

I This chapter describes Clemson University's Laptop Faculty Development Program and its assessment, offering the program as one model for designing faculty development to successfully implement laptop mandates. The chapter also acquaints readers with the many types of in-class, laptop-based activities that meet best-practice criteria for effective teaching.

Laptops in Class: What Are They Good For? What Can You Do with Them?

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A number of North American colleges and universities are launching or considering laptop mandates for their students (see http://www.wcmo.edu/wc_users/homepages/staff/brownr/NoteBookList.html for a current list of about 180 universities with laptop or notebook computer initiatives), in the expectation that faculty will devise intelligent ways for the students to use them in class as well as outside. Many faculty regard these mandates with skepticism, if not cynicism, for several good reasons. Although students no doubt learn to use laptops, the skills involved are little different from those needed on a desktop, and they may be outmoded by the time students graduate and obtain employment. Furthermore, laptop mandates have not arisen in response to any major curricular change or teaching or learning problem; nor do they help meet any particular learning objective. All they might help are information technology budgets (Olsen, 2001).

As a result, classroom use of laptops has suffered an inauspicious beginning. In universities with a laptop mandate, few faculty have integrated the machines into their classroom teaching (Olsen, 2002), and many of those who have tried became disillusioned with the amount of Web surfing, e-mailing, and cheating going on in class (Mangan, 2001; "Georgia System Ends Laptop Program . . ." 2001). Some schools have sought to reduce these problems with restrictive software, and some, such as Duke University, have decided entirely against laptops because of not only these problems but others as well: the additional expense for students, the prospect of preparing the faculty, and the dearth of evidence that laptops enhance learning (Olsen, 2002).

This volume makes a strong case that laptop skeptics should look again, that very good things *can and do* happen with laptops in the classroom. Each chapter between the introduction and the concluding comments features a success story in a discipline, and some in multiple courses, at Clemson University. They address the costs and difficulties of integrating laptops effectively into classroom teaching, in particular the time spent in faculty training, the hours of additional course preparation, the technological glitches, and the creative effort. Interestingly, through assessment of Clemson's Laptop Faculty Development Program we have learned that such student behavior problems as Web surfing and e-mailing almost disappear when the laptop activities truly engage the class.

What Led to Clemson's ETS-OTEI Laptop Faculty Development Program?

In fall semester 1998, Clemson University's College of Engineering and Science (CoES) began a pilot laptop program that offered one to three sections of first-year courses taught by about a dozen adventurous faculty in mathematics, computer science, chemistry, physics, general engineering, history, and English. Laptop sections of Spanish and communication studies were added as the CoES pilot developed, and faculty in business management began their own pilot program. Fall 2002 marked the end of the pilots and the beginning of a universitywide laptop mandate requiring entering freshmen in two of the five colleges to buy and bring their own laptops to campus. Two more colleges took up the mandate in fall 2003, and the fifth in fall 2004.

We believed that, with appropriate training in laptop technology and pedagogy, faculty could make innovative and intelligent student-active use of laptops. We hoped that students would be more engaged and motivated to work harder, would have the chance to interact better with the instructor, and ultimately would learn more. These hopes indeed inspired the Laptop Faculty Development Program at Clemson University, a unit set up in June 2002 under two well-established departments, Educational Technology Services (ETS) and Office of Teaching Effectiveness and Innovation (OTEI). The idea of one unit answering to two departments might make a bureaucrat faint, but it works. ETS and OTEI play nonoverlapping roles, ensuring the best that is possible in both technology and pedagogy respectively. Over the years, these units have collaborated quite smoothly on many projects and have freely shared staff and other resources. OTEI also performs various assessment functions for ETS.

What Does Successful Laptop Faculty Development Include?

Each academic year, the provost has earmarked a modest amount of funding to award laptops to faculty who want to teach a new or existing laptop course and agree to fully participate in the program. A committee makes the

awards on the basis of the overall quality, practicality, and immediacy of the faculty member's laptop-teaching plan. The requirements are not superficial. Faculty commit to forty hours of training, and they are required to give back to the program by participating in the laptop faculty and student assessment surveys, leading workshops, giving presentations, writing articles, and participating in other forms of disseminating needed knowledge in this new field.

The pedagogy workshops are interdisciplinary communities of faculty (four to six) who explore laptop pedagogy together. Following the required six weeks, many of these communities elect to continue meeting weekly because they find the support beneficial in many ways. They continue to explore pedagogically sound use of laptops in conjunction with other technology and begin shifting their teaching styles from traditional lecture to more student-centered approaches relying on interaction, participation, collaboration, and hands-on experience.

The laptop pedagogy communities initiated and facilitated by the Laptop Faculty Development Program provide a collaborative climate through which participating faculty coauthor papers, develop presentations they give together at conferences, and create cross-discipline laptop assignments. Faculty also attend other workshops during the academic year that they deem of greatest use to them. They have dozens to choose from, including ETS technology workshops, OTEI teaching workshops, and laptop pedagogy symposia with demonstrations by experienced laptop faculty. They also visit at least a few classes conducted by experienced laptop faculty and discuss their observations in the laptop pedagogy communities to help shape their use of laptops in class.

Graduate students employed in the Laptop Faculty Development Program offer technical expertise to help faculty realize their vision for laptop use with students. The work of these employees has ranged from simply helping faculty get familiar with their laptops to Web site development, from teaching faculty how to use new software or hardware to developing complex interactive online class materials. Additionally, these graduate students and the program manager make hundreds of office "house calls" each year to give laptop faculty technical support and pedagogical advice at an individual level of need.

How Can We Assess Laptop Faculty Development? What Are the Results?

From its inception, the Laptop Faculty Development Program assumed a crucial assessment function. Performance measures include tracking attendance and meeting dates of laptop pedagogy communities, attendance at additional ETS and OTEI technology and pedagogy workshops, and participant evaluations of those events, as well as the number and quality of collaborative projects, major innovations, publications, presentations, and program responses to faculty and student needs.

Near the end of each semester, a laptop faculty and student survey targets laptop courses taught by faculty who participated in the program. The student items reflect our hopes for the program: Did students feel more engaged in this laptop class than they did in their other traditionally taught classes? Did they think the laptop helped them learn more? Did they sense they interacted better with the instructor? Did they believe they worked harder? Did they feel inadequately prepared to do the laptop assignments? Most of the faculty items roughly paralleled those for the students: Did they think their students were more engaged? learning more with the laptops? interacting better? Did they believe they taught differently (presumably more student-actively) with laptops than in traditional courses? Did they feel prepared by virtue of their training to teach with laptops? The results of these surveys continue to inform the program's next steps, notably what more it can do for faculty and students to enhance the teaching and learning value of laptops in the classroom.

We conducted the survey of faculty and students in nineteen laptop courses taught in fall 2002, spring 2003, and spring 2004. Some of those courses had multiple sections, and some were taught for more than one semester. Seventeen faculty members participated in the survey; several of them covered more than one course or section. The number of students who participated was 616. All the responses were confidential and anonymous.

We learned from the survey results that most students and faculty agree that students are more engaged and learn more in their laptop classes than in their traditionally taught classes. Sixty-one percent of students reported that they were more engaged, while 86 percent of faculty reported students were more engaged. Forty-eight percent of students reported they learned more in the laptop course than in traditional courses, with only 13 percent saying they learned less in their laptop course. Seventy-five percent of faculty reported that their laptop students learned more.

Faculty and students also agreed that faculty-student interaction was not hampered by using laptops in class (58 percent of students reported no difference, and 48 percent of faculty reported their interaction actually improved with laptop students). We also learned that students do not think they work harder in laptop classes (59 percent reported no difference). They reported that the convenience of a laptop—for example, always knowing where to find the online class materials and being able to upload assignments—made class work easier, and hands-on activities in class with the instructor there to help made complex course content easier to learn. Other students, who reported increased difficulty with a laptop course, made clear their problems stemmed from lack of computer skills or technical problems with their laptops. Most faculty members (91 percent) reported they did change their teaching style, and they largely felt prepared to teach their laptop course (77 percent).

The survey made clear that some students (14 percent) are not as proficient with computer technology as might be expected. In response to this

finding, ETS established a student technology training task force to solve the problem. The task force developed a CD-ROM of technical tutorials that was distributed to freshmen and transfer students during the summer orientation and a checklist of technical tasks and references available through a freshman portal on Clemson's homepage. Throughout the two days before classes begin, ETS staff members meet with freshmen and transfer students one-on-one to ensure that each student's laptop is set up and working properly and that each student has the working knowledge of basic computing needed to be successful as of the first day of class. Once a student successfully completes the ETS session, an "ETS Approved" sticker is put on the student's laptop to alert faculty that the student and the laptop are ready for laptop assignments in class.

What Can We Do with Laptops in Class?

The *real* question requires more elaboration: What can we do with laptops in class that (1) has genuine learning value for students (is interactive, participatory, experiential, or hands-on) and (2) cannot be done as well or at all without a laptop, at least not in class? In fact, many of the laptop activities suggested here could be done as homework on any kind of Internet-linked computer. So why not just assign computer activities to be done out of class and forget about laptops?

According to Walvoord and Anderson (1998), one guaranteed way to enhance students' understanding is to use homework as their first exposure to new material, typically in a reading assignment, and then focus class time on the interactive-processing part of the learning, during which students apply, analyze, synthesize, and evaluate the material. Laptops lend themselves well to such activities. In-class computing activities bring other learning opportunities as well: students working under the instructor's guidance; small groups working under controlled conditions; synchronous, whole-class activities (for example, a simulation); active-learning experiences that would be impossible in reality (dangerous or costly labs); and immediate exchange of and feedback on answers, solutions, and information.

Eight categories of in-class laptop activities meet both the conditions we have set. Where appropriate, we mention which chapter(s) in this volume illustrate the application. Many of the proposed activities are just obvious possibilities that reflect general best practices in teaching.

Student-Data Collection. Laptops make it easy to collect information and responses from students in a variety of ways, and to display them to the class if desired. The survey tool on any of the leading course management systems (CMS) allows anonymous collection. If student identity is useful or relevant, an instructor can choose from e-mail; a CMS testing or assignment collecting tool; or, to make student postings public, a CMS discussion board.

What data might be worth gathering?

- Virtual first-day index cards with personal information, major, career aspiration, reason for taking the course, expectations of the course, and so on
- Class survey of opinions, attitudes, beliefs, experiences, reactions to the readings, and so forth
- Classroom assessment data, such as ungraded quizzes, the Muddiest Point, the One-Minute Paper, and the like
- Reactions or questions *as they arise* during a video, demonstration, lecture, guest speaker, or class activity
- Student feedback on peer presentations
- Midsemester feedback on the course or teaching methods

The many institutions that have placed forms for student assessment of instructor online (Sorenson and Johnson, 2003) also stand to benefit. Laptops in the classroom promise to restore the high student response rate found with paper forms.

Student Assessment. Objective in-class tests given on laptops encourage electronic cheating unless we can monitor students judiciously. This means having plenty of proctors or a network computer environment with sophisticated security software. However, it is safe and convenient to administer some online forms of student assessment in class (practice test, low-stakes quiz, open-book or open-note test, collaborative group quiz, nonformulaic essay test). Low-stakes quizzes, especially if given daily, help ensure that students do the assigned reading for the day. For such accountability purposes, an “essay test” can mean just a short paragraph summarizing, reacting to, or answering a question on the readings. Group quizzes not only assess but also make students think and talk about the material. These forms of assessment render cheating unnecessary, too difficult, or not worth the effort.

Student Self-Assessment. The Web offers a variety of instruments measuring personal characteristics, abilities, and preferences, not all of which are fanciful time-wasters. Some may actually increase student self-understanding and complement the subject matter of the course. Here are just a few respectable instruments that are free (unless otherwise indicated):

- Learning styles and preferences (go to <http://www.clemson.edu/OTEI/links/styles.htm> for links to a variety of such instruments)
- Personality and temperament, using the Keirsey Temperament Sorter (<http://www.advisorteam.com/user/ktsintro1.asp>)
- Career-relevant aptitudes (<http://www.careerkey.org/english>)
- IQ (<http://web.tickle.com/tests/uiq>)
- Political ideology (<http://www.digitalronin.f2s.com/politicalcompass/index.html>)
- Leadership (<http://connect.tickle.com/search/websearch.html?query=leadership> has links to several such instruments, most of which involve an expense)

Student Research. With the resources of the Internet at their fingertips, students can conduct documentary, experimental, and survey analysis and even do field research using laptops in class; a number of Clemson University faculty have used laptops this way. History professor James Burns breaks his Western Civilization classes into small groups that research topics on the Web and report their major findings to the rest of the class. He defines the topics and, for the sake of efficiency, suggests high-quality scholarly Web sites for the students to explore. In their General Engineering courses (see Chapter Eight in this volume), Matthew W. Ohland and Elizabeth A. Stephan send their students to the Web to research physical parameters and the effect of problem constraints. Their students also use motion sensors to collect data on vibration, pH response, force versus displacement, and other phenomena in real time; they then use Microsoft Excel to analyze the data.

In his Advanced Experimental Psychology course (see Chapter Two), Benjamin R. Stephens has his students use customized online systems to design and execute their own experimental research projects, using themselves as subjects. They then write up their results and electronically exchange papers, serving as reviewers for one another. In Ellen Granberg's Introductory Sociology (see Chapter Six), students access and analyze General Social Survey data, made available on the Web by the National Opinion Research Corporation (NORC) at www.icpsr.umich.edu/gss. The site even offers statistical applets for easy analysis. Finally, biology professor William M. Surver and his colleagues are redesigning several courses so that students will research solutions to complex real-world problems on their laptops, as well as collect and analyze data from laboratories broadcast live from remote locations.

Faculty in any discipline will find scholarly research resources in the collections at these sites: <http://www.merlot.org/Home.po>, http://www.uwm.edu/Dept/CIE/AOP/LO_collections.html, and <http://www.clemson.edu/OTEI/links/subject.htm>.

Before seeking their *own* Web resources for in-class or out-of-class research, students may do well to learn first how to evaluate them. A site that links to ways to assess Web sites for scientific value and validity is <http://www.clemson.edu/OTEI/links/evaluating.htm>.

Field research is yet another activity that laptops make easier, more efficient, and more immediate. This volume has chapters on two such examples. Glenn Birrenkott, Jean A. Bertrand, and Brian Bolt pride themselves in giving their Animal and Veterinary Sciences students a hands-on education, so they conduct many of their classes at various university farms. It has been a challenge to figure out how to carry and use laptops in such dusty, wet, and remote locations, but they have succeeded, allowing their students to measure and evaluate the growth, milk production, economic value, and income-production points of various animals, all on location (see Chapter Seven). Although normally in the classroom, Barbara E. Weaver has taken

her English classes to the South Carolina Botanical Garden; students identify and chronicle locations where nature and technology collide (see Chapter Nine). Finally, in Applied Economics and Statistics Rose Martinez-Dawson has sent her students into local supermarkets to conduct price-comparison research.

Simulated Experiences. Laptops make it easy to give students a virtual learning experience under the instructor's guidance. An example featured in this volume is Paul Hyden's application of Excel simulations and demonstrations to illustrate abstract concepts in his business statistics class (see Chapter Four).

Instructors can find elaborate computer simulations on CD-ROM or the Web in many disciplines: the Business Strategy Game, Decide, Marketplace, the Global Supply Chain Management Simulation, and the Manufacturing Management Lab (developed by Clemson University professor Larry LaForge; <http://people.clemson.edu/~rllafg/mmlhome.htm>), all for business; SimCity for urban planning; Whose Mummy Is It? for ancient history; Unnatural Selection for biology and environmental studies; and SimIse and SimWorld for political science and environmental studies, to name just a few.

Virtual science laboratories are also available on CD-ROM and the Web (for example, <http://www.abdn.ac.uk/diss/ltu/pmarston/v-lab/> for biology and geography; and <http://dsd.lbl.gov/~deba/ALS.DCEE/TALKS/CHEP-meeting9-18-95/CHEP.pres.fm.html> for physics, with advice on developing labs for one's own courses).

Analysis of Digitized Performances. Although other technologies can be used to play music and to view dance, dramatic, acrobatic, and athletic performances, digital technologies offer a definite advantage for the instructor—most prominently, precise control over exactly what is played or shown when—and for the students, especially regarding the quality of the recording. In his music appreciation course, Andrew Levin adds some distinct learning advantages to going digital with laptops (see his coauthored Chapter Three). Small student groups listen to selected compositions played on laptops with an ear toward answering several interpretive and analytical questions. The students discuss the music, replaying it as needed, and discover its distinctive qualities on their own. Using customized software, they upload their responses to the Web; then Levine projects all their answers to the entire class. During the discussion that follows, he can correct any faulty responses before storing them for students' future reference.

Student Collaboration. Laptops allow students to collaborate in class on assignments and problems that require them to use the Web or special software, such as an HTML/Web editor, Microsoft Word, Publisher, PowerPoint, Excel, Access, SAS, AutoCAD, Matlab, and Maple. We have already seen examples under "student research": Burns's Western Civ students conducting Web research in small groups; Stephens's Advanced Experimental Psychology students reviewing and improving each other's research papers; and Ohland and Stephan's General Engineering students

working in pairs to collect and analyze data. One more Clemson example is William Moss's Advanced Calculus and Differential Equations course. He runs it as a "studio" course in which student groups spend all but the first fifteen minutes of class time solving problems in Maple. Moreover, laptops allow students to exchange and collaborate on all manner of multimedia presentations, portfolios, and other projects.

Learning Exercises. When students have laptops, the instructor is free to design or find online exercises (individual or small-group) that reinforce and apply the material. Perhaps the previous seven categories of activities qualify as valuable online exercises as well, but we have something more specific in mind here: a form of interactive practice by which students can learn on their own both during and outside of class. The clearest example in this volume comes from Roy P. Pargas's course in computer data structures. Laptops have allowed him and colleague Kenneth A. Weaver to redesign it to approximate the master-apprentice model (see Chapter Five). Pargas has his students download and manipulate applets of various data structures so they can observe and test each structure's dynamic behavior—a far better way to learn than watching the professor sketch static segments of the process on the board. Being a computer scientist, Pargas can program whatever applets he deems helpful to his students' learning. What about the rest of us?

In fact, hundreds and perhaps thousands of these learning exercises are available free on the Web. They are usually called *learning objects* (LO), a relatively new term for a variety of online learning tools and aids. They are formally defined as digital instructional resources that are reusable in a number of learning contexts. Most definitions also include the criteria that a learning object present a discrete, self-contained lesson that requires three to fifteen minutes to complete and that it contain its own learning objectives, directions, author, and date of creation (Ip, Morrison, and Currie, 2001; Beck, 2002). The most discriminating standards also require that the object be interactive (Wisconsin Online Resource Center, n.d.), a criterion that Pargas's applets meet. Within these parameters, a learning object may be quantitative or qualitative; text-based, auditory, or graphic (static or animated); or any combination thereof.

Learning objects for just about every discipline can be found in designated LO repositories. Perhaps the most famous ones are MERLOT (Multi-media Educational Resource for Learning and Online Teaching) at <http://www.merlot.org> and the Wisconsin Online Resource Center at <http://www.wisc-online.com/index.htm>. Project Interactivate offers a rich variety of learning objects for the sciences and mathematics; it is at <http://www.shodor.org/interactivate>. Information Technology Services at Brock University in Ontario, Canada, displays its in-house-created learning objects at http://www.brocku.ca/learningobjects/flash_content/index.html. There are repositories of repositories, hosted by the University of Texas at San Antonio at <http://elearning.utsa.edu/guides/LO-repositories.htm> and the University of Wisconsin at Milwaukee at http://www.uwm.edu/Dept/CIE/OP/LO_collections.html.

Learning objects are also scattered around the Web for specialized topics, such as biology, nursing, and bioengineering, at <http://www.cellsalive.com> and optics at <http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/index.html>.

Conclusions

Our survey findings and the teaching innovations of the Clemson University laptop faculty clearly show that laptops can provide the impetus for instructors to make their classes more student-active, thereby increasing student engagement and learning. These benefits can accrue without sacrificing the quality of student-instructor interaction or adding to the student workload. But they do not automatically accompany laptop use; nor can laptops transform a poor instructor into a good one. Rather the benefits flow from *faculty* involvement, commitment, and effort, specifically:

Active participation in both technology and pedagogical training
 Willingness to change aspects of their teaching style and formats—in particular, to move toward a studio, master-apprentice, interactive, hands-on, discovery-based, experiential, or collaborative model of teaching and learning (obviously more challenging in a large class)
 Willingness and ability to invest considerable time in developing pedagogically sound and student-engaging laptop assignments, exercises, and projects

The faculty who developed the innovative, pedagogically valuable uses of laptops featured in this volume displayed all these essential qualities from the start.

We emphasize these demanding requirements imposed on faculty to caution laptop advocates who may look to technology for easy, time-saving solutions. But we also advise the naysayers that they'd better look again. Laptops are not just another glitzy technological toy. They can make good things happen in the classroom and enhance learning in ways that no other current technology can.

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