large-enrollment, introductory courses. Currently 20 institutions have reported results of their experiments concerning cost reductions. Based on these data, the differences between institutions are readily apparent. For example, the cost per student in biology at one institution was $506 dollars but only $199 for a similar course at another university. The difference was accounted for class size and the sections per instructor. Costs were reduced by increasing the number of sections handled by the instructor and use of less expensive staff support. For example, one institution reported that online delivery of content, to replace lectures, "presented content so well that instructors did not need to spend time delivering content, thus enabling one faculty member, with the help of a course assistant, to be responsible for four mathematics courses simultaneously while spending less time than would be needed to offer only one course without the software" (Rio Salado College, 2001).

Twigg (2003) provided an analysis of the "Course Redesign" program saying, "The approach most favored by the Round I projects was to keep student enrollments the same while reducing the instructional resources devoted to the course" (para 17), and shifting some related tasks to technology-assisted activities. In two institutions, the "key cost-saving device" was replacing expensive labor (faculty and graduate students) with relatively inexpensive labor, such as undergraduate coaches to grade homework assignments. At one institution, classroom space was freed up by substituting online activities for face-to-face classroom instruction.

The technological innovations used in course redesign were reported as follows:

- Online course management systems that reduced or eliminated the amount of time faculty spent on nonacademic tasks such as recording, calculating and storing grades; photocopying course materials; posting changes in schedules and course syllabi; making special announcements; and transporting syllabi, assignments, and examinations.
- Online automated assessment of exercises, quizzes, and tests.
- Online tutorials that resulted in less preparation time for teaching assistants.
- Shared resources among different instructors to reduce duplication of effort (i.e., revising course materials, preparing for classes, student aids (i.e., solutions to problems, study guides, supplemental reading materials self-assessment activities).

While the "Program in Course Redesign" was heralded by Twigg as an "unqualified success," it seems that cost savings were achieved mostly by alterations in the assignments of personnel time and ratios of students to instructors. As Twigg commented, "The differences are directly attributable to the different design decisions made by the teams, especially regarding what to do with the faculty time that was saved."

**Scalability of Blended Instruction**

Distance education is an alternative for students who are otherwise unable to participate in on-campus courses, but few colleges have leveraged the technologies for students enrolled on campus. In a report to the University of California Regents, Murphy (2003) said, "To have a truly revolutionary effect on instruction in general, however, requires that these innovations be scalable to other instructors and courses, and that they be strategically implemented to meet pedagogical goals" (para 3). In order to make such innovations scalable, it is necessary to consider the current and emerging possibilities for applications of technology to course elements.

Scalability is the capability to serve a larger number of users without degradation or major changes in existing procedures. Asynchronous delivery seems to be the only viable, scalable method. Synchronous technology cannot reduce costs (i.e., two-way interactive video, one-way video with two-way audio, and closed-circuit, and satellite), because it requires the instructor and students to meet at a particular time and location, and it only marginally increases the number of students who may participate. While costs increase because of the need for equipment at all sites, and there are additional charges for uplinking, salaries of non-instructional personnel, and so forth, the major factor is the constrained number of students who can be served in real time. The asynchronous model is potentially more cost effective if it can serve more students. Asynchronous delivery on the WorldWideWeb (WWW) can result in cost savings, depending upon how many students may enroll. However, many institutions restrict enrollments in distance education.

The more effective the technological delivery, the more likely the lesson will match or surpass traditional lecture. Many applications of technology in lecture classes are add-on slideshows, which often become the basis for online content. As online delivery becomes more intelligent, perhaps with cognitive modeling that personalizes instruction and adjusts automatically to each student's characteristics, online tutorial instruction will become increasingly important. Davis and Ragsdell (2000) reported on the adaptation of the Keller personalized system of instruction

(PSI) that used "appropriately sized learning modules" consisting of audio, video, and dynamic textual content to replace the lecture portion of a course. The PSI relies on greater structure, shorter learning steps, reduced verbal loads and self-pacing. The student advances to the next topic upon mastery of each unit, and there is an emphasis on repeated testing and immediate scoring (Keller, 1968, p. 83)

As a capital-intensive strategy, many more students must be served with the same number or fewer instructors. An asynchronous model can be scalable to permit realignment of faculty resources with technology, rather than attempting to expand faculty resources to meet load demands created by the conventional organizational pattern (i.e., instructors x time slots x seats). This can also reduce the physical demands and costs associated with classrooms and lab use.

**Elements of Blended Instruction**

The blend of adaptations and technology may be important in both cost savings and in learning enhancements. Consideration should be given to the various aspects of a course including (a) lecture, (b) self-study, (c) application, (d) tutoring, (e) collaboration and (f) evaluation.

**Lecture.** Several techniques are used to improve the lecture in addition to general guidelines for an effective lecture. An innovation at the City University of New York is peer-led teaching. Students who have previously done well in the course become guides and mentors to assist a new class of students through difficult course content. They are less expensive than graduate teaching assistants. The University of Waikato has experimented with a course in management information using a student-centered approach as an alternative to lecture with tutorials, a workbook, and assessment, where students spend their time in class in small groups to discuss their work rather than listen to lectures.

One of the easiest innovations is streaming video and/or audio. A lecture equivalent in multimedia can be a simple video of the actual lecture delivered to a class, but more desirable would be video segments specifically designed for each concept. The Michigan State University physics department uses a web site as a lecture in physics rather than as a substitute for a textbook. Professor Matt Nickerson uses streaming video for Humanities 1010 at South Utah University. An example of streaming audio that employs voice over with graphics is a course by Ed Meyen at the University of Kansas. Cal Poly Pomona has an interactive physics course.

The computer can provide content for a lecture as text, slide presentations, or a sophisticated tutorial. This can help overcome time and manpower barriers, and any content in an electronic form can be easily corrected or revised. A computer simulation can be an effective method of providing students with skills, knowledge, and realistic applications of knowledge. Examples of simulations are at Cornell in physics and the International Communication and Negotiation Simulations at the University of Maryland.

Some devices used by professors to break up lecture are (a) Think-Pair-Share, where students write for a minute or so then discuss with another student and reach consensus, and may be called upon to share with the class (Creed, 1996); (b) One Minute Paper, where students write their names on a paper and briefly answer questions, such as "What was the most important point made in class today?" (Angelo & Cross, 1993); Traveling File, where questions are placed in a "traveling file," the class is divided into discussion groups, and each group receives a different file, which they open, discuss and respond, place the answer in the folder, and the process continues until all groups have answered all questions, which are then read to the class by the instructor (Karre, 1994). Some universities use electronic response pads in large classes to electronically take attendance, give examinations, and poll students during lectures. Obviously, these strategies may improve interaction and student engagement, but they will not necessarily reduce costs.

**Self-study.** Most courses require one or more textbooks, which is often the content of the course. Some professors require 2 or 3 textbooks for a course. In introductory courses there is sufficient duplication of content on the Internet to be used in place of textbooks, and professors who are competent in their disciplines can create their own multimedia applications to substitute for books. However, textbook costs are totally absorbed by students and represent no savings to the institution.

**Application.** Common application techniques include experiments and activities in labs, writing terms papers, and conducting research. Problem-based learning (PBL) has been suggested as an authentic learning activity to replace or supplement current methodologies (West, 1992). PBL has been most widely employed in medical schools but also in pharmacy, nursing, and dentistry (Vernon & Blake, 1993; Bridges & Hallinger, 1991). PBL is considered to be learning in context (Collins, Brown, & Newman, 1989). Rather than lectures, notes, and examinations, students are presented ill-structured problems from the real world. Cognitive coaching is a critical component. While students actively define problems and construct potential solutions, a teacher (model, coach) avoids directing the group but assists them in defining their problems and organizing to solve them. Examples of PBL are at the University of Delaware and McMaster University. It is difficult to see how savings can be achieved by means of PBL, which can actually require a lower ratio of instructors to students. Only in the case of replacement of labs through computerized simulation, there do not seem to be many areas in this category that are susceptible to significant cost savings.

**Tutoring.** A number of university courses employ a variety of interactive courseware and computer-assisted instruction for students. Publishing companies are providing both CD-ROMs and online content for students as a supplement to their paper content. The use of Java and Flash in the development of specific tutorials is enjoying growth. Harvey Mudd College provides online tutorials in calculus, and The University of Sheffield, Purdue University, and Oxford University have tutorials in chemistry online. While these technological applications may improve student engagement, they cannot result in cost savings unless they replace substantial portions of lecture or extend the impact of an instructor across several sections.

**Collaboration.** In recent years there has been a growing interest in the use of collaborative models of learning in higher education, especially the use of cooperative learning techniques (Slavin, 1987). Cooperative Learning is a way to use small groups to get students to work together to increase their achievement. Drake University maintains a web site for its faculty on active and collaborative learning. The International Association for the Study of Cooperation in Education maintains a web site and provides a newsletter of interest to higher education professionals.

Many professors in distance education use electronic Listservs and Forums or Threaded Discussions, and these can be used in conjunction with a didactic course. Computers to support cooperative learning and team work is also known as groupware or computer-supported cooperative work (CSCW). Interactive Technology Publishing provides a comprehensive list of resources. A tool that may have application for online collaboration is a Wiki, derived from the

Hawaiian meaning "quick." There are many Wiki "communities" online that provide access so that members can have the rights to edit a common web document. As in other instances mentioned above, these strategies do not necessarily reduce demands on instructors nor result in savings.

**Communication.** In addition to the tools of Listserv and Forums, chat and e-mail can be used for communication among students and the instructor. With rare exceptions, it is probably true that most professors and students use e-mail. Oxford University provides a thoughtful consideration of the uses and problems associated with using e-mail in teaching.
Like other technology applications, there seem to be little direct savings in cost, although any form of electronic communication that reduces faculty conferences in real time may result in a savings.

**Evaluation.** A restriction in any large class is the limitation on conducting frequent, formative assessments. With computer-adapted testing (CAT), immediate results can be used for formative evaluation rather than only summative. CAT differs from ordinary test administration because items can be selected from a large pool of equated items based on probes that estimate the subject's ability according to response patterns. The CAT establishes a testing "floor" and "ceiling" by presenting a subject with an item of medium difficulty that is followed by a simpler or more difficult item, depending upon the student's responses. If a CAT is not feasible, many software programs have their own item banks and it is not difficult to import item banks from other sources so colleges can create their own. By aggregating item banks in a continuum of task difficulty according to the curriculum, formative assessment can be made more meaningful. If the purpose of assessment is understood to be that of assisting students to recognize that they are learning what is intended, providing frequent feedback to students and teachers is an obligation. This represents assessment of the highest validity.
Computerized testing may result in a savings in time and real costs. This use of technology can result in some savings if paper is replaced with electrons.

The following table shows a range of possible adaptations that can be used in large classes, including adaptations of traditional course methods and technological alternatives

| Course Element | Traditional Course | Adaptations | Technological Alternative |
|---|---|---|---|
| **Lecture** | didactic lecture | peer-led teaching<br>student-centered class<br>think-pair-share<br>one minute paper<br>line estimate<br>traveling file<br>case study<br>discovery model<br>scheduled labs<br>discussion sections | slide presentations<br>streaming video<br>streaming audio<br>computer simulation<br>web-based lecture<br>tutorial |
| **Self-study** | textbook and readings<br>notetaking | study groups<br>journal | alternative text<br>audio text |

| | | | |
|---|---|---|---|
| | study skills | | computer-assisted instruction<br>streaming video<br>streaming audio<br>computer simulations<br>web-based lectures<br>tutorial<br>blog |
| **Application** | labs<br>papers<br>conducting research) | PBL<br>tutors<br>peer tutors | computer-assisted instruction<br>tutorial and simulation<br>online tutorial |
| **Collaboration** | labs<br>student-centered class<br>think-pair-share<br>line estimate<br>one minute paper<br>traveling file | cooperative learning | listserv<br>forum<br>threaded discussion<br>Computer-supported cooperative work<br>Wiki |
| **Tutoring** | Individualized instruction<br>programmed learning | peer tutors | computer-assisted instruction<br>online tutorial<br>virtual reality<br>intelligent tutoring systems |
| **Communication** | meet during office hours | | chat<br>e-mail |
| **Evaluation** | quizzes<br>tests | computerized tests | computer-adapted testing<br>item bank<br><br>electronic portfolio |

**Cost Savings Targets in Blended Instruction**

The productivity measure in higher education is the "student-credit hour," which is variable from one institution to another. The productivity of an instructor is determined by both the "course load" (how many courses are taught in a semester) and the student-credit hours generated. For about a century, the "student credit hour" has been accepted as a common measure of productivity in higher education in the United States, and it is widely used to compare distributions of work within and across programs and institutions. The credit-hour measure is used to report the cost of instruction per student hour and to assess cost-effectiveness and productivity for entire institutions, colleges, departments, and individual instructors.

Faculty load is more subject to the vagaries of local policies and not directly interpretable, since in some institutions, and depending upon market forces, there are significant differences in what constitutes a load. In a non-research institution, for example, a full load may be 4 or 5 courses per semester. In a research institution, part of the load may be for "research," either because the faculty member must "buy" out release time from teaching with funded research or is provided with some portion of load to conduct research. Thus, a professor may have two or three courses. In areas where there are shortages of professors, higher salaries are paid for essentially the same duties and the work load may be lighter because of supply and demand negotiations. For example, if professors in the business school are in short supply, they can command higher salaries than professors in other colleges where candidates are more plentiful, and they can negotiate smaller classes and lighter loads.

Despite its flaws, the student credit hour is the basis for work loads, student outcomes, cost per student, and other measures. Using this crude measure, it is obvious that large classes are cost-effective, in the sense that it is economical for services received for the money spent, especially if the instructor has a low salary. The main lesson learned in the "Course Redesign" project (Twigg, 2003) seems to be that increasing student-credit hours per instructor saves money. There are two ways to do this, (a) large lecture classes or (b) lectures supplanted by online tutorials. In fact, closer examination of the results reported by Twigg shows that the main savings were accounted for by increasing the student credit hours for instructors. The largest percentage savings, ranging from 37 to 77 percent, can be attributed to this. In fact, at Virginia Tech, which posted a 77% savings, 40-student sections were managed by one instructor at .50 load using an online course-delivery method. In effect, distance education was used for on-campus students.

Another potentially significant way to save costs may be through some form of reusable learning objects (RLO). Research in this area has been underway for a number of years in the hope that knowledge, or rather information, can be chunked and tagged (i.e., text, graphics, videos, audios, databases, and so forth) with XML (Extensible Markup Language) and placed in a database to be shared and easily reused to generate a course of instruction according to standards adopted under the "Sharable Content Object Reference Model" (SCORM) and accessed by means of a Learning Management System (LMS). Apparently there remains a considerable amount of work to do before this can be achieved, if it ever can, but the concept could be applied to the static elements of course content without a sophisticated database structure. That is to say, a university or a group of cooperating developers could create content strands that are important for introductory courses and retain them in a repository, share them, and reduce the need for revisions and course creation each semester without SCORM or an LMS.

Developing a repository of content that can be used now and in the future will save time, money, and effort by replacing lectures and reducing course preparation, a truly capital-intensive strategy. With greater responsibility for content delivery shifted to technology, it is theoretically possible that fewer instructors would be needed. In many courses in psychology, chemistry, mathematics, humanities, statistics, and so forth, much course content is identical semester after semester and unlikely to change much in the future. By tying electronic instructional units to tests and activities, a comprehensive body of courseware could be developed that would be serviceable with little maintenance for many semesters to come.

Some academics regard "capital-for-labor" as a "Taylorization" of academic labor (Hanley, 2002). Technology threatens faculty who fear technological displacement. Of course, almost all industries have been affected by technology, either through elimination of entire industries or replacement of human labor with more efficient automation. That it may also occur in higher education is not inconceivable. This is not necessarily a zero-sum alternative, because before deciding that technology will merely "industrialize teaching and learning and degrade academic labor," as asserted by Hanley, instructional issues should be considered as they now exist for large lecture classes. Large lecture classes are not necessarily effective for student learning and motivation, regardless of the cost differential. If technological adaptations improve student engagement, provide content that matches learning styles, allow self-pacing, accommodates different learning rates, and frees the instructor's time for applications and higher-order thinking rather than expository lectures, large lecture classes will be difficult to justify regardless of the consequences for the employment of professors. Warehousing students cannot be defended on any grounds other than costs.

## Conclusion

"Blended Learning" is some combination of technology and traditional classroom instruction that may improve learner outcomes and/or save costs. Any resource can be conceptualized according to how it targets such barriers as cost, time, convenience, and quality of instruction. The way elements are blended can depend upon a variety of local factors related to the average faculty and staff salaries, faculty work assignments, support staff, and related facilities costs, but clearly the most important factor is faculty salary and work load. How these interact with development, delivery, and maintenance costs will determine the extent of savings. While students and faculty are dissatisfied with large lecture classes, synchronous instruction will not reduce costs. Asynchronous instruction can reduce costs, depending upon the number of students enrolled. If technological applications can be effective in teaching and learning, they may be used to reduce college instructional costs and extend other benefits that are currently unavailable on the college campus. Greater reliance on technology might result in several benefits: (a) equivalent or improved instruction, (b) an engaged model of learning, (c) accelerated completion of courses, (d) self-paced or personalized instruction (e) reduced dropout and reenrollments in the same courses, and (f) reduction of course duplication and redundancy. But the future of blended learning or instructional technology in higher education will most likely be determined by how instructional issues are negotiated between administrators and faculty, an issue between management and labor.

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