Student Laptop Ownership Requirement and Centralization of Information Technology Services at a Large Public University

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EXECUTIVE SUMMARY

A large, highly ranked public university implemented a requirement for all incoming undergraduates to own a laptop computer starting in fall, 2000. To control increased expenditures for information technology, this requirement has shifted some of the cost of technology to students by decreasing the need for centralized general-purpose computing laboratories.

At the same time, a shift towards centralized academic computing support occurred. This shift was away from information technology resources, services and support based in individual departments. This shift, engineered by the newly formed office of the Chief Information Officer (CIO), was envisioned to generate cost savings through economies of scale.

The educational impact of the laptop requirement is starting to be felt, but adoption is not widespread in daily classroom use. Envisioned cost savings have not yet become apparent. However, laptop ownership has enabled some new classroom activities, and helped to reinforce the leading-edge image of the university.

ORGANIZATION BACKGROUND

The subject of this case study is a large US-based public university with a liberal arts focus. Ranked well within the top 50 universities by US News and World Report (2001), and within the top 10 public universities overall, the institution had a solid history of leadership in education. Like most public universities, a large component of the subject's mission was to bring low-cost and high-quality education to the undergraduates of the state. With tuition under $5000 per year for in-state students, and numerous nationally recognized academic programs, the university had a good record of accomplishment on this mission.

Universities, by definition, are composed of schools and colleges. All universities have a variety of undergraduate academic programs based in the schools and colleges, typically including liberal arts (such as humanities and social science), the sciences (physics, biology, chemistry), and professional studies (business, journalism). Graduate programs at the subject organization included the range of undergraduate programs listed here, plus medical professions and others, with over 100 different Ph.D. and Master's degrees offered.

The different schools and colleges within the subject university had different needs and uses for information technology. By 2000, all students and faculty, regardless of their academic program or home department, made significant use of information technology. Students made regular use of email and the Internet for class research, communication

with their peers and faculty, and fundamental activities such as course registration and tuition billing.

Within the university, there had historically been inequity across academic units (the schools, colleges and academic departments that compose them) for information technology access and support. Units with strong internal and external funding (from grants and other sources) might have been able to provide laboratory or research facilities for students and faculty, while units without such funding needed to split their technology funds for a variety of purposes.

Laboratory and research facilities would include materials that were discipline specific (such as Bunsen burners for wet chemistry labs), but all disciplines relied on general-purpose microcomputers and servers. In addition, these computers required staff support to purchase, configure and maintain. In many disciplines, specialized software was required that could be quite expensive or time consuming (in support staff hours) to acquire, configure and maintain.

Special-purpose laboratory and research facilities supported faculty and graduate students, but undergraduates tended to require general-purpose computing facilities. The subject university, like most universities of its size, had a centralized non-academic unit that controlled most general-purpose computing facilities. This academic computing unit ran central servers for the campus (backup servers, email servers, Web servers, etc.) and numerous computing laboratories with microcomputers, printers and a variety of software. The unit also offered training and support on a variety of topics, from basic email use to advanced statistical computing.

Because the academic computing unit focused on student needs, departments could effectively outsource their requirements for microcomputer support, software maintenance and staffing to the unit. Historically, this meant that schools and departments without significant specialized computing needs and flexibility in funding had very little discretionary budget for information technology. The result, which was most apparent in the humanities and some other academic disciplines, was that faculty and staff had woefully outdated desktop computers, little or no appropriate software, and no departmental support or funding for upgrades.

To summarize the organizational setting:

1. A top-ranked public university, with a mission to educate undergraduates from across the state at a reasonable cost.

2. A centralized non-academic academic computing department, offering centralized servers, training, software and support. This department ran numerous microcomputing laboratories on campus for student use.

3. Many academic units (schools, colleges and the departments that composed them) with strong internal infrastructure for information technology, including specialized computing facilities, personnel and a recurring budget.

4. Many other academic units that relied on the academic computing department for their students' needs, but had little or no budget or staffing resources to meet the needs of their faculty, or the specialized needs of their discipline, or to equip classrooms or other shared spaces.

SETTING THE STAGE

A large US-based public university faced significant challenges in keeping up-to-date computing facilities for students and faculty. Because the budgeting process for the university could be unpredictable, and funding and funding sources for a particular department, school or college were changeable, deans and department heads were forced to choose between information technology expenditures and other necessities. In a given year, a dean might be forced to choose between physical infrastructure (such as office renovation for staff), supplies (such as a new photocopier) and information technology (such as new faculty desktop PCs). The dean might have no assurances that the same level of funding would be available in a future year, making long-term planning difficult.

In the late 1990s, the subject university recognized several important facts:

1. Little standardization in information technology purchases and practices existed, resulting in many different and hard to maintain microcomputers and related facilities, with little staff to effectively maintain them.

2. Specialized software for particular disciplines was available in some laboratories, but not others. Centralized university-wide practices for software acquisition was available for the lowest common denominator software only (e.g., Microsoft Office and operating systems, statistical software from SAS, and desktop applications and utilities such as Norton Anti-Virus).

3. Centrally administered computing laboratories were extremely popular, but also very expensive to run. Regular upgrades to hardware and software were required, and staffing and infrastructure were required, as well as space.

4. Many faculty members, as well as departmental computing laboratories for students, were languishing with computers more than 4 years old. Some buildings had not yet been updated to bring 10baseT networking to all classrooms and offices. Wireless standards, while emerging, were too changeable for campus-wide deployment.

5. Increasing numbers of students owned computers, from a variety of vendors, in laptop and desktop formats. These students made use of network connections in the dorms, libraries and elsewhere to do their work. Students without their own computers would visit computing laboratories, but many laboratories lacked modern hardware or software.

6. Computers were becoming critical to the everyday academic lives of students and faculty. Several leading departments, combined with the overall technology

prevalence on campus, made it clear that ubiquitous networked computing was a near-term expectation for constituencies.

These and other facts led the campus administration to seek to control costs through increased centralization of computing services and facilities, and to create standard expectations for student computer ownership. In early 1998, a plan was announced that was intended to control costs while mandating student ownership of laptop computers. The plan was put into effect for all undergraduate freshmen incoming in fall 2000, who were required to own a laptop computer compliant with university specifications. While there was no specific requirement for graduate students, several graduate programs decided to implement their own laptop ownership requirement. The decision to require student ownership of computers was not unusual among higher education institutions (see Communications of the ACM, 1998). The subject university was an early adopter, and one of the earliest large public universities to require computer ownership.

After an open bidding process, the university negotiated with a leading multi-national hardware vendor to supply laptop computers to the university at a moderate discount, with customizations and warranty services not otherwise generally available in 1998. Students, as well as campus departments and faculty, could purchase this vendor's computers via the university, or they could purchase a computer elsewhere, as long as it met the minimum performance requirements.

In spring 1999, as part of the overall program for increased centralization and standardization, several academic departments that had sub-standard computing facilities were upgraded. These departments, including biology and English, would also deliver some of the first laptop-customized content for the freshmen of 2000.

CASE DESCRIPTION

The Cost and Necessity of Computing

> A laptop is only so useful if it's not networked. Either make the wireless cards part of the package or increase the number of Ethernet jacks by a factor of 25 or so. (Student quote from Li & Newby, 2002)

Soaring costs combined with increased reliance on information technology, including basic microcomputers and software, had been recognized at academic institutions since at least the early 1980s. By the late 1990s, the pace of hardware and software innovation and increased performance had resulted in a tough reality: the effective lifetime of a modern computer was at most 3 to 4 years. Even this short lifetime assumed capable systems administration and upkeep, including regular software upgrades for the operating system and applications.

The harsh reality was that leading universities needed to provide good computing facilities for students and faculty. Ongoing upgrade needs were a fact, as was the need for expert support staff to maintain the equipment, plan, and train the users. Features of the latest software and new devices (such as scanners, color printers and digital cameras)

were and are desirable in the academic setting. Demand for centralized services of all types was high and growing.

By the end of the 20th century, email and Web pages at leading universities had achieved infrastructure status. Everything from student registration to coursework happened via email and the Web, and even short outages of central computing facilities could have disastrous impact. At the subject university, the response was to centralize services under a new Chief Information Officer (CIO) position and task this officer with controlling costs, increasing quality of service, and ensuring equity of access to computing for all students and faculty.

Recognizing that budget disparity and autonomy were challenges to the CIO's goals, the university administration's response was to increase centralization. Whereas departmental computing laboratories had been the norm, centralized laboratories would be favored (with funding for departmental computing slashed). Instead of each department, school or college having technology staff dedicated to that unit, the units would turn to the centralized administrative computing unit for assistance. Departments were not forced to utilize centralized services, and many chose to maintain their own separate infrastructure for email, Web pages, tech support, etc. In order to do so, the departments had to possess sufficient budgetary latitude (from grants and many other sources), along with a department chair or dean willing to allocate the needed funds.

The result of this centralization was generally favorable. Those departments with specific needs (and the money to support them) could go their own way. Departments without money or specific needs, which included most of the large departments offering service courses to undergraduates, could utilize more cost-effective centralized services. In turn, those departments would lead the way at integrating laptop computers into their courses.

The CIO envisioned cost savings because of student ownership of laptop computers and increased centralization of facilities. The cost savings after 2 years, if any, were hard to see and never made public by the administration. In fact, evidence of increased expenditures for computing was available in most departments – and in the student loans of incoming freshmen. Centralized computing facilities and their support infrastructure (staff, software, etc.) did not go away, and continued to require costly upgrades. Demand for training and other services, as well as centralized large-scale platforms for statistical and scientific computing, continued to grow. While it seemed logical to assume some cost savings due to better standardization on microcomputing equipment and decreased need for specialized departmental staff, real budgetary figures supporting these cost savings were not made available to support this case study.

Criticism of the Laptop Ownership Requirement

> I was frustrated because I already have a laptop (one I'm still paying for), although it's four years old and can't be upgraded to current standards. (Student quote from Li & Newby, 2000)

The implementation of the laptop requirement, along with increased centralization and standardization, met with some resistance, especially from technically proficient faculty. Because of the budgetary control the central administration of the university has over most departments, as well as standards for incoming students, the plan was able to go forward with few changes. Criticism included:

1. Pedagogy. The utility of laptops (or any computers) for undergraduate education had not been adequately demonstrated, and the fit with some academic programs was not clear.

2. Cost. At $2000 to $3000 (depending on the model purchased), the laptop computer increased the first year tuition, room, board and fees total costs for a student by 30-50%.

3. Longevity. The student laptop was expected to last for all 4 years of the undergraduate education (and a warranty service for those bought through the university was intended to maintain this functionality). However, 4-year old computers were seldom able to utilize modern software or devices, and were difficult or impossible to upgrade.

4. Infrastructure. While 802.11b wireless was available in some parts of campus, most classrooms had no network connectivity and few or no power outlets for student use. This limited the utility of the computers for many types of applications that faculty could envision.

5. Support. Little faculty training was included, and there were few incentives for faculty to incorporate laptop use into their courses. At the same time, students were offered almost no training on how to utilize their computer effectively, with little attention to proper ethics or security for computer use.

Overall, however, events proceeded as planned. Faculty upgrades to biology, English and other departments preceded the first semester of laptop-enabled freshmen. The curricula for several large-section freshman-oriented courses were upgraded to include laptop use for science laboratory and writing assignments.

Ten to twenty percent of incoming freshmen were given grants to help cover the cost of their laptop computers, or pay for them entirely. The others were offered some help in getting a student loan to cover the cost of the computer. Part of the grant funding came from proceeds from the laptop sales by the campus, and part came from central university sources.

Use in the Classroom and on Campus

> I've seen some students taking notes on their laptops, but I've also seen students using computers in class to surf the web, engage in instant messaging conversations, and check their email.
>
> People will check their email or play games in class instead of paying attention, annoying the rest of us with their typing. (Student quotes from Li & Newby, 2002)

Some of the best uses of laptop computers in the classroom appeared in the academic units that already had the best computing infrastructure and support. High-technology departments such as computer science, information science, journalism and business had already integrated the use of Web pages and modern microcomputer software and applications into their curricula. In these departments, faculty had access to the same modern infrastructure, and many faculty members had already adapted their courses to utilize it.

Unfortunately, many students at the subject university were unable to benefit from these leading departments. This was either because they did not take courses there, or simply because the first two years or so of the undergraduate education emphasized general liberal arts requirements over specialized courses. These general liberal arts courses were likely to be taught in very large classrooms (over 100 students), often by teaching assistants or adjunct faculty, and with little integration of laptops.

In those courses where the laptop plan had focused, laptop use was evident. Students were able to engage in writing exercises, science laboratory experiments, and other educational activities. These activities were not previously available, or were not as flexible and powerful as they were with the laptops.

Because all incoming freshmen had laptops, prevalence of their use was evident everywhere on campus. Students in libraries and classrooms would use their laptop computers for taking notes and, where available, to access the Internet. Off-campus housing, like on-campus dormitories, offered high-speed network access. Even cafes and other off-campus eateries started to provide power outlet access and 802.11b network connectivity for their patrons. By 2002, most of the campus was covered by 802.11b. Power and workspaces remained hard to find in most parts of campus.

The use of centralized services by these laptop-enabled students somewhat decreased the demand for general-purpose software in public computing laboratories. Demand for special-purpose software and equipment however, such as multimedia software and scanners, was higher than ever. Student laptop computers came with at most a few hundred dollars worth of software: an operating system, a Web browser, office productivity software (including a word processor) and utilities. A computer in a well-equipped departmental laboratory would often have in excess of $10,000 of software, ranging from statistical applications to modeling, with many high-end peripheral devices.

The demand for centralized email, Web pages, and other server-based facilities continued to grow. So did the demand on the university's already considerable network bandwidth to the outside world, as everything from multimedia email, to Web pages, to peer-to-peer file sharing gained in popularity. Demand for centralized training did not grow much for the first generation of laptop-enabled students, primarily because these students (usually recent high school graduates) were already familiar with email, the Web and office applications.

Student Perceptions

> Because I'm so inexperienced with computers, I felt compelled to purchase my laptop from U. xx -- thus making it an even more expensive purchase -- so that I would be guaranteed assistance in case of any problems.
>
> I've been frustrated because most professors do not require it in class. … xxxx does not require us to use the computers enough to justify the laptop requirement.
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> Faculty will need to greatly increase their computer skills to successfully incorporate laptop use in the classroom. Another is the variation in faculty support, some professors seem to think the requirement is unnecessary and therefore have little reason to incorporate laptops into their courses. (Student quotes from Li & Newby, 2002)

A doctoral student in information science at the subject university, in cooperation with the author of this case study, performed research on student perceptions of the laptop requirement (Li & Newby, 2002). The study, first conducted in fall 2001 with a follow-up in spring 2002, gathered qualitative and quantitative data from graduate students and faculty in the school of information and library science, which had historically been a leader in the use of information technology at the subject university.

The school studied was not an accurate mirror of the rest of the university, but exhibited many of the same trends. The school implemented its laptop requirement for graduate students one year after the university's requirement, for fall 2001. The research did not address the general undergraduate population, but rather the more specialized graduate population of the school. Nevertheless, the empirical data gathered in the research echo the less formal reports, student newspaper articles, informal interviews, course syllabi and other sources of data used for this case.

The overall perception of the students is that laptops were under-utilized in the classroom, and their uses did not justify the expense of the laptop purchase. Students who purchased from the university believed they over-paid, and wished they had better guidance to make an informed purchase elsewhere. Students who purchased elsewhere felt uncertain about the support they could get from centralized computing. Students did not see pedagogical benefits to laptops in the classroom, and questioned faculty commitment to their use.

Nearly all students (out of 41 responses, from a student population of about 275) were willing to be patient as the school's faculty decided how to integrate laptop use in the classroom. By the end of spring 2002, however, many students had never been required to bring their laptop to the classroom, and had not taken courses that had integrated the laptop.

The research also solicited input from the school's 17 full-time faculty, but very little was forthcoming. Analysis of course syllabus materials revealed that of 100 or so course sections offered in the school during the 2001-2002 academic year, only a handful made regular use of laptops in the classroom. Another handful made occasional use, as a

replacement for scheduling time teaching in the school's computer laboratory. The vast majority had no explicit laptop requirement.

These negative results are offset somewhat by the phase-in of the laptop requirement for the school. As for the undergraduate requirement for the university as a whole, incoming students were given the requirement, but students already enrolled were not required to purchase a laptop. For the school, most graduate students graduated in two years, resulting in about one-half turnover in the student body every year. Thus, only the second year would see nearly 100% of students with the laptop requirement. Nevertheless, the fact that such a small proportion of course sections have made use of the laptop requirement during the first year is disquieting.

Success?

> It will probably take several years to assimilate the laptops. We're still just figuring out how they will be most useful.
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> In the future, many of the students entering the program will have grown-up using laptops in their classrooms before they even get to the university level, so I think it will be the norm rather than being a special requirement. (Student quotes from Li & Newby, 2002)

The leading-edge image of the university, along with the value of the education it provides to the people of the state, was served well by the laptop requirement. Significant upgrades to centralized services occurred, awareness and support for the integration of computing into coursework improved, and interested faculty members had good intellectual and practical resources for this integration. Departments with specialized needs were, generally, able to meet those needs as well as they were previously or better. The shift towards increasingly capable centralized resources enabled many departments to eliminate some general-purpose training, facilities and services.

The actual educational impact of the laptop requirement was largely unmeasured, and at least to some extent immeasurable. In 1998-1999, over 75% of undergraduates possessed a computer. The laptop requirement meant that students with a computer could bring the computer to class, to the library, etc. Would this portability result in better education? It seemed clear there were several good examples of classroom activities that were enabled or improved when students had a laptop computer. The long-term impact on quality of education, across a 4-year undergraduate program, was more difficult to assess.

CURRENT CHALLENGES/PROBLEMS FACING THE ORGANIZATION

> Right now we have great discussions in some classes, but if we all have our attention directed at our laptops we will be losing a lot of the interpersonal communication and class participation.
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> Inside class, discussion may be reduced for everyone concentrates on his or her screen and is busy typing. Outside class, however, interactions may increase for students are free to contact each other when they have

> an idea via email if they have the wireless connection to the Internet. (Student quotes from Li & Newby, 2002)

Information technology alone was not sufficient for high-quality undergraduate and graduate education. Challenges facing the subject university included eroding budgetary support from the state, the need for renovations to buildings, soaring costs for library materials, and so forth. Faculty and staff salaries in most departments were not competitive with peer institutions. Demand for education, especially undergraduate education, had grown because of population shifts and a growing high school populace.

Despite information technology's role as one factor among many, it was one of few items with immediate understanding and appeal among all the major constituents of the university (students, faculty, staff, administration, state officials, national accrediting agencies and others). Providing ubiquitous computing and networking was, undoubtedly, the near-term future of leading universities. The subject university had taken an early leadership role among public institutions at reaching towards this future.

The laptop implementation and related technology centralization and upgrade described here was likely to produce numerous new challenges, some of which had already emerged by the second year of the laptop requirement. These challenges included:

1. Software and hardware obsolescence. After only two years of requirements for undergraduate laptop ownership, base requirements for CPU speed and disk drive size doubled. It would be difficult, by the 3rd and 4th year of laptop ownership, to support and service older computers. The software and devices of 2003-2004 might not run effectively, or at all, on the laptop computers of 1999-2000.

2. Providing upgrades. Students were given almost no training in the daily maintenance of their laptop. Operating system and application upgrades, while available cheaply through university site licenses, might be impractical for students with little training and support. Critical security upgrades were similarly likely to go unapplied.

3. Campus warranty service for computers purchased through the major manufacturer's program was in demand. As computers get older, warranty service needs increase, and could result in increased costs as well as greater potential for poor service. (Consider: at the start of the laptop requirement, 100% of laptops owned by students in the program were less than 1 year old. But in the steady state, when all students have laptops, the average laptop will be 2-3 years old.)

4. Ergonomic challenges were encountered by many students. The campus was not diligent about suggesting external monitors and keyboards for students to use with their laptops while at home. (It did improve dorm furniture to offer better ergonomic positioning for typing, however.) Classrooms were ill equipped to enable students to sit with proper body position to avoid strain, including repetitive strain injuries, while using their computers. Health complaints by students were heard in many classes: lower back pain, wrist strain, eyestrain, and

other ailments. There was at least some potential for lawsuits resulting from the lack of appropriate furniture and training for student use of laptop computers.

5. Lack of cost savings was, as described above, a strong possibility. Despite increased effectiveness and utility of computing on campus, it seemed unlikely that significant decreases in the budget for information technology would occur. While this was not, in itself, a problem, state agencies and administrators with budgetary oversight for information technology expenditures could decide to take other measures to control costs.

Many questions about the specific implementation choices made by the subject university remained, as well. At a fundamental level, requiring a laptop over the cheaper desktop alternative can be questioned. The multi-national vendor with which the university contracted for provision of laptops is another decision that could be questioned: were there sufficient cost savings from this vendor? By 2002, the vendor (which has significant control over the particular laptop model available through the university laptop program) had never made the top-end technology available. When combined with twice-yearly updates to the model availability, this has resulted in offerings that were badly outdated and not favorably priced by the end up the update cycle.

The notion of standardization for campus computing was difficult, and it seemed that the CIO's goals for standardization were potentially unattainable. While the single vendor was, in fact, the choice of the majority of incoming students (rather than buying a computer elsewhere), there were at least four different models sold to students per academic year. (The models were a medium and high-end laptop, and both were updated at least once during the academic year as technologies changed.) Thus, the steady state expectation (after 4 years) is that at least 16 different models would have been sold and in widespread use. (In addition, a similar variety of desktop models would have been deployed to departments and computing laboratories.) It was hoped that the vendor would continue to make repair and support of the older models viable and cost effective, but this is yet to be seen. Furthermore, the possibility of changing vendors existed for a future time.

The overall quality of centralized information technology services was subject to debate. As mentioned above, training for new students' use of their laptop computers was extremely limited – less than 3 hours in the summer before their first semester. The nature and variety of demands that students (and faculty) would make on the centralized support unit was not immediately clear. Academic computing provided significant services for students as part of the efforts described here, including a 24-hour telephone support hotline, some 24-hour computing laboratories, and better cooperation with administrative computing and the registrar to insure all students had a unified login and password to services. Nevertheless, growing pains and unanticipated events were anticipated. Challenges in the first two years included student misuse of the campus network, high-tech cheating, and lack of awareness of security risks to networked computers.

CONCLUSION

> I like my laptop and I'm glad I have it, but there are times when I'm not sure the cost was justified by how I use it.
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> In my opinion, the biggest issue regarding the laptop requirement, is balancing/ justifying the cost with students' needs.
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> The fact that laptops aren't integrated into the curriculum and that students drop $2,000 for nothing! (Student quotes from Li & Newby, 2002)

The university described in this case was highly ranked nationally, and a leader among peer public institutions. With a large and diverse student body, it was not feasible to provide an information technology solution that met the needs of all constituencies. By increasing the centralization of information technology services on campus, and implementing mandatory laptop computer ownership for incoming students, a tighter control on costs was expected. Higher quality information technology services were also expected. While actual cost savings were difficult or impossible to measure (and may never materialize), there were clear indicators of increased efficiency through centralization.

The pedagogic benefits of ubiquitous laptop ownership were, from the point of view of the campus CIO and others behind the laptop plan, of secondary concern. Uses for laptop computers in several large undergraduate classes were created, but most classes only benefited to the extent that individual faculty or departments choose to develop laptop-friendly courses or course segments. In most departments, there was little or no pressure for faculty to integrate laptops in to their curricula. However, some departments, especially those with graduate professional programs, significantly redesigned their programs to make use of laptops (and provided faculty with support and inspiration to participate).

The number of families in the US that own computers has continued to grow, and as a result, the number of undergraduate students with computers has continued to grow. It is reasonable for these students to expect that computers, which are already a part of their home lives and high school curricula, will be important tools for their college careers. The university described in this case took a proactive step towards ubiquity of networked computing in society, by making them ubiquitous on campus. Despite challenges, oversights and obstacles in the particular implementation described here, it seemed likely these steps were in the right direction.

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