REPORT

When Computers Go to School

How Kent School Implemented Information Technology to Enrich Teaching and Learning

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Preface

Kent School, a private college preparatory school in New England that was founded by clergy of the Episcopal church almost 100 years ago, is a pioneer in the use of information technology for instruction and learning. Few academic institutions had undertaken a technology program of comparable scope when Kent initiated its program in 1996, so there were few precedents to guide Kent safely past the pitfalls inherent in using a new technology. Accordingly, some missteps were taken during the first two years of the program—not an unusual experience for pioneering organizations. What is unusual is the speed with which Kent analyzed the situation, marshaled its resources, made midcourse corrections, and persevered. Equally noteworthy is Kent's willingness to share its experiences so that they may serve to guide and benefit other educators.

This report synopsizes key findings of a longitudinal study, commissioned by Kent School, of the use of information technology for teaching and learning at Kent. The report has two purposes. It aims to serve as a convenient summary of the full report (which was delivered to Kent) for use by the Headmaster, the Technology Committee, and other members of the faculty. It also aims to share with the educational community at large some of the insights Kent gained about the use of technology for teaching and learning.

From these insights can be drawn two main themes that are likely to be of interest to educators who are pursuing the academic applications of information technology. First, faculty and students' comments suggest the potential ways that information technology can be used to enrich teaching and learning, and the innovative uses of the technology developed by the Kent faculty may have practical applications in other educational settings. Second, this study posits that the degree to which faculty and students integrate information technology into their activities is likely to depend in large measure on the way the technology is implemented.

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The members of Kent School's Technology Committee envisioned information technology being used to enhance or extend the learning process when they recommended in 1995 that the school initiate its technology program. Since then, the school's experience with information technology has taught two broad lessons. The technology can be used to enrich teaching and learning. However, the degree to which faculty and students integrate it into their academic activities depends on its being implemented appropriately.

Typically, faculty reported that the technology helped them "energize" or "engage" students both during class and outside it. They reported that the technology provided rich resources that they used to illuminate lessons and develop "authentic" learning exercises for their students. Further, they reported that information technology reduced the investment of time and effort in activities that are peripheral to the learning process. Students' comments were consistent with those of the faculty.

Kent's experience demonstrates the importance of sound implementation practices to the successful integration of the technology into teaching and learning—it was found that the benefits of information technology are not likely to be obtained simply by putting computers into the hands of faculty and students. Some specific findings from Kent's experience follow:

- Proactive communication informed individuals of the true benefits to be gained from the technology and the true cost they would incur to use it.
- Training reduced the time and effort required to learn to use the technology successfully.
- Equipment was upgraded and, as a result, it was easier to use and more reliable than formerly.
- User support was enhanced to minimize the costs individuals incurred when components of the technology malfunctioned or were damaged.

Implementation at Kent is an ongoing activity. It aims to anticipate and proactively accommodate both technological advances and the evolving needs and preferences of faculty and students.

Although the overall advance of information technology can be predicted, not every situation affecting its use can be foreseen. Fortunately, Kent could draw on a reserve of human, technical, and financial resources to remedy problems before the negative outcomes compounded. To make corrections quickly and relatively inexpensively, and to limit the number of individuals who might be subjected to negative experiences with the technology, schools less favored than Kent might consider (1) scaling back technology programs that

would otherwise commit all available resources and thus provide a reserve that could be used to address unforeseen situations or (2) starting with a pilot program that would flush out unanticipated problems—and limit their scope so that they could be corrected with fewer resources—before initiating a fullscale program.

Acknowledgments

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I am also indebted to M. Willard Lampe, II, former Academic Dean, and Thomas K. Roney, Chair of the Mathematics Department and Chair of the Technology Committee, who coordinated, respectively, activities related to the first and second phases of this study. Their assistance and advice were invaluable in helping the study achieve its goals. Adam Fischer, Director of Information Services and Technologies, who led the revised implementation activities that are described in this report made central contributions to the research. Other members of the faculty and staff gave generously of their time to further the study. Their efforts, insights, and contributions are greatly appreciated, and I hope that they will excuse me for not acknowledging them individually.

The study and this report benefited substantially from the comments and suggestions of colleagues at the RAND Corporation, in particular, Susan Gates, Sheila Kirby, Eileen Miech, Abby Robyn, and Brian Stecher.

CHAPTER ONE

Introduction

There is no universal agreement whether schools should invest in information technology for teaching and learning. On one hand, authorities such as the President's Committee of Advisors on Science and Technology, Panel on Educational Technology, have integrated information technology into their vision of a curriculum that would help individuals acquire new knowledge, develop critical thinking skills, and solve existing and new problems creatively (President's Committee, 1997). It has been posited that technology can facilitate learning by enhancing students' ability to experiment, practice, and experience the real world (e.g., Papert, 1996). Further, the ability to use information technology well will affect individuals' personal productivity and economic well-being and, in the aggregate, the nation's competitive position (President's Committee, 1997; Castro, 1998). The popularity of computers in schools suggests that these and similar arguments have resonated with educators; for example, in 2000, 98 percent of all public schools had access to the Internet, 77 percent of the classrooms had access to the Internet, and one computer with Internet access was available for every seven students (Cattagni and Farris, 2001).

On the other hand, respected scholars have asked, "Is Spending Money on Technology Worth It?" (Cuban, 2000), and many have concluded that it is not. One position seems to be that investments in technology are not prudent because it is underused—when indeed it is used at all (see Cuban, 2000, 2001; Costlow, 2001). To this point, great expectations have existed for educational technology since at least the early 1980s (see Lesgold and Reif, 1983), but relatively few successes with it have been reported. Although that position does not foreclose the possibility that technology might someday be used effectively in education, a less sanguine perspective questions whether technology would be a boon to education. More specifically, it questions whether students can cope with a richness of information resources and whether technology-mediated applications will render the curriculum banal and produce individuals of shallow intellect largely by externalizing and homogenizing thought and by eliminating introspection (see Turkle, 1995; Birkerts, 1994). In this vein, it has also been asserted that technology will routinize the educational process and deskill educators (Noble, 1998).

Kent School's Experience with Technology Illuminates the Debate

Kent School's experience suggests that information technology can be used to enrich teaching and learning for both faculty and students. However, successful integration of the tech-

nology into education does not necessarily follow when computers are put into the hands of teachers and students. Individuals' motivation to integrate the technology into their activities appears to be influenced substantially by the way the technology is implemented.

Kent's experience suggests guidelines for implementing the technology, which other educators may find informative. Initially, Kent's implementation practices resulted in some unintended outcomes—a finding that is not surprising because Kent pioneered an ambitious, new application of educational technology, largely on its own, with few mentors to guide its efforts. What is surprising is the speed with which Kent evaluated the progress of its technology program, marshaled its resources, revised its implementation practices, and persevered to achieve results that, in general, faculty and students reported were successful. Consequently, Kent's experience is a particularly valuable source of insights; the early period warns of potential pitfalls, and the subsequent period suggests practical guidelines for sound implementation strategies.

Kent School and Its Technology Program

Kent School is a private college preparatory school in New England. It enrolls approximately 550 students, male and female, in grades 9 through 12. Approximately 93 percent of the students are "boarders" who live on campus during the academic year. Typically, Kent students come from environments where education is valued highly and where it is taken for granted that they will enroll at a college or university and earn at least a bachelor's degree. Typically, the students' parents are affluent, but the school grants a number of scholarships, which introduce a measure of socioeconomic diversity into the student body. The student body also is diverse with respect to ethnicity, race, religious background, and geographical distribution (students come to Kent from all regions of the United States as well as Canada, Latin America, Europe, the Middle East, India, and Asia).

Kent's faculty includes approximately 75 members, more than half of whom hold one or more advanced degrees including the doctorate. Classes are small, usually having 8 to 12 students. The curriculum honors traditional educational values and includes courses in Greek, Latin, and theology, which reflects Kent's heritage as a school founded by clergy of the Episcopal Church almost 100 years ago.

Although Kent embraces tradition, it is not a newcomer to information technology. In 1966, faculty and students were connected to General Electric's computer-timesharing facility. The following year, Kent arranged for its faculty and students to use Dartmouth College's computer facilities and the recently developed "BASIC" programming language, which members of the faculty used to design programs for mathematics and language courses. In the late 1960s, the school acquired a mini-computer. In the late 1970s and early 1980s, stand-alone personal computers began to appear around the campus. In 1995, Kent's Technology Committee advised the headmaster that information technology could provide students with experience "important not just to their future productivity, but to their very understanding of their world and its possibilities" (Kent Technology Committee, 1995). The committee made the following recommendation:

> The Committee intends that technology at Kent School should serve the curriculum and the community. Technology acquisitions should be driven by identifiable curricular goals to enhance or extend the learning experience. Technology improve-

> ments should enable students (and teachers) to become more active agents of their own learning. The technology we choose to incorporate should improve communication within the school community and between the community and the world.

Shortly after the committee presented its recommendation, in 1996 Kent embarked on a program to integrate information technology into teaching and learning. To that end, the school installed a computer network and equipped all faculty and students with laptop computers that they could carry with them to class, the library, etc., and connect to the network from almost anywhere on campus, which gave them ready access to email, shared folders, and the Internet. Two years after its inception, Kent invited the RAND Corporation to review and comment on the program.

Methodology of This Study

This study uses an "exploratory case study" research design (Yin, 1989). Experimental strategies were not appropriate because all faculty and students had equal access to the technology when the study began. Data were collected mainly during academic years 1998–1999 and 2000–2001. Core data about participants' use of the technology and their attitudes toward it were gathered through surveys that were administered, respectively, during winter term 1998 and winter term 2000. The surveys, each of which consisted of approximately 10 pages of questions about an individual's use and perceptions of information technology, asked faculty and students to estimate quantities (e.g., hours on specified tasks), check applicable items on lists, mark choices on Likert scales, and write brief descriptions or comments. The faculty surveys included faculty-specific questions and, likewise, the student surveys were tailored to their use of the technology. Over 75 percent of the faculty and students completed each of the surveys.

Survey data were illuminated by interviews of faculty and technology department staff, focus groups of students selected at random from representative groups (e.g., year in school, gender, native English-speaking or not, and boarder/day student status), observations of classes, and observations of technology department operations. Self-reported measures were, where possible, triangulated with other sources (e.g., individuals' estimates of their use of email were compared in the aggregate with system-maintained logs of message volume). Data were analyzed in the aggregate (i.e., data were not identified by individual) using, largely, simple descriptive statistics. Analyses of the data with respect to certain dimensions (e.g., whether students' native language was English, whether they lived on campus) are not discussed in this report because differences are not statistically significant and do not appear to be germane to the issues covered here. Socioeconomic data were not collected to protect the privacy of students receiving scholarships. Information about the initial years of Kent's technology program, (i.e., before this study began) was gathered mostly from comments written on the questionnaires and expressed during interviews and focus groups; it was supplemented in part by data from archival sources.

Organization of This Report

Chapter Two, with the aim of addressing the question whether information technology can be used to benefit teaching and learning, summarizes the uses and benefits of the technology that were reported by Kent faculty and students. Several of the examples are innovative and

may be of particular interest to other educational institutions. Details are provided in the appendices about three of them: the integration of Kent's intranet into the curriculum; an application that helped students bridge spatial and cultural distance; and an application that enabled an instructor to devote more time to the substance of students' work by reducing the manual effort required to correct their assignments.

Chapter Three reports that even though, in general, faculty and students expressed positive opinions about the technology, many of them were hesitant to integrate it into their activities. The chapter summarizes data about their use of the technology and posits a theoretical rationale to explain their behavior. The data suggest that information technology is not likely to be used well, if indeed it is used at all, unless it is implemented in ways that are responsive to the intended users' perceived needs.

Chapter Four reviews lessons learned at Kent that may be particularly helpful to educators who would like to integrate information technology into teaching and learning.

CHAPTER TWO

Kent Used Information Technology to Enrich Teaching and Learning

Traditional methods of instruction and learning were used at Kent before the start of its technology program. For example, in the main, faculty wrote or drew on their classroom's white board to supplement their lectures; they discussed course material with students during face-to-face meetings; and they received students' work in hardcopy (i.e., on sheets of paper), which they returned to the students a day or so later after reviewing it and writing their comments on it. Typically, students typed or handwrote assignments; used a bound dictionary and thesaurus; went to the library to locate pertinent books and other reference materials for research papers and other assignments; asked questions about lessons during face-to-face meetings with their teachers; and, during science course laboratories, measured phenomena manually, recorded the measurements by hand, and performed related analyses with the aid of a calculator into which they keyed the data.

Faculty and Students Reported That Information Technology Enriched Teaching and Learning When It Was Used Well

The references to faculty and students that follow in this report are based on their responses in the surveys (which were completed by approximately 60 members of the faculty and approximately 450 students during each of the two data collection periods, academic years 1998–1999 and 2000–2001) and their comments during interviews (with faculty) and focus groups (with students). The references describe the opinions reported by the majority of the faculty and students (except where noted) and omit specific percentages and numbers for brevity.

Typically, faculty and students reported that information technology enriched instruction and learning when it was used well. There was general consensus that information technology made positive contributions by effecting one or more of the following improvements relative to traditional methods of teaching and learning:

- presentations of course material during class were better organized, easier to understand, and more engaging
- classroom exercises had greater educational impact
- homework was more engaging and more effective

- the technology motivated and helped students "do my best"
- "class was always in session," which provided additional opportunities to learn.

Presentations of Course Material During Class Were Better Organized, Easier to Understand, and More Engaging

Faculty reported that students appeared to be more engaged and to understand lessons better when instructors used the technology to supplement their lectures. Faculty stated that projecting an outline of the lesson during class helped students "stay on the same page" (which was true figuratively for classes in general and true literally in classes using multiple texts, for example, to compare several translations of a work). Students' comments were congruent with the perceptions of the faculty. Students reported that classes were better organized when instructors used the technology, and good organization, they stated, helped them follow the lesson, enabled instructors to cover more material during class, reduced the number of excursions on distracting tangents, and made more class time available to discuss the course material. Students commented that instructors often were able to explain topics more clearly when they supplemented their lecture with graphics, audio, and video instead of simply writing or drawing illustrative material on a classroom whiteboard. They reported that it was tedious to watch instructors write or draw on the board; in fact, it was somewhat annoying when "a lot of time" was used to write or draw on the board because the time could have been used more effectively by the instructor to explain the lesson more fully or by the class to discuss it at greater length. They commented that visual materials (particularly with color and graphics) "grab a student's attention . . . and keep you more focused because you are interested."

Faculty used presentation materials in a variety of ways. Some displayed the materials and expected students to take notes as they had done when instructors delivered instruction in the traditional manner. Some gave a copy of the presentation to students at the start of the class because, they stated, it enabled students to focus on the lesson instead of concentrating on taking detailed notes. Some emailed a copy of the presentation to students who were absent from class.

Faculty reported that technology-mediated presentations took more time and effort to prepare than traditional lecture materials, but, once prepared, they were easier to update, revise, and supplement. They also reported that technology made it relatively easy to weave visual and sound objects seamlessly into their lectures. Their perception is consistent with findings of other studies: Students' comprehension increased as additional senses (aural, visual, and tactile) were involved in the learning process, but instructors tended not to incorporate images and sound into lessons before information technology was introduced largely because traditional audiovisual equipment was difficult to operate while simultaneously delivering a lecture and being attentive to a classroom of students (see Devin and Robyn, 1997).

Classroom Exercises Had Greater Educational Impact

Faculty reported that the technology enabled them to conduct classroom exercises that were more effective than traditional exercises. For example, before the technology program, students in English Department courses wrote essays by hand during class, submitted them at the end of the period, and then, one or more days later, received their work with the teacher's comments written on it. In contrast, the use of laptop computers and word proc-

essing facilitated an iterative process in which instructors reviewed students' essays as they were being written, made suggestions that prompted students to revise their work, and repeated the suggestion/revision cycle during the class period. One member of the English Department faculty explained: "It changes students' approach to writing if they can be involved more actively and see their work being changed, e.g., for subject-verb agreement."

Science Department faculty reported that technology increased the educational value of laboratory experiments and enabled students to conduct experiments formerly not feasible. When students collected data manually, the underlying principles were obscured at times because the measurements tended to be imprecise, relatively few data points could be recorded, and errors sometimes were made in calculations and graphing. When electronic instruments were introduced into the courses, students were able to collect precise data for numerous observations and then transfer the data directly to their laptops for analysis and graphing. Using the technology, less time and effort were needed to conduct experiments than formerly. A member of the Science Department faculty explained: "Data are quickly gathered in labs using [the recording instrument]. Time is then spent on analyzing what the data mean." Faculty observed that some students completed the assigned exercise and then—on their own initiative—repeated it with variations to address questions that occurred to them during the original procedure, e.g., "What will happen if I [changed this condition]?"

Homework Was More Engaging and More Effective

Faculty and students reported that information technology minimized manual labor that they deemed was incidental to the educational value of assignments. For example, students reported that word processing software greatly facilitated the process of writing papers because it enabled them to revise and format their work easily, access a thesaurus readily, and benefit from automatic spelling and grammar checking. They reported that the Internet—and particularly the advantage of being able to access it from their rooms—enabled them to do research for assignments faster, more thoroughly, and more conveniently than when they used traditional reference materials; further, the Internet usually provided information that was current and from primary sources, unlike some reference materials. However, students usually added, to use the Internet well they had to learn appropriate search techniques and learn to evaluate websites' reliability and credibility (skills that, in general, students reported that they learned at Kent).

Typically, faculty reported that the technology, principally the Internet, offered rich information resources that could be used to develop homework assignments, providing "authentic" experiences for the students. Faculty observed that students tended to pursue these assignments more vigorously than traditional coursework, and students reported that the assignments were more interesting than traditional exercises. Some of these assignments incorporated a sense of playfulness, which has been found to be an effective educational method (see Martocchio and Webster, 1992; Perry and Ballou, 1997). For example, students "went to Paris" to do homework for a French course. One of their assignments was to plan a trip to the movies—in Paris—for the coming weekend. They selected a film by reading movie reviews in the Internet edition of a Paris newspaper. Then they found the theater(s) at which it was playing, show times, and admission prices. Having selected the movie, theater, and performance, students then went to the Métro website to determine the subway lines they would take to the theater, the train schedule, and the fare. During class, students dis-

cussed the particulars of their "trip to the movies," and some chose on their own initiative to use presentation software to describe their trip. Other French instructors adopted variations of this assignment, e.g., arranging a cycling trip through the French countryside (finding suitable routes, accommodations, and places of interest) and, as the new operators of a country inn, planning a seasonal menu for their guests.

Faculty and students reported that technology reduced the "turnaround time" for homework, i.e., the interval between completing an assignment and receiving the instructor's comments on it. Both faculty and students stated that teachers' comments were more valuable when the work was fresh in a student's mind. Generally, instead of waiting for class to meet, students submitted assignments as soon as they completed them (by attaching them to email or dropping them in a shared folder) and faculty returned them in like manner. Faculty also reported that this method eliminated the need to collect and distribute homework during class, which made more time available for instruction and discussion. Typically, faculty typed their comments on students' work that was submitted electronically, and some faculty and students observed that typed comments differed in substance from handwritten comments. Consistent with this observation, some of the faculty reported that it was easier to type a comment than write it; as one stated, "My typed comments are more comprehensive than ones I write by hand because it is easier for me to type than write." (This topic is revisited in this chapter.)

The Technology Motivated and Helped Students "Do My Best"

Faculty reported that the technology "generates more extended effort, more polished work, and . . . develops the ability to articulate ideas." They cited the benefits of tools such as grammar and spelling checkers, thesauri, and dictionaries, but the central theme of their comments was that word processors enabled written assignments to be edited and revised easily, and this encouraged students to refine their ideas, articulate them more clearly, and argue them more persuasively. Students concurred. "You'd settle for a sentence rather than retype it. Now I edit and change my work." "It helps me do my best." Students stated that computers "make you want to strive to do your work more thoroughly." One expressed the idea this way: "there is no excuse not to improve your work because revisions can be made so easily."

Faculty and student's comments contained three related subthemes. Approximately 5 percent of the students volunteered that the technology, especially the Internet, enabled them to pursue knowledge independently, which most of them stated—or implied—that they might not have done had more effort been required. Two students commented:

> The web gives me the opportunity to research something that I may have missed in class. When I hear something that interests me, but I don't want to force the class into a tangent, I'll look it up on the Internet. It gives me the chance to explore and learn things . . . because the Internet is so convenient.

> Whenever I get a question in my mind, I look up the Internet and find my answers rather than having to keep the question in my head a long period of time and then forget about it.

The second subtheme suggested that the technology changed the way some students developed an assignment, which may have implications for the substance and exposition of

their work (this study did not explore those implications). For example, approximately 4 percent of the students commented that instead of organizing their thoughts formally before writing a paper or essay (e.g., by preparing an outline), they preferred to let their ideas "flow" and then refine what they had written.

The third subtheme concerned the possibility that students who had different levels of academic achievement may have integrated the technology differently into their schoolwork. In 2000–2001, 77.5 percent of the students who responded to the survey question about the impact of the technology (n = 431) assessed that information "technology has had a positive impact on my education" (which is up from 66.0 percent in 1998–1999). Given the caveat that this study was not designed to test hypotheses about the relationship between technology and academic achievement, it is interesting to observe that this opinion was held by a larger percentage of the students who ranked their academic achievement in the first quartile (highest grades) than by students who ranked their academic achievement in other quartiles. The data are summarized in Table 2.1. The "Percent of Quartile" column shows the percentage of students in each quartile who judged that technology had a positive impact on their education. The "Average Assessment" column shows the mean average of those students' assessments of the impact of the technology (p = 0.06) using a scale that ranged from 7, strongly positive impact, to 1, strongly negative impact.

Table 2.1
Students' Report of the Impact of Technology on Education, by Academic Level (2000–2001)

	% of Quartile	Average Assessment
1st quartile (highest grades)	83.8	5.54
2nd quartile	77.1	5.40
3rd quartile	71.8	5.37
4th quartile (lowest grades)	64.7	4.71

"Class Was Always In Session," Providing Additional Opportunities To Teach and Learn

Faculty used the technology to supplement the typical face-to-face faculty-student discussions held during classes, office hours, and study halls. A member of the faculty commented, "I use email to establish a one-on-one conversation with each of my students, which ties the whole course together and, in essence, tears down the walls of the classroom—class is always in session." Students reported that it was helpful to ask questions anytime about assignments, course material, extracurricular activities, etc., knowing that their questions would be read at the instructor's convenience and would not interrupt the instructor's activities. In 2000–2001, 83 percent of the students reported that they used email to communicate with faculty (up markedly from 32 percent in 1998–1999). Students commented: "I can ask questions anytime and don't have to wait for the next class." "[You send a message and] 20 minutes later, there is a response that helps you." "I can get help from faculty without leaving my room."

Some of the faculty integrated email (and, later, shared folders) into coursework. In some instances, communication was bidirectional (teacher-student); for example, students in several courses kept journals and emailed their daily entries to their instructor, which the instructor reviewed and returned while the experience was fresh in the students' minds, with

encouragement and direction that was intended to guide the students' work the following day. In other instances, communications were multidirectional, that is, faculty used the technology to facilitate discussion among students; typically, faculty participated in these discussions to stimulate the discussion and refocus students' attention when they embarked on tangents or pursued faulty lines of reasoning. The following entry in a "class journal" illustrates one instructor's use of the medium to extend class beyond the temporal and spatial confines of the classroom:

> I am very pleased with your journal entries this time round. A couple very good points were made. First of all, I am pleased that you are struggling to decide which character [in the reading assignment] is the most believable or trustworthy. This is important because [the two main characters] both have slightly different ideas about what actually happened. I suspect that the real truth lies somewhere in the middle. We will discuss [this situation more fully] in class. For right now, it is enough to know [the instructor specified the issue] . . . think about this for our next class discussion.

Approximately 10 percent of the faculty reported that they asked students to use the media to comment briefly on material to be covered during the next class, e.g., identify the central themes. Some of these instructors commented that they read these comments to gauge their students' understanding of the material, which helped them tailor the lesson to the students' specific needs more efficiently than if they waited to assay the students' comprehension while they were delivering the lesson during class. Some noted that these assignments tended to encourage students to come to class prepared. Pertinent to that observation, the "Just-In-Time Teaching" (JITT) method—which is used at some colleges and universities and requires that students submit "warm up" exercises (e.g., quizzes on the current day's lesson) to their professor before class via email or a shared folder—is said to encourage students to read the assigned material before class, reflect on it, and be prepared to discuss it responsibly during class (see Novak and Patterson, 1998).

Kent Faculty Developed Innovative Uses of Technology for Their Courses

Among the innovative uses of information technology that were developed by Kent faculty, five appear to have unique potential to benefit teaching and learning in ways that are likely to be of special interest to educators. They are described below. The first four suggest that information technology can be used to encourage students to participate more actively in their education. The fifth indicates that the technology can help teachers devote more of their time to the substance of their students' work by assisting them with the time-consuming tasks required to address the routine errors in students' work.

Technology Was Used to Bridge Spatial and Cultural Distance

Lisa Durkee Abbott (who graciously consented to be identified by name and to write a description of her project for this report) used email to bridge the distance, spatial and cultural, between her English 2 students and a group of high school students in New Mexico. These email exchanges enabled Kent students to gain insights into the content of a novel that was largely "unfamiliar and even unbelievable" for them but not for the students in New Mexico.

The project generated enthusiasm among students and caused them to read the course material more attentively and to think about the concepts more deeply than they might have done otherwise. Subsequently, because of their classmates' experiences, other students were eager to enroll in the course and participate in the project. Ms. Durkee Abbott's description of this project is included as Appendix A.

Technology Helped Students Learn from Each Other

One instructor asked students to read chapters of a novel and submit a concise analysis (via email or dropped in a shared folder) by the morning of the day the chapters would be discussed in class. The instructor downloaded the students' work that morning before class, reviewed it, and selected one students' work, which the instructor projected onto a whiteboard in the classroom. Students were asked to suggest ways the author's ideas might be expressed to better advantage and to identify grammatical and spelling errors. As students made suggestions, the instructor used a marker to edit the text on the whiteboard. At the same time, the author updated the copy in his or her laptop (and used it later as the introduction to a longer paper). Some of the edits were self-explanatory (e.g., spelling corrections). Other edits became points of discussion; they were lined out or erased and replaced, perhaps several times, as the instructor asked "what if we . . . ?" and guided the class along their intellectual journey. When the instructor's goal was reached, the edited version and the original version were compared to show students the results of their collective efforts.

This instructor's innovative use of the technology provided opportunities for students to learn from each other, which has been said to break "the unavoidable monotony of passive lecturing, and, more important, the students do not merely assimilate the material presented to them; they must think for themselves and put their thoughts into words" (Mazur, 1996, p. 14). As with the in-class writing exercises described above, students were able to experience the process of transforming a composition. As with other applications described above, there was a "playful" dimension that appeared to be effective; in this instance, the instructor made a game of proposing improvements and finding errors and awarded one point for each substantive comment.

Technology Helped Students Assess Their Comprehension of Course Material

Several instructors developed internal websites that enabled students to test their knowledge of the course material interactively. The tests were not factored into students' grades, but teachers reported that students, particularly students who tended to earn higher grades, used the self-tests regularly to solidify course concepts and prepare for examinations. Faculty reported that the self-tests provided information that helped them identify students who needed additional help and topics that needed further explanation. When this study ended, the Technology Department was developing a template that would help faculty, particularly those who had modest technical skills, create web-based self-tests in a variety of question formats (e.g., multiple choice, true/false, "click the location of . . . on the map above").

Technology Helped Students Discover Their Creative Talents

A member of the Art Department faculty stated that computer-mediated tools enabled students to "make art" in a new medium (digital space) without being limited by their mechanical skill. The technology enabled students, even those "who grew up thinking they can't draw," to discover their creative talents and explore aesthetic issues through "problem solv-

ing" by, first, creating compositions and, then, manipulating the images, colors, and backgrounds and creating special effects. The instructor noted: "I want them to understand the power of images [in advertising, films, political campaigns]." The instructor reported that the technology "energized" students and motivated them to work more diligently than formerly (which echoes comments made above, e.g., the technology motivated students to "do my best"); "[they] are less willing to settle for 'less than perfect.' Manipulation of the works without physical constraints and the ability to achieve stunning results increase students' desire to do more."

Technology Was Used to Make a Point (Again, and Again, and Again)

A member of the faculty used the technology to reduce dramatically the considerable time that was required to explain routine errors in students' coursework and, as a result, was able to devote more time to the substance of the students' work. The instructor explained that students make typical errors as a course unfolds, so teachers write the same comments numerous times on many papers and, for some students, many times on the same paper. Typically, because of time pressures, an instructor's comments are detailed the first time a problem appears in a student's work, then the comments are abbreviated at subsequent instances of the error. Occasionally, students misunderstand the shorter comments.

To address this situation, the instructor developed a library of detailed comments about typical errors. The appropriate comment could be inserted – with one keystroke – into students' papers (which were submitted electronically) wherever one of these errors occurred. The instructor reported that students benefited because comments were more complete than formerly, and, because the process saved considerable time, the instructor was able to provide more detailed guidance about the substance of the students' work. (The instructor also observed that repetition provided emphasis, and, to illustrate the point, related that a student said when seeing that a comment had been made many times in his paper, "I guess you really mean it.") Appendix B contains more information about this innovation.

Information Technology Was Integrated into Courses in Numerous Ways

Kent faculty integrated information technology into their courses in many ways, only a few of which are described above. Among other applications, faculty:

- wrote an etextbook that students downloaded to their computers (which students reported was more engaging than a traditional textbook)
- illustrated the variety and evolution of theological concepts by augmenting lectures with examples of great religious art and music and recordings of contemporary religious leaders' speeches/sermons
- designed an Internet "treasure hunt" that encouraged students to collect interesting facts about geometry
- used "real time" information from Wall Street researchers and analyses of daily market activity to examine the American economy
- developed a web-based system that helped students collect and organize research for a major project (the project aimed to help them appreciate the preparation required to argue a case before the United States Supreme Court; it culminated with teams of

students presenting their arguments to a formal session of a moot court, where practicing judges and lawyers—some having Supreme Court experience—presided)
- supplemented lectures with software that enabled students to observe mathematics in motion (which students reported enabled them to grasp the concepts more effectively than by studying diagrams in a textbook)
- created a multimedia presentation for a music course that integrated visual material (e.g., lecture notes, musical scores, and pictures of featured musical instruments, composers, and performance venues) and aural material (e.g., excerpts from compositions and samples of the sounds made by various musical instruments)
- enabled students to create web pages that collectively described a medieval community and, in the process, de-mystified websites and helped students develop critical skills for evaluating information on the web (as one student who had taken the course explained, "Anyone can put anything on the Internet")
- added voice notations to students' work, so the instructor's comments literally spoke to the students.

The "Kentranet," Kent's internal website, which was introduced during academic year 1999–2000, facilitated some of the applications described above and presented additional opportunities to integrate information technology into courses. Faculty were able to post course syllabi on Kentranet web pages along with assignments, reference material, supplementary material, review questions, practice quizzes, and links to complementary websites. An architect of the Kentranet described it as "a way to have the teacher sitting next to the students as they do their work outside the classroom." More information about the Kentranet is included in Appendix C.

Even Though the Technology Could Be Used to Enrich Teaching and Learning, Some of the Faculty Were Hesitant to Adopt It

One might have assumed that the applications described above would have motivated faculty to incorporate the technology eagerly into their courses. However, when the study began, approximately half of the faculty were found to be hesitant to use information technology other than for basic applications such as word processing, and when the study ended, although their use of the technology had increased, approximately one-fourth of the faculty still were using it in relatively limited ways. The next chapter posits a theoretical rationale to explain individuals' motivation to integrate the technology into their activities.

CHAPTER THREE
Implementation Influenced Integration

This chapter proposes a theoretical rationale to explain faculty and students' behavior with respect to information technology. More specifically, it presents factors that appear to have motivated some individuals at Kent to embrace the technology enthusiastically while others chose to integrate it into their work only in limited ways. Further, it posits that the way the technology was implemented shaped these factors and, thus, influenced individuals' decisions whether and how to use the technology. This chapter focuses primarily on the motivation of faculty to use the technology because, as will be discussed, teachers' decisions whether and how to use the technology appear to determine the manner in which their students incorporate it into their schoolwork.

Various rationales have been offered to explain teachers' hesitancy to adopt new instructional methods. Schools have been said to be "conservative institutions with entrenched routines" (Castro, 1998, p. 85)—a condition that has existed from Classical times (see Havelock, 1994; Bosco, 1994) to the present (see Castro, 1998; Puryear, 1998). Teachers' hesitancy to integrate technology into the curriculum (Pelgrum, 1998, pp. 106–109; Valdez et al., 1999, p. 5) has been attributed to inadequate technical training (see Cuban, 2001) and, to this point, Pelgrum (1998, p. 106) comments, the "main factors convincingly shown to play a role [in cases of underuse of the technology] were lack of adequate preparation of teachers, lack of time to get acquainted with this new technology, and lack of software." Consistent with the notion that training is an important factor, a study by Slavin and Fashola (1998, pp. 65–66) of educational programs (which were not mediated by information technology) identified "extensive professional development and follow-up technical assistance" for teachers as one of the four factors that contribute to educational programs' "effectiveness":

> A characteristic shared by almost all of the effective programs we identified is the provision of extensive professional development and follow-up technical assistance. . . . [M]ost of the successful programs we identified provide many days of in-service followed by in-class technical assistance to give teachers detailed feedback on their program implementations. Typically, teachers work with each other and with peer or expert coaches to discuss, assess, and refine their implementations.

The data collected in this study suggest that technical training played an important role in the motivation of faculty to integrate information technology into their courses. However, training was only one of several factors that appeared to influence teachers' use of the technology.

Theoretical Rationale to Posit That Implementation Influenced Integration

It is a long-held dictum in the information systems field that individuals make a benefit-cost analysis when they determine whether and how to use the technology (see Eason, 1984; Markus and Keil, 1994; Shackel, 1988). Individuals are motivated to use it when the benefits exceed the costs and, conversely, to avoid it when costs exceed the benefits. This notion has been extended (Devin, 1994) to posit the reasons individuals may behave differently when facing what appear—from an organizational perspective—to be the same benefits and costs.

The extended model incorporates the self-efficacy concept (Bandura, 1982), which holds that individuals' motivations vary from situation to situation based on their assessment that (1) their personal effort is likely to gain some measure of the rewards that are available in the given situation, and (2) the rewards they expect to gain will be greater than the effort they expect to expend. In other words, it is anticipated that individuals will take positive action in situations where they perceive the net rewards (benefits less costs) are attractive and attainable. In a given situation, individuals who assess their efficacy at relatively high levels are more likely to take positive action than other individuals because the net rewards will appear greater to them than to others; more specifically (1) they are more likely to be confident that their efforts will achieve a full measure of the potential rewards, whereas other individuals are likely to anticipate fewer rewards, if indeed any at all, and (2) they are likely to estimate that less effort will be required to achieve the rewards than will individuals who assess their efficacy at lower levels.

The Role of "Efficacy Information"

Bandura (1982) explains that individuals do not necessarily consider themselves equally efficacious in all situations; they may rank themselves as experts in one area (e.g., education) and novices in another (e.g., the use of computers). He states that they use "efficacy information" to form their assessment. The four sources of efficacy information are personal experience (in both the focal situation and in similar situations), observing peers' experience, hearing colleagues' comments, and being exposed to promotional materials; of these, personal experience and the observation of peers are the strongest sources of efficacy information.

Individuals' assessment of their efficacy is not necessarily fixed; they are likely to reassess it in the face of new efficacy information (Bandura et al., 1980). For example, positive personal experiences in a situation tend to increase individuals' assessment of their efficacy in that situation (or reinforce already high levels of self-efficacy), whereas negative personal experiences tend to lower individuals' assessment (or reinforce low self-efficacy). In clinical settings, therapies incorporating increasingly positive personal experiences have been used to help individuals overcome debilitating phobias, e.g., to enable agoraphobics to participate in public activities after years of fearing to leave their homes (see Bandura et al., 1980).

The Role of "Implementation Practices"

By extension, with reference to information technology, it can be posited that "implementation practices" (i.e., selecting, introducing, installing, and maintaining the components, along with training activities for prospective users) influence individuals' assessment of their efficacy by shaping the efficacy information that they use to make their assessment. More specifically, as will be discussed below, implementation practices can (1) determine whether individuals have appropriate information to gauge accurately the technology's potential bene-

fits for them and the related costs they are likely to incur, (2) shape their personal experience when they use the technology, and (3) shape their peers' experience with it (which, as noted above, is a strong source of efficacy information). This notion is supported by studies reporting that the way individuals use information technology is related to the way it is implemented (see Lucas, 1981; Markus and Keil, 1994) and training strategies that promote initial successes with the technology are likely to lead individuals to use it more fully than training strategies where individuals experience frustrations and failures (see Carroll and Carrithers, 1984).

Use of Technology at Kent Was Consistent with the Self-Efficacy Concept

Consistent with the self-efficacy concept, Kent faculty and students who ranked their level of technological expertise at higher levels, on average, used the technology more intensively and had more positive attitudes toward it than individuals who ranked their technical expertise at lower levels. On average, a greater percentage of the students who assessed their technical expertise at higher levels than other students reported that they preferred to gather research materials through the Internet rather than from reference books, preferred to submit homework to faculty through email instead of handing in hard copy, judged that the technology had a positive impact on their education, and judged that they were better prepared for college because of their exposure to information technology at Kent.

Findings for the faculty are similar. For example, faculty who ranked their technical expertise at higher levels (on a scale ranging from 7, "expert," to 1, "novice") reported that they used information technology more frequently during class than did faculty who assessed their technical expertise at lower levels. The data summarized in Table 3.1 were provided by 55 members of the faculty who both (1) ranked their technical expertise and (2) reported the frequency with which they used the technology during class.

On average, faculty who assessed their technical expertise at higher levels also reported higher levels of comfort in using the technology during class. The comment of a teacher in an earlier study (see Devin and Robyn, 1997) captures the attitude of less technically proficient teachers. In that study, the teacher explained that teachers who had modest technical skills chose not to use the technology because they reasoned: "Why take the risk? Chalk and erasers never fail you."

Table 3.1
Frequency of Use of Technology During Class (2000–2001)

	Average Technical Expertise
Most of the classes	5.6
About half of the classes	5.5
1–5 classes during a course	4.4
Do not use during class	3.4

Revised Implementation Practices Encouraged Technology Use That Had Been Hindered by Some of the Initial Practices

The data suggest that some of Kent's initial implementation practices imposed heavy costs on faculty and students, particularly 50 percent of the faculty who in 1998–1999 assessed their technical proficiency as "average" or "below average." It appears that, in general, they chose to use the technology to a limited degree because they judged the applications entailed costs that exceeded the potential rewards. In the main, this group appears to have been the primary beneficiary of revisions to the implementation practices that made the technology's benefits more accessible and its costs less burdensome.

The remainder of this chapter discusses Kent's implementation practices in terms of "advertising," training, hardware and software, and technical support. "Advertising" relates to proactive dissemination of efficacy information to prospective users. The other areas, primarily, shape personal experience with the technology and, secondarily, shape peers' experiences, which individuals observe and incorporate into their personal efficacy assessment. In each of the four areas, implementation practices are grouped in two time periods: The "initial" period covers practices that were operational during the first two years of the technology program; data about them were collected during 1998–1999. The "subsequent" period covers practices that were revised or initiated after 1998–1999 and were operational when data were collected during 2000–2001.

Advertising Communicated Information About Personal Benefits and Costs

The word "advertising" in everyday speech connotes persuasion and hyperbole, but in the information systems literature it refers to forms of proactive communication that are intended to convey accurate information about a system to its prospective users, so that they can make an informed decision whether and how to use it (Licker et al., 1987). Advertising can be accomplished via demonstrations of peers' experience, users' testimonials, printed materials, etc.

Initially at Kent, accurate information about the technology was minimal and rumor appeared to prevail. In the main, advertising was an incidental by-product of seminars and workshops that were held early in the technology program to familiarize faculty with the technology. The message at those sessions was not always positive. In 1998–1999, an instructor who chose not to use technology during class commented, "it looked like it would take a lot of time to prepare [a presentation using the technology]—and I can get the same message across on the board, maybe not as flashy, but as effective."

In the absence of proactive advertising, some of the faculty and students reported that they based their decisions about technology on prior personal experience. As one member of the faculty reported, "I bought an [brand] in 1983 for my family. I went nuts with it. I hated it. . . . It was harder to use than to write manually." Other individuals were influenced by comments of colleagues and classmates who encountered problems with the technology. Students noted that reports of their classmates' experiences rippled through the school and, their comments suggest, some of this information was embellished as it was passed from person to person. It became clear during focus group discussions in 1998–1999 that statements such as the following, which appeared at first to be hyperbole being used intentionally for emphasis, were in fact accepted as literal by some of the students: "There is nothing [worth-

while] on the Internet." "No one uses email." "I won't go to the Tech Center because they never do anything right."

Subsequently, proactive advertising was initiated. Two forms were particularly effective. The Technology Department started an outreach program. Heads of academic departments were encouraged to invite a member of the technical staff to a department meeting where they would explain and demonstrate aspects of the technology that were likely to have benefits in that academic discipline. These small and informal sessions facilitated a dialog between faculty and technology staff. Faculty were encouraged to discuss their perceptions of the technology; technical staff helped faculty recalibrate assessments that were based on misinformation and helped faculty articulate their technology-related needs. This new approach addressed a perception that had been stated by a member of faculty in 1998–1999:

> The director of technology told us to call if we want to talk about using computers. But, when do I have the time? And, how do you know what to ask when you don't know what you don't know? Maybe someone from the Tech Center should spend a day with each department.

The headmaster disseminated efficacy information proactively and effectively by inviting two members of the faculty to demonstrate innovative uses of the technology, which they had developed for their courses, at a general assembly of the faculty. This venue enabled faculty to observe colleagues' successes with the technology, an opportunity they might not have had otherwise (because, usually, they taught classes at the same times). It will be recalled that observing peers' experience provides the second strongest form of efficacy information; in addition, faculty assemblies convened by the headmaster are endowed with special distinction and significance, so by including the demonstrations on the agenda, the headmaster signaled clearly the importance of information technology to the school's academic goals. A member of the technology staff reported, "Our phones rang off the hook after the presentation. Everybody wanted to learn to do what [the presenters] did."

Finding: Demonstrating peers' technology applications that are relevant to teachers' courses encourages teachers to adopt information technology.

Learning to Use the Technology Was Not Trivial

Few information systems other than some kiosk applications (e.g., in malls and airports) and some games can be operated intuitively. Typically, individuals must invest time and effort to learn to use technology that is new to them, and training has been found to minimize their personal costs (see Compeau and Higgins, 1995). Further, technology training that promotes early successes and minimizes initial frustrations and failures has been found to increase the likelihood that individuals will persevere with technology that is new to them (Carroll and Carrithers, 1984).

Initially at Kent, learning to use the technology entailed relatively high costs in terms of personal time and effort. It was assumed that faculty would learn to use it largely on their own. This strategy appeared to be satisfactory for a few members of the faculty, mainly those who had experience with comparable technology or were technophiles (discussed below), but although 83 percent of the faculty reported that they usually gained experience with the technology by working alone and using, in the main, trial-and-error methods, the majority of them reported that learning independently was extremely time-consuming, frustrating, and, not infrequently, unsuccessful. In general, it appeared that they responded to technical diffi-

culties either by "satisficing," i.e., adopting the first workable solution even if it was suboptimal (see Simon, 1981), or by abandoning their attempt to use aspects of the technology other than its basic features.

Several seminars and workshops were offered to help faculty get started with the technology, and 85 percent of the faculty reported in 1998–1999 that they had attended at least one of the sessions. However, the sessions were not well received by faculty; the consensus was summarized concisely by a teacher who said, "[the sessions] were not a good use of my time." It appeared the sessions attempted to cover too many topics; consequently, they were long and the agenda included information that was not relevant to the interests of all of the attendees. Further, attendees were not grouped according to their level of technical proficiency, and, as a consequence, faculty who judged themselves "novice" reported that they came away from the sessions without understanding the material and those who ranked their technical skills at the "expert" level reported that they "didn't learn anything new." One teacher commented:

> I went to three or so, then stopped going. I felt I didn't learn anything new. They were doing just the basics—nothing applicable to use in the classroom. It's how others use computers in class that I want to know. I want to see all the steps involved and how to do it. That's the surest way to encourage you to use it in your own classroom.

Initially, the director of technology had planned to supplement independent learning with one-on-one sessions, seminars, and workshops. However, only a few of the one-on-one sessions were held before an unanticipated medical condition compelled the director, who would have conducted the sessions, to work mainly from home.

Subsequently, one-on-one training and mentoring reduced sharply individuals' costs to learn to use the technology. It will be recalled from the section above that the technical staff attended department meetings at which they demonstrated features of the technology and encouraged faculty to contact the technical staff to learn to use any of those features. The ensuing meetings were carefully focused one-on-one training sessions. Faculty who participated in these sessions reported that they were using the technology more intensively than formerly and, typically, they attributed their increased use of the technology to the one-on-one training they received. Faculty reported that the one-on-one approach was more effective than the seminars and workshops they attended because:

- sessions were conducted at a convenient time, and the length of the session was tailored to their preferences
- sessions covered only skills that were relevant to their immediate interests, consequently,
  - — sessions took less time than workshops
  - — skills tended to be used directly after training, before they were forgotten
  - — a small skill set was easier to master than a relatively comprehensive set
- training was directed to their level of technical skill, and they felt free to ask questions without embarrassment or concern about inconveniencing others
- outcomes tended to be positive and encouraging.

During the 2000–2001 interviews, faculty reported that they also were gaining new technical skills by working with mentors, i.e., asking colleagues who had mastered a particular application to help them use it. Shortly before the end of this study, group sessions were tried again (technical staff offered a number of hour-long training sessions on topics that were assumed to be of general interest to faculty, e.g., basic uses of Excel spreadsheets), but attendance was sparse because, technical staff stated, it was difficult to find a time that was mutually convenient for more than a few of the faculty.

Finding: One-on-one training activities are more effective than group sessions because they are targeted directly to teachers' technical skill level and interests, and they reduce learner embarrassment.

Hardware and Software Shaped Individuals' Personal Experiences with Technology

Faculty and students acquired efficacy information from personal experience with their laptop computers, the classroom equipment, and the school's network. Individuals who assessed their technical expertise as being at relatively high levels were less affected by hardware and software problems than other individuals, who, typically, reported that the problems were disheartening.

Initially, faculty and students, particularly those who assessed their technical skills as being at relatively low levels, reported that they avoided using all or part of the technology because they had unfavorable experiences with it. For example, 45 percent of the faculty reported in 1998–1999 that they had access to a computer (usually a desktop model) in addition to their laptop, and the majority reported that they preferred to use it (generally for word processing) instead of their laptop. The laptops selected initially for the technology program were described as "unbearably slow" and unreliable; by 1998–1999, 70 percent of them had been serviced or repaired; they crashed or froze (students complained that they often lost their work when this happened); and not infrequently they would not connect to the network. A faculty member reported:

> I never know when I come to school in the morning if I will be able to get on the network. There have been lots of glitches. Last year I had month-long problems with the ports on my computer, which I have now circumvented by simply not attempting to [use certain applications].

Administrative policies exacerbated the problems. It was assumed that faculty computers (which were purchased by the school) would be replaced every three years; in the interim, "upgrades" would be a personal expense.[1] However, the first computers did not have Ethernet cards (which were required to connect the computer to the school's network), and faculty who chose not to incur the costs of modifying their laptop could not use it to access the Internet or the school's email. Further, the computers did not have adequate capacity to accommodate the software that was delivered the following year to incoming faculty and students; faculty who did not modify their laptop could not read homework that was submitted electronically by students who used the latest software unless the students took an extra step to convert the file to the earlier software format. Faculty reported that many students

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[1] This policy followed from advice given by Kent's principal technology mentors, who were "adamant that their experience proved" that teachers must "have a [financial] stake" in their equipment if they were to be "invested" in the outcome of the technology program.

"forgot" to convert their work, so faculty had to ask them to resubmit assignments, which raised concerns about equity (e.g., work could be revised before it was resubmitted). As a consequence, some of the faculty chose to have students submit their assignments in hard copy.

Faculty and students reported that classroom equipment was not "user friendly" and valuable class time was spent to set up the equipment and then take it down. As a consequence, faculty reported that they were disinclined to integrate the technology into their classes. For example, material from computers and the Internet was displayed on large television sets that were difficult to set up (they required a converter to translate the computer signal to television format) and awkward to use and the image on the screen was not of good quality. Moreover, most of the classrooms were not equipped with the television sets, so teachers who wanted to use one had to bring the equipment (which was heavy) to their classroom on a cart (which was awkward). As another example, teachers had to bring a "hub" to their classroom to conduct exercises where students would connect simultaneously to the Internet (classrooms had one network outlet, and the hub served rather like a multiple-outlet extension cord that connects several appliances to one wall outlet). Class time was taken while students connected cables from their computer to the hub at the start of the class and then disconnected, disentangled, and rolled up the cables at the end of the class.

Faculty and students experienced difficulties with the network (i.e., lines, switches, servers, and software that manage local email service and access to the intranet and Internet). Faculty reported that they could not use it to communicate with students because students did not access their school email accounts regularly. Students reported that they avoided the school's email system and the Internet because the network was slow and unreliable; approximately half of the students reported that they preferred to submit assignments in hard copy rather than via the network because "that way you know your teacher gets it," and, in 1998–1999, about half had email accounts with Internet service providers, which they used to communicate with family and off-campus friends. The students' difficulties with the network can be attributed in part to a server with inadequate capacity and in part to a lack of understanding of the limitations placed on their network accounts and the procedures required to maintain them. For example, students complained that they did not receive email messages that were sent to them. Some of the students did not know that incoming messages were blocked when the storage space allocated to them on the server was full. Other students deleted messages to free storage space, but still did not receive new messages because they did not know that messages had to be deleted from two locations. As a result, there was the general perception among students that the network operated capriciously.

Subsequently, corrective action eliminated most of the disincentives and constraints that had been attributed to the initial hardware and software, but, arguably, the major change was to implement a proactive hardware and software strategy that anticipated and accommodated technological advances and the evolving needs of faculty and students. The laptops that had been issued initially to faculty were upgraded or replaced at the school's expense, and new laptops for faculty were leased rather than purchased to ensure that their hardware and software would continue to be fully compatible with their students' components, which would be upgraded each year for the entering students. Faculty who developed innovative applications of the technology for their courses were given high-end components to facilitate their work and recognize their contributions as technology mentors to their colleagues.

Digital projectors replaced television sets in the classrooms. The new projectors were lightweight and approximately the size of a large textbook, so faculty could carry them easily to the classroom. They connected quickly and were relatively intuitive to use. The image they cast was sharp, bright, and legible from all points in a classroom. Moreover, the image could be sized to fill a wall or projected on a white board, which enabled material to be easily highlighted or edited during class. When this study ended, wireless hubs were being tested that would enable faculty and students to access the intranet and Internet in classrooms without a tangle of cables and time taken for set-up and take-down tasks. A comment made by a member of the faculty about the projectors typifies the effect of the revisions to the hardware and software practices:

> Regarding use of a computer in class [with a TV monitor], I was discouraged and didn't want to put a lot of time into something that doesn't work well. Things are different with the new projectors [we all want to use them].

Major improvements were made to the network to anticipate and accommodate the faculty and students' steadily increasing use of email, the Internet, and the Kentranet. The network backbone was increased from 10 MB to 100 MB, markedly improving access speed even with growing network traffic. Additional servers were added to the network. Further expansion of the students' server was planned, which would enable students to store their work on the server, where it would be available if their laptops malfunctioned (they would be issued loaner computers to use while their computers were being serviced). Some network maintenance functions were outsourced and some network components were leased to provide the school with the latest network security measures, upgrade key components regularly, and ensure that highly specialized technical assistance was available immediately when network problems occurred. Further actions, which aimed to accommodate steadily increasing traffic on the network, were being initiated at the end of this study. Among them, communications software was being tested to balance peak-hour loads on the students' server; it aimed to give academic traffic (e.g., to the Library of Congress website) precedence over other connections (e.g., to music video websites).

Finding: Selecting adequate and appropriate hardware and software provides systems that are more user-friendly and have fewer breakdowns.

User Support Exacerbated Or Mitigated the Cost of Using the Technology

Initially, users received relatively little help when their computers and software malfunctioned or were damaged. It was assumed that the assistant to the director of technology and a corps of "Student Techs" (students who worked part-time as technicians in the Technology Center) could provide adequate "user support," that is, the trouble-shooting, maintenance, and repair services that reduce the inconvenience, frustration, and, sometimes, monetary expense incurred by individuals when technology components malfunction or are damaged.

This strategy might have succeeded but for three unexpected events. First, medical reasons compelled the director of technology to work from home for an extended period and many of the director's tasks were delegated to the assistant, detracting from the assistant's primary duties, which were to remedy relatively complex hardware and software problems and oversee the Student Techs. Second, the initial laptop computers required substantially more maintenance than had been anticipated, which stretched the resources of the Technical Center. Third, adding to the Technical Center's workload, many students compromised

their equipment by downloading nonacademic programs from the Internet onto their computers, even though they had been warned that these downloads were likely to be troublesome.

In 1998–1999, faculty and, in particular, students reported that problems with their laptops and software were not corrected promptly and, sometimes, were not corrected at all. Students reported that the Technical Center often was closed when they went there for help, there was a long wait for service when the Center was open, often problems were not corrected after "all that time" had been spent, and the technical staff were "abrupt" and "rude" (which might be attributed to their heavy workload, particularly demands on the assistant that limited his ability to supervise the Student Techs' activities, and their perception that some students "recklessly" compromised their computer by downloading games, etc., from the Internet). The consequences were not trivial. Some students determined that the potential benefits of the technology did not offset the costs of trying to resolve their problems with it. One student commented:

> No one can talk to hackers. They are arrogant and unapproachable. I have had a broken Ethernet card since September and don't want to go deal with the people down in the computer Tech Center, so I'm not using the Internet or email.

Subsequently, user support was enhanced dramatically. Additional staff were hired for the Technology Department. Staff were cross-trained, so that individuals who had other department responsibilities could provide additional user support during periods of high demand. Efforts were made to reduce the variety of personal computers on campus by providing incentives to encourage students to purchase one of the models recommended by the school (e.g., guaranteeing that a loaner would be provided if a recommended computer was out of service for repairs); it was anticipated that having fewer models would enable the Tech Center to provide more responsive user support because (1) technical staff could develop expertise specific to those models, (2) the Technology Department could maintain an inventory of the parts needed for typical repairs, and (3) fewer of the students' computers would experience compatibility problems when attempting to connect to the school's network. A typical comment, made by a student in 2000–2001, suggests that this strategy was successful:

> Last year, the Tech Center sent my computer outside and two weeks later it still wasn't fixed. This year, it crashed and was fixed the next day.

Faculty and students who reported that their computers had been serviced at the Technology Center rated their experience more favorably in 2000–2001 than in 1998–1999. In 2000–2001, 65.7 percent of the faculty reported a highly satisfactory experience; 14.7 percent made that assessment in 1998–1999. In 2000–2001, 18.8 percent of the students rated their experience as highly satisfactory, and 13.4 percent made that assessment in 1998–1999. Although there was a marked improvement in the faculty's assessment of user support, work remained to be done to improve students' experience. At the end of the study, a more effective triage was being developed for students' technology-related problems because, although faculty reported that their problems were addressed quickly, some students reported that they had to explain their problem to several individuals before it was resolved.

Other changes were about to be implemented when the study ended. One of the most visible was to be the move of the Technology Center to the center of the campus,

making it more readily accessible to faculty and students (thus addressing a concern identified when data were collected in 1998–1999, i.e., individuals deferred getting help with minor technology-related problems because they found it difficult to go to the Tech Center during the brief periods between their classes, and as a result their computers did not work as well as they might have).

Finding: Malfunctioning technology components require prompt repair at an easily accessible location to maintain users' commitment to the technology; standardizing the components provides for easier and faster maintenance.

A Snapshot of Faculty Use of the Technology During the "Initial" and "Subsequent" Periods

As indicated by the comments above, on average, faculty and students reported higher levels of use of the technology in 2000–2001 than in 1998–1999. Table 3.2 is a snapshot of faculty's main academic uses of the technology at the two time periods, and all of the activities show an increase. Faculty use of the technology is depicted because, as discussed in the next section, the data suggest that faculty use of the technology determined in large measure how students used it for schoolwork.

In particular, more faculty were using the technology to complement instruction during classes (45 percent in 2000–2001, up from 28 percent in 1998–1999), they were using it more intensively to review students' work (on average, 3.0 hours per week in 2000–2001, up from 1.6 hours in 1998–1999), they were spending more time to communicate via email (on average, 5.6 hours per week in 2000–2001, up from 3.2 hours in

Table 3.2
Faculty's Principal Academic Uses of the Technology

Academic Use	1998–1999	2000–2001	Ratio (2000–2001/ 1998–1999)
Percentage of faculty using technology to:			
Complement instruction during class	28	45	1.61
Prepare course materials	82	94	1.16
Get supplemental material via Internet	63	72	1.14
Develop and update Kentranet web pages	n/a	21	—
Review students' work	32	38	1.19
Communicate via email			
With faculty and staff	93	95	1.02
With students	63	84	1.33
With students' parents	42	65	1.55
Average hours/week:			
Reviewing students' work	1.6	3.0	1.88
Using email	3.2	5.6	1.75

1998–1999), and more of the faculty reported that they communicated with students via email (84 percent in 2000–2001, up from 63 percent in 1999–2000).[2]

Use of the technology was reported and observed to have increased on qualitative as well as quantitative dimensions. In 1998–1999, when the technology was used during class, typically it was used to project lecture notes or an outline of the day's lesson. In 2000–2001, presentations tended to include graphics, animation, videos, sound, and dynamic links to Internet websites (and one instructor had designed a presentation where variables could be changed interactively during his lecture to demonstrate cause and effect relationships). Faculty reported more frequently in 2000–2001 than in 1998–1999 that they used the Internet to "find research targets for class assignments," "find answers to questions raised by students in class," and get "data we use daily in class"; and during the first year of the Kentranet (Kent's internal website, which was introduced during academic year 1999–2000), slightly over one-fifth of the faculty had integrated it into their courses, e.g., to post syllabi, supplemental course material, and practice exams. In April 2000, the director of technology's "Annual Report of the Technology Program" reported that the Kentranet had more than 5,200 pages and nearly 26,000 links (albeit some were for nonacademic programs and activities).

Some Additional Considerations

The revised implementation practices appear to have encouraged individuals to integrate the technology more fully into their activities. However, other factors as well are likely to have influenced faculty and student's use of the technology.

Faculty Influenced Students' Use of the Technology

The data suggest that the degree to which students integrated the technology into their schoolwork was determined in large measure by the faculty. Some uses of the technology generally were optional on the part of students, e.g., writing and filing class notes, engaging in email activities, and pursuing personal interests. Other uses of the technology, students reported, were required or "expected" of them by at least some of the faculty, e.g., preparing papers and other written assignments, gathering research materials from Internet websites, and checking the Kentranet for course-related information. The average hours per week spent on required activities was relatively the same for all students regardless of their level of self-assessed technical expertise. However, consistent with the self-efficacy concept, students who assessed their technical expertise at higher levels reported that on average they spent more time using information technology on activities that were optional than did students who ranked their technical expertise at lower levels. The data are summarized in Table 3.3.

If indeed faculty influence students' use of the technology, it would seem reasonable to anticipate that students' academic uses of the technology will increase as faculty integrate it more fully into their courses. That notion is supported by data on faculty-student email

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[2] Teachers used the technology mainly to prepare course materials and get supplemental materials. This suggests an immediate focus for training. However, as information technology becomes easier to use, and as teachers become more familiar with it, it seems likely that the training focus will shift increasingly to methods that enable teachers to embed the technology effectively into their instructional activities.

Table 3.3
Students' Average Hours per Week Using the Technology for "Required" and "Optional" Activities (2000–2001)

	Required Activities			Optional Activities		
Technical Expertise	Papers	Internet for Class	Kentranet for Class	Class Notes	Email	Internet Personal
Above average	4.0	2.7	1.1	0.63	8.2	5.4
Average	4.3	2.6	1.1	0.55	6.9	3.6
Below average	3.9	2.5	1.3	0.31	4.9	3.4

communication. In 1998–1999, faculty and students reported that they did not use email regularly for intracampus communication; 63 percent of the faculty reported that they used email to communicate with students, but, in the main, that traffic consisted of occasional announcements about classes and upcoming exams, and only 32 percent of the students reported that they used email to communicate with faculty. Later that year, the headmaster began to disseminate important information to faculty through email, which obliged them to check their email accounts regularly. As faculty became more accustomed to using email, it became a campus norm. (This is consistent with the concept that a "critical mass" must be established before email is adopted within an organization; see Markus, 1987.) In 2000–2001, 84 percent of the faculty reported using email to communicate with students, and the uses of the medium, as described above, were substantive. That year, 83 percent of the students reported using email to communicate with faculty, which is up markedly from 32 percent in 1998–1999.

Technophiles Appear to Have Enjoyed a Special Motivator

Arguably, the technology itself served as a motivator for individuals who I call "technophiles." They pursued the technology even in the face of obstacles that discouraged colleagues and classmates because they appear to have enjoyed meeting the challenge it presented, increasing their technical skills, and developing new ways to integrate it into their activities. During interviews and focus groups, typically, technophiles elaborated on the ways they used the technology to achieve course-related benefits; other individuals tended to focus on the instrumentality of the technology, i.e., that it simplified tasks and enabled work to be done faster.

"New" Faculty and Students Had More Experience with Information Technology

The higher level of use of the technology in 2000–2001 relative to that in 1998–1998 may have been due in part to increased technical proficiency on the part of "new" faculty and students (individuals who entered Kent after 1998–1999). For example, new students reported that they had been using a computer for a longer time before entering Kent than their counterparts in 1998–1999 (4.4 years in 2000–2001 compared with 3.8 years in 1998–1999); and fewer of them reported first using a computer for schoolwork after entering Kent (11.3 percent of the female students in 2000–2001 compared with 18.5 percent in 1998–1999, and 9.8 percent of the male students in 2000–2001 compared with 15.3 per-

cent in 1998–1999). Further, as shown in Table 3.4, more of the new students ranked their technical expertise above average than did their counterparts in 1998–1999 (38.3 percent of the new female students in 2000–2001 compared with 31.8 percent of the female students in 1998–1999; and 62.0 percent of the male students in 2000–2001 compared with 48.8 percent of the male students in 1998–1999).

"Returning" Faculty and Students Reported That Their Technical Proficiency Had Increased

Regular use of the technology may have led faculty and students to use the technology more intensively and in new ways. This would be consistent with other research, which reports that individuals at first substitute new information technology for procedures within accustomed tasks and, subsequently as they become familiar with it, they use it to work in new ways and do different sorts of work (Szlichcinski, 1983). Haddad (1998, p. 27) particularized this concept to teachers:

> As technology in the school allows teachers to perform traditional task[s] with a speed and quality that were unattainable before, it will permit better use of their time not only to teach differently but also to develop professionally.

In 2000–2001, "returning" faculty and students (individuals who were at Kent in 1998–1999) reported that they were more proficient with the technology than they had been in 1998–1999, and they generally attributed the improvement to their frequent use of the technology at Kent. They reported improvements in specific skills (e.g., typing) and also that they found the technology less intrusive than it had been initially. A student commented:

> When starting to use a computer, I'd lose my thoughts because I was concentrating on typing and using the computer. Now it's not a problem and I can express myself better when I think [about my assignment] as I type.

The improvement in returning students' self-assessed technical expertise is striking, and the change is especially striking for students who judged their technical skills as below average. In 2000–2001, on average, only 6.3 percent of the returning female students ranked their technical skills as below average compared with 20.9 percent of their cohort in 1998–1999 and 16.2 percent of the new female students. Similarly, on average, 4.3 percent of the male students assessed their technical proficiency as below average in 2000–2001 compared with 17.1 percent of their cohort in 1998–1999 and 10.8 percent of the new male students. The data are summarized in Table 3.4.

Table 3.4
Students' Self-Assessed Technical Expertise (in percent)

	1998–1999	2000–2001		
		At Kent in 1998	Entered Later	Total
Female students				
Above average	31.8	41.6	38.3	39.1
Average	47.3	52.1	45.5	47.0
Below average	20.9	6.3	16.2	13.9
Total	100.0	100.0	100.0	100.0
Male students				
Above average	48.8	63.8	62.0	62.4
Average	34.1	31.9	27.2	28.3
Below average	17.1	4.3	10.8	9.3
Total	100.0	100.0	100.0	100.0

CHAPTER FOUR

Conclusions

Two broad lessons can be drawn from Kent School's experience with information technology: The technology can be used to enrich teaching and learning. The degree to which faculty and students integrate it into their academic activities, however, is contingent on its being implemented responsively to the needs of the intended users.

Kent's experience demonstrates that information technology can be used to "enhance or extend the learning process" as, indeed, was envisioned by Kent's Technology Committee when they recommended in 1995 that the school initiate its technology program. Typically, participants in this study reported that the technology helped faculty "energize" or "engage" students both during class and outside it, which they said increased the diligence with which students applied themselves and, as a result, the quality of their coursework. They reported that the technology provided rich resources that faculty used to illuminate lessons and develop "authentic" assignments for their students. Further, they reported that the technology reduced the time and effort required to perform certain tasks and, as a result, it encouraged individuals to work more diligently than they might have done otherwise. Kent faculty developed innovative applications of the technology for their courses, which may provide a glimpse of the future—where it seems likely, if not certain, that the potential of the technology to benefit teaching and learning will increase, largely for two reasons. First, processor speeds are forecast to continue to double every 18 months for at least another decade (Moore, 2001), which will increase the raw power of the technology and, as a result, the versatility of the software and the ease with which it can be used. Second, as teachers gain experience with the technology—its advanced versions in particular—it seems likely that they will discover new ways to integrate it into education (see Haddad, 1998; Szlichcinski, 1983).

Kent's experience also suggests that the benefits of information technology are not likely to be obtained simply by putting computers into the hands of faculty and students—the way the technology was implemented influenced individuals' motivation to integrate it into their activities. A few individuals, who I have called "technophiles," adopted the technology enthusiastically at the start of the technology program and persevered with it in the face of difficulties. Many other individuals hesitated; and it can be argued that they made a prudent decision not to abandon methods they had used successfully in favor of new methods that entailed substantial costs and offered uncertain benefits. Typically, they used the technology to a limited degree until the implementation practices were revised in ways that rebalanced individuals' personal benefits and costs; more specifically:

- Advertising proactively advised individuals of the true benefits they could expect to gain from the technology and the true costs they would incur to use it.
- Training reduced the time and effort required to learn to use the technology successfully.
- Equipment was upgraded and, as a result, it was easier to use and more reliable than formerly.
- User support was enhanced to minimize the costs individuals incurred when components of the technology malfunctioned or were damaged.

Although one cannot generalize from one case study, other educators may find it helpful to consider the following strategic assumptions that are embedded in Kent's revised implementation practices:

Implementation Is an Ongoing Activity

Kent's revised implementation practices were not a "one-time-fix" but are an ongoing activity that aims to anticipate and accommodate technological advances and the evolving needs and preferences of faculty and students. More specifically, the strategy encompasses (1) maintaining and proactively upgrading the installed hardware and software to ensure that they will continue to serve faculty and students' evolving technology-related needs, and (2) providing on-going training and other assistance that will help individuals transition comfortably to unfamiliar software and new generations of the technology.

Adequate Resources Are Available to Remedy Unexpected Situations

Although the overall advance of information technology can be predicted, not every situation affecting its use can be foreseen, as Kent's experience demonstrates. Fortunately, Kent had a reserve of resources—human, technical, and financial—on which it could draw to remedy problems before their negative outcomes compounded and solidified individuals' bias against the technology. To make corrections quickly and relatively inexpensively, and to limit the number of individuals who might be subjected to negative experiences with the technology, schools less favored than Kent might consider (1) scaling back technology programs that would otherwise commit all available resources and, thus, provide a reserve that could be used to address unforeseen situations or (2) starting with a pilot program that would flush out unanticipated problems, which, relative to a fullscale program, would require fewer resources to correct.

Judicious Allocation of Resources Increases the "Bang from a Buck"

Kent's experience suggests that it is likely to be resource-efficient to first differentiate among prospective users' technology-related needs and then allocate resources accordingly. For example, training resources were allocated primarily to faculty, who were relied on to help their students acquire course-specific technology skills (however, faculty were encouraged to invite

a member of the technical staff to demonstrate features of the technology to their students when, for example, faculty integrated technology with which they were gaining experience into their students' coursework). As another example, although there was no indication that faculty needed more powerful hardware and software than that used by their students, it appeared worthwhile to assign higher-end components to the "pioneers" who developed innovative uses of the technology for their courses and served as mentors to their colleagues.

Kent's experience suggests that it is a false economy to choose resource allocation tradeoffs that conserve a school's resources but impose high costs on the intended users. Such tradeoffs are likely to be counterproductive if the costs borne by the intended users prompt them to underuse or avoid the related technology.

APPENDIX A

The Internet Was Used to Bridge Spatial and Cultural Distance

Lisa Durkee Abbott, January 1999

Asked to briefly describe a project I have done with my English 2 students, I have to begin, I think, by describing the network we tap into. "Breadnet" is the network provided for the Bread Loaf School of English, Middlebury College's graduate school of English. Breadnet was created to link teachers of English (students and alumni of the program) around the country and, to some extent, around the world, with the goal being greater ongoing communication between teachers of like mind and subject matter. There are many conferences online related to the study of English. After talking about it for a couple of summers without actually doing it, a former classmate and I took advantage of the network to do an exchange with our students.

Discovering that we both teach a novel called "Bless Me, Ultima," by Rudolfo Anaya, a native New Mexican, we thought it would be interesting for our classes to read the responses of students who approach the novel from very different cultural backgrounds. My friend teaches the novel in New Mexico to students for whom much of the geographic and cultural realities are very familiar. For my students, despite the diversity of their backgrounds, much of the novel's content is unfamiliar and even unbelievable.

Last year, we began our exchange with simple introductions between students, having assigned each of our kids a particular partner in the other class. Even these opening introductions were eye-openers for some of the students, with some expectations met and others wonderfully broken as stereotypes were found not to be true in many respects. Following these introductions, we swapped responses to particular passages that the students themselves found intriguing. I asked them to find passages that they thought most reflected something mythical that had no proven base in reality. This was a deliberately loaded question seeking from the New Mexican counterparts some explanation of the validity of those beliefs. The resulting exchange was particularly productive. A less interesting but reasonably productive project was their exchanging more structured analytical essays. They swapped peer evaluations of content (not structure), adding their own reflections on the same topics.

Although this project went reasonably well, there were difficulties we will look to avoid this year. One problem regarding the ease of exchange for me was in how to transmit the students' information. I first tried collecting disks from each student. This was fine, but sending the information directly via their own e-mail accounts was easier for those students who were on-line. Now that each student has easier access to the network, that problem will be eliminated. This year, I will also try to do more of our on-line work from the classroom, connected to a hub. This will ensure that I have documents from each student. One of my

friend's frustrations was that she could send her work all at once, from their computer lab. I, unfortunately, had to send work in a more piece-meal fashion. Other changes this year will include our waiting until we've finished the novel to discuss it in a critical fashion. We will also attempt to continue the exchange with more decidedly cultural topics in the following term. We might read some of the same poems from a variety of sources, for example.

My students last year were disappointed when the unit was over, having grown to look forward to responding to their electronic classmates. Their enthusiasm was exciting for me to see, as they read more closely in order to respond in greater detail, and to better understand what their long-distance peers had to say. My current students are already looking forward to this project, having heard about it from my former students as well as from me.

I hope that this description is helpful. I know that as I grow more comfortable creating a computer lab of sorts in my classroom I may take advantage of other conferences that exist on Breadnet. I might, for example, work on an exchange for "Huckleberry Finn" with a former classmate who teaches in Mississippi. The possibilities in this regard are endless.

APPENDIX B

Information Technology Was Used to Enhance the Guidance Provided on Students' Coursework

The following is taken from an email message sent to the author by the instructor who developed the innovative use of information technology that is described in Chapter Two, "Technology Was Used to Make a Point (Again, and Again, and Again)."

> The process begins when I receive a paper, either emailed directly to me or shared in a network folder. The first thing I do is protect the document (tool/protect document), which will make my corrections show up in another color and would make the corrections of a second editor show up in still another color, and so on. I actually avoid making the corrections for the student. Instead, I prefer to comment on the text, and the insert/comment command creates pop-up boxes anchored to whatever text is selected. When I tire of typing the same comment on several papers, I create an autotext entry that will allow me to insert comments much more efficiently. I can also insert a hyperlink to a site that addresses, for instance, how to fix a comma splice. Macros let me insert the autotext comment and hyperlink at the same time. For the comma splice, the macro would insert a comment anchored to the offending text and a link to a helpful site. I can then create a toolbar button associated with the macro, one that says "comma splice."
>
> The point of all of this is that I provide more help to my students when I have so much of the basic hectoring in boilerplate. I just select the text and hit the button(s). With that much out of the way, I am free to devote more time to praising what went right with the paper and to addressing matters of style . . . I also appreciate that it is so much easier to maintain a running record of all the comments I make on student papers. I simply select all or some of the comment text, copy it, and paste it into a separate Word file I keep on each student.
>
> It now takes me about as long to mark up a paper on-line as it does with the dreaded red pen, but I feel that I can get more done with that time.

APPENDIX C

Kent's Internal Website Provided Novel Benefits for Teachers and Students

Faculty reported that the Kentranet, Kent's internal website (see the discussion in Chapter Two), helped them organize course materials and made time available during class that formerly was taken by activities peripheral to teaching and learning. One chair of an academic department reported that materials were being put on the internal web to assist new faculty in the department and provide continuity among department courses. A member of the faculty summarized the benefits of the Kentranet that, generally, were cited by other faculty:

> The Kentranet enabled me to become more organized as a teacher. I post homework on line. Saves a lot of time in class. I post answers to quizzes on line; have interactive tests on line; post students' work—serve as examples for future students in my courses. Posting materials saves giving handouts in class and having students losing course materials. I have pop-up messages: with congratulations [to students on current work] and alerts about coming exams. The supplemental material includes examples from professional journals in my field and the College Board site. I know students are using it because they ask me about the material in class.

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