

## **Applying Laptop Computers and Course-Management Software to Enhance Undergraduate Student Learning**

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### Abstract

This paper demonstrates how networked laptop computers (and/or personal computers) may be used with course management software to accomplish the following four goals while enhancing student learning:

- Simplify the process of communicating course information to students.
- Assess student performance without using paper, pens, and pencils.
- Keep students apprised of their grades without intruding on class time and faculty office time.
- Systematically and efficiently accumulate evidence of student performance.

Students and faculty, alike, benefit from more productive uses of their time and are increasingly computer literate.

Computers have capabilities that can enhance the teaching and learning process in many ways, and, they can free users of many necessary but often more mundane and less satisfying aspects of student and faculty work.

So, by marrying human capabilities, needs, and desires with computer technology, students and faculty can accomplish more with less, i.e., more effective and satisfying student learning and faculty teaching with less student and faculty time and effort expended. Alternatively, even more student learning and faculty teaching is possible with the same time and effort expended.

This paper is a case history of the use of networked laptop computers, personal computers, and course information software spanning a two-year period of progressively advancing computer and software applications. Its focus is primarily on quiz and exam administration and keeping students apprised of their performance.

### Introduction

Laptop computer use is becoming more common on university campuses. Some universities are requiring the use of “laptops” by their students. At other universities, students have

independently concluded that “laptop” use will aid their learning. Additionally, course management software is being used on hundreds if not thousands of university campuses.

This paper presents the author’s two plus years of experience in using course management software combined this academic year with the use of networked laptop computers.

### University Description

Lawrence Technological University (LTU) is a private university that enrolls approximately 4000 students in associate, baccalaureate, masters, and doctoral programs. A large portion of the student body, particularly in programs in which the author teaches, consists of non-traditional students, i.e., students who are older than traditional college age, transfer students from other colleges and universities and other programs within LTU, and/or students who are enrolled on a part-time basis.

LTU mandated freshman student use of laptop computers beginning with the 2000-2001 academic year. Sophomore and junior students were phased in during the 2001-2002 and 2002-2003 academic years, respectively. And, senior student laptop-computer use is scheduled to begin with the 2003-2004 academic year. Accompanying student-required “laptop” use was a request for faculty to incorporate computer applications, as appropriate, to course subject matter and student learning.

The University introduced an early version of Blackboard course-management software to the faculty during the 2000-2001 academic year.

A major effort to support faculty in incorporating new computer applications in their courses was also launched with the University’s establishment of the Veraldi Instructional Technology Resource Center (VITRC), with a large and growing array of computer instruction, and with VITRC-sponsored faculty best practices presentations.

The Blackboard Learning and Community Portal System™ (Release 6) was implemented by the University beginning with the spring 2003 semester.

### Author’s Computer Background

The author has been a faculty member and administrator in higher education for over 35 years, and has used computers primarily for word processing purposes on a gradually accelerating basis for about 25 years. Keyboarding skills have been learned without formal typing or keyboarding instruction. Touch-typing proficiency has not been achieved.

For approximately two decades the author has encouraged student use of electronic means to both author course assignments and submit them for grading.

The author began using Blackboard’s Online Gradebook feature when the University first introduced Blackboard. In the fall of 2002, the following features of Blackboard were added: course documents to provide students with an electronic course syllabus, course information and

announcements to provide electronic rather than photocopied material, and the digital dropbox for providing quizzes and exams to students and for students to submit assignments and completed quizzes and exams, and the discussion board to facilitate student out-of-class collaboration in preparing case studies.

### Computer Backgrounds of Students

Students have typically completed LTU's Technical Computer Applications course, which consists of introductions to computers, "C" programming, and Lotus 1-2-3, and includes problems to be programmed.

Students in some academic programs are not required to take the Technical Computer Applications course and have proficiency at the Introduction to Computer Applications level, which consists of introductions to e-mail, word processing, spreadsheets, data base applications, and computer graphics.

Still other students have had no academic computer instruction. Students may have had no academic computer instruction as a result of enrolling in a course the author teaches before enrolling in LTU's Technical Computer Applications course. (The Technical Computer Applications course is not a prerequisite to most of the courses the author teaches.) Some of these students may have acquired enough understanding of computers through other means, e.g., through their employment or their personal computer use to place out of LTU's Introduction to Computers course. And, some students in this group may have graduated (possibly years ago) from high schools that did not require computer instruction.

In short, some students are highly proficient in the use of computers and relevant software, and experience minimal computer anxiety when introduced to new computer applications. And, some students are not at all proficient in the use of personal and/or laptop computers and relevant software, do not have keyboarding skills, and/or experience relatively high levels of computer anxiety when introduced to new computer applications. The vast majority of students would best be described as having computer and software proficiency and anxiety levels that lie on continuums between the described extremes.

### Administration of Quizzes/Exams

The author uses short answer essay quizzes as a means of determining student concept understanding, determining student abilities to apply concepts, and providing feedback to students. Feedback consists of notations, comments, and questions designed to get students to think about their answers in new ways. Quizzes generally consist of a pair of questions on each of two or three topics. One question from each topical pair must be answered in order to earn allocated credit.

A comprehensive final examination is also electronically administered. Final exams generally consist of 25 to 30 short-answer-essay questions from which students elect 15 questions to answer.

This approach was employed using on a paper-and-pencil exams (and, more recently, quizzes) for many years.

Some experimentation in the fall 2002 semester yielded the following quiz and final exam administration approach: (Quiz[zes] and exam[s] are henceforth referred to as Q/E.)

- Q/E are composed in the same manner in which they have been composed for years using Microsoft Word software, but with directions suitable for electronic Q/E completion and submission.
- Q/E are submitted to Blackboard's digital dropbox of each student. (Q/E submission to digital dropboxes has been accomplished from the author's laptop computer located in the classroom or in the author's office.)

The courses in which the electronic Q/E approach was utilized in the fall 2002 semester were Management and Supervision, and Organizational Behavior. Two sections of each course, one day section and one evening section, were included.

Courses in which the electronic Q/E approach is being utilized in the spring 2003 semester are Management and Supervision (one day section), Operations Management (two sections, one day and one evening), and Productivity and Work Measurement (one evening section).

#### Contrasts Between Electronically-Administered and Traditional "Paper-and- Pencil" Quizzes/Exams

Following are especially notable distinctions between traditional paper-and-pencil Q/E and those administered using Blackboard's digital dropbox. These distinctions are presented in approximately the order in which they are experienced in Q/E administration. Each distinction is followed by anecdotal comments denoting whether students and/or faculty experience an advantage or disadvantage.

Each advantage and disadvantage that is or may be experienced by students is presented in one of the following exhibits: Exhibit 1. Technological and Life Skills Advantages That Are or May Be Experienced By Students, Exhibit 2. Learning Advantages That Are or May Be Experienced By Students, Exhibit 3. Course Performance Advantages That Are or May Be Experienced By Students, or Exhibit 4. Disadvantages That Are or May Be Experienced By Students.

Each advantage and disadvantage that is or may be experienced by faculty is presented in one of the following exhibits: Exhibit 5. Educational Advantages That Are or May Be Experienced By Faculty, Exhibit 6. Non-Educational Advantages That Are or May Be Experienced By Faculty, or Exhibit 7. Disadvantages That Are or May Be Experienced By Faculty.

Notable distinctions are:

- Students who do not request university computer accounts in a timely manner may request special accommodation, e.g., the opportunity to complete Q/E with paper and pencil.

Disadvantage: Student

Students who are granted temporary opportunities to complete paper and pencil Q/E are faced with “playing catch-up” to learn electronic Q/E procedures once they acquire the prescribed University computer account.

- Provides potential learning enhancing applications for laptop computer use on campuses requiring laptop use by students.

Advantage: Student

Students will experience additional, potentially beneficial, laptop computer applications, and may believe to a greater extent that any technology fee (or portion of their tuition) is more justified than if they did not experience such additional laptop computer applications.

Advantage: Faculty

Potential administrative pressure applied to faculty to use computers in instruction may be reduced.

- Students who do not acquire the prescribed laptop computer in a timely manner may request special accommodation, e.g., the opportunity to complete the Q/E on a university personal computer in a computer laboratory.

Disadvantage: Student

Students who are granted special accommodation to complete Q/E on a university personal computer in a computer laboratory may need to determine availability of computer labs and of personal computers during Q/E time.

Disadvantage: Student

Students who take Q/E on university personal computers in computer laboratories during class time may require more time to permit necessary travel to and from computer labs and computer start-up and shutdown.

- Provides opportunities for students to develop keyboarding skills.

Advantage: Student

Students have keyboarding experiences that are similar to those of many positions at which may presently be, or later become, employed.

Disadvantage: Student

Students with no or poor keyboarding skills have an additional challenge that must be met in order to meet their course expectations; or, alternatively, they may have to reduce their course expectations.

- Students are provided with opportunities to develop their laptop computer and software skills, and confidence in their abilities to use computers and software to accomplish meaningful work.

Advantage: Student

Career and life successes of many students will likely be partially dependent upon their abilities to productively use technology and upon their personal confidence, both of which may be potentially enhanced by course applications that require using previously unfamiliar procedures.

Disadvantage: Student

Electronic Q/E success requires that students follow procedures that are not forgiving, whereas faculty members using pencil and paper Q/E may be somewhat to very forgiving.

Advantage: Student

Though students may view unforgiving computer procedures negatively, such procedures become advantages as students conclude that following reasonable, structured procedures is an important life skill.

#### Exhibit 1. Technological and Life Skills Advantages That Are or May Be Experienced By Students

Students will experience an additional, potentially beneficial, laptop computer application, and may believe to a greater extent that any technology fee (or portion of their tuition) is more justified than if they did not experience such an additional laptop computer application.

Students have keyboarding experiences that are similar to those of many positions at which they may be employed.

Career and life successes of many students will likely be partially dependent upon their abilities to productively use technology and upon their personal confidence, both of which may be potentially enhanced by course applications that require using previously unfamiliar procedures.

Though students may view unforgiving computer procedures negatively, such procedures become advantages as students conclude that following reasonable, structured procedures is an important life skill.

- Q/E may be provided to students who cannot be in class due to illness, accident, or work travel, but who are able to complete the Q/E at another internet-accessible location.

Advantage: Student

Students who may otherwise miss class and a Q/E would be able to complete it in a timely manner at another internet-accessible location.

Advantage: Faculty

Faculty may devote less time to discussions about makeup Q/E and to preparing and grading makeup Q/E.

- Q/E may be programmed to make them available to students at a predetermined date and time.

Advantage: Faculty

Faculty may predetermine and program into the course management system when students are to receive the Q/E, e.g., at times when the faculty member has conflicting obligations.

## Exhibit 2. Learning Advantages That Are or May Be Experienced By Students

Faculty may expect more of their students and may ask more questions requiring higher order thinking skills, e.g., questions that require students to integrate concepts, since students have the ability to access any of their electronic notes.

Students may be able to learn more as a result of better-placed faculty comments and notations.

Students receiving Q/E feedback outside of class may be more likely to thoroughly review feedback rather than scanning feedback received in class, filing the feedback for later review, and, perhaps, never consulting that feedback again.

Students may, upon faculty request, e.g., edit answers and present the edited version adjacent to the initial version for further faculty feedback.

Feedback on individual Q/E remains readily accessible to the student, e.g., for studying for comprehensive exams that may follow, unless and until students delete it, or until the course ends and student access to the course digital dropbox is discontinued. There will likely be fewer incidents of lost feedback.

Students may take a more active interest in the consequences of their course performance inasmuch as their scores are readily and cumulatively available.

Students may quickly and easily determine their current course performance level.

Student ability to monitor course performance by referring to a single summary, rather than individual feedback on numerous assignments, enables more appropriate student decision making, e.g., to study more and/or more effectively, to adjust course grade expectations in keeping with cumulative grade information, and to withdraw from the course in a timely manner if performance is poor.

The learning experience is elevated and students learn more.

- Students have the ability to submit higher quality Q/E answers.

Advantage: Student

Students may edit and polish their writing with electronic Q/E rather than paper and pencil Q/E even during the pressure of a Q/E experience.

Advantage: Faculty

Faculty may experience benefits of being able to grade at least marginally higher level student answers because computer use provides students with an enhanced ability to edit and polish their writing than is typically possible with paper and pencil Q/E.

- Students have the ability to access any of their electronic notes.

Advantage: Student

Some students may be less inclined to take hand-written notes and to memorize information and more inclined to take electronic notes on their laptop computers and to concentrate on how to organize; access; process; apply; and, possibly, synthesize and integrate concepts.

Advantage: Faculty

Since students have the ability to access electronic notes, faculty may expect more of their students and may ask more questions requiring higher order thinking skills, e.g., questions that require students to process apply, synthesize, and integrate concepts.

Disadvantage: Faculty

If notes are not to be used by students while completing electronic Q/E, faculty face a need for student honors codes, where honors codes are not presently in use, and/or a substantial policing challenge.

Advantage: Student

Students receiving Q/E feedback outside of class may be more likely to thoroughly review feedback rather than scanning feedback received in class, filing the feedback for later review, and, perhaps, never consulting that feedback again.

Advantage: Faculty

Faculty will not need to allocate class time to share Q/E feedback since Q/E feedback may be immediately shared upon Q/E grading. Class time previously devoted to sharing Q/E feedback may be allocated to other learning activities.

- Copies of submitted Q/E remain in student possession even though the Q/E has been submitted for grading.

Advantage: Student

Students may reflect upon their answers between the time of Q/E completion and the time of receiving faculty feedback and may reach some of the same conclusions that the faculty member may later share with them, possibly enabling some students to become more amenable to critical feedback.

Disadvantage: Faculty.



Faculty will likely have to spend more time preparing Q/E since previous Q/E are available to new students in electronic formats, which are more easily communicable than are paper and pencil Q/E.

### Exhibit 3. Course Performance Advantages That Are or May Be Experienced By Students

Students who may otherwise miss class and a Q/E would be able to complete it in a timely manner at another internet-accessible location.

Students may better edit and polish their writing with electronic Q/E rather than paper and pencil Q/E even during the pressure of a Q/E experience.

Students may reflect upon their answers between the time of Q/E completion and the time of receiving faculty feedback. Students may reach some of the same conclusions that the faculty member may later share with them, possibly enabling the students to become more amenable to critical feedback.

Students receive value from prompt performance feedback that is greater than the value of less prompt feedback. With electronic Q/E, there is no need to accumulate graded Q/E for return at the next class meeting; Q/E may be returned to each student as each Q/E is graded.

- Faculty may read student Q/E answers on laptop or personal computer screens and make comments/notations at the point of relevance (possibly, e.g., in mid-sentence) rather than in the margins or at the end of the Q/E, resulting in greater connectedness between a comment's/notation's stimulus in student answers and resulting faculty comment/notation.

Advantage: Student

Students may be able to learn more as a result of better-placed faculty comments and notations.

Advantage: Faculty

Faculty may share more and higher quality comments and notations with students, and may experience better student performance as a result.

Advantage: Faculty

Faculty may read Q/E answers in font types and sizes of their preference rather than student handwriting or printing.

Disadvantage: Faculty

Some faculty may prefer to grade "paper and pencil" Q/E rather than do so on computer screens.

- Q/E grading may be faster and less fatiguing for faculty, even those with novice-level typing skills.

Advantage: Faculty

Faculty with at least novice-level typing skills may find Q/E grading faster and/or less fatiguing.

- Faculty may request and students may make faculty requested changes and electronically resubmit them without any conversation between faculty and students.

Advantage: Student

Students may, upon faculty request, e.g., edit answers and present the edited version adjacent to the initial version for further faculty feedback.

Advantage: Faculty

Faculty may be more inclined to challenge students to edit Q/E answers and are able to more conveniently evaluate students' second-attempt answers if they elect to so challenge students.

#### Exhibit 4. Disadvantages That Are or May Be Experienced By Students

Students who are granted temporary opportunities to complete paper and pencil Q/E are faced with “playing catch-up” to learn electronic Q/E procedures once they acquire the prescribed University computer account.

Students who are granted special accommodation to complete Q/E on a university personal computer in a computer laboratory may need to investigate to determine available computer labs and personal computers during Q/E time.

Students who take Q/E on university personal computers in computer laboratories may require more time to permit necessary travel to and from computer labs and computer start-up and shutdown time.

Students with no or poor keyboarding skills have an additional challenge that must be met in order to meet their course expectations, or they may have to reduce their course expectations.

Electronic Q/E success requires that students follow procedures that are not forgiving, whereas faculty members using pencil and paper Q/E may be somewhat to very forgiving.

- Upon grading Q/E, faculty may immediately return them to student digital dropboxes, where they will remain until deleted or filed elsewhere by the student.

Advantage: Faculty

Faculty need not accumulate graded Q/E and return them en mass at future class meetings.

Advantage: Student

Students may receive prompt performance feedback even when they are unable to attend class meetings that immediately follow Q/E.

Advantage: Student

Students receiving Q/E feedback outside of class may be more likely to thoroughly review feedback rather than scanning feedback received in class, filing the feedback for later review, and, perhaps, never consulting that feedback again.

Advantage: Faculty

Faculty will not need to allocate class time to share Q/E feedback since Q/E feedback may be immediately shared upon Q/E grading. Class time previously devoted to sharing Q/E feedback may be allocated to other learning activities.

Advantage: Student

Feedback on individual Q/E remains readily accessible to the student, e.g., for studying for comprehensive exams that may follow, unless and until students delete it, or until the course ends and student access to the course digital dropbox is discontinued. There will likely be fewer incidents of lost feedback.

- Grades may be recorded before or after Q/E are returned to students.

Advantage: Faculty

Faculty who neglect to record one or more student's scores may refer to their electronic copy of the student's Q/E at their convenience; there is no need to ask the student to provide the original Q/E.

- Students have the information to notify the professor of any Q/E score posting errors.

Advantage: Student

Students may take a more active interest in the consequences of their course performance inasmuch as their scores are readily and cumulatively available.

Advantage: Faculty

Faculty members share responsibility for accurate grading with their students as a result of students having the information to notify the professor of any Q/E score posting errors.

- Students' up-to-date cumulative scores are immediately available upon faculty Q/E score posting.

Advantage: Student

Students may quickly and easily determine their current course performance level.

Advantage: Faculty

Faculty may quickly and easily determine each student's current course performance level, possibly (depending upon the scoring system) with no manual calculations.

#### Exhibit 5. Educational Advantages That Are or May Be Experienced By Faculty

Faculty may expect more of their students and may ask more questions requiring higher order thinking skills, e.g., questions that require students to integrate concepts, since students have the ability to access any of their electronic notes.

Faculty experience the benefits of being able to grade at least marginally higher level student writing because computer use provides students with an enhanced ability to edit and polish their writing than is typically possible with paper and pencil Q/E.

Faculty may share more and higher quality comments and notations with students, and may experience better student performance as a result.

Faculty may be more inclined to challenge students to edit Q/E answers and are able to more conveniently evaluate students' second-attempt answers if they elect to so challenge students.

Faculty will not need to allocate class time to share Q/E feedback since Q/E feedback may be immediately shared upon Q/E grading. Class time previously devoted to sharing Q/E feedback may be allocated to other learning activities.

The learning experience is elevated and faculty may be stimulated to satisfy increased student thirst for learning.

- Course information software calculations enable students to determine how well they are doing relative to their classroom peers.

##### Advantage: Student

Student ability to monitor course performance by referring to a single summary, rather than individual feedback on numerous assignments, enables more appropriate student decision making, e.g., to study more and/or more effectively, to adjust course grade expectations in keeping with cumulative grade information, and to withdraw from the course in a timely manner if performance is poor.

##### Advantage: Faculty

Faculty are freed from many mundane conversations, e.g., performance-related complaints, such as "That Q/E was too difficult!"; requests regarding exam scoring; and questions, such as "How am I doing?"

## Exhibit 6. Non-Educational Advantages That Are or May Be Experienced By Faculty

Potential university administrative pressure applied to faculty to use computers in instruction may be reduced.

Faculty may predetermine and program into the course management system when students are to receive the Q/E, e.g., at times when the faculty member has a conflicting obligation.

Faculty need not accumulate graded Q/E and return them en masse at a future class meeting.

Faculty may read type of a font size preferred by the faculty member rather than student handwriting or printing.

Faculty with at least novice-level typing skills may find Q/E grading faster and/or less fatiguing than grading pencil and paper Q/E.

Faculty who neglect to record one or more student's scores may refer to their electronic copy of the student's Q/E at their convenience; there is no need to ask the student to provide the original Q/E.

Faculty share responsibility for accurate grading with their students as a result of students having the information to notify the professor of any Q/E score posting errors.

Faculty may quickly and easily determine each student's current course performance level, possibly (depending upon the scoring system) with no manual calculations.

Faculty are freed from many mundane conversations, e.g., performance-related complaints, such as "That Q/E was too difficult!"; requests regarding exam scoring; and questions, such as "How am I doing?"

Faculty members may meet challenges to justify student grades and to provide samples of student work with little extra work by electronically retaining student Q/E.

- Faculty may rather easily maintain a portfolio of each student's Q/E by retaining copies of graded Q/E.  
Advantage: Faculty  
Faculty members may be challenged by individual students, parents, and, occasionally, attorneys. Professional and regional accrediting agency representatives often ask to see samples of student work; and, sometimes they ask to see samples of "A," "B," "C," "D," and "F" student work. Faculty members may meet challenges to justify student grades and to provide samples of student work with little extra work by electronically retaining student Q/E.

- More class time and more out-of-class faculty-student interaction time may be focused on substantive subject matter without having to refocus many student questions, comments, and complaints.

Advantage: Student

The learning experience is elevated and students learn more.

Advantage: Faculty

The learning experience is elevated and faculty may be stimulated to satisfy increased student thirst for learning.

#### Exhibit 7. Disadvantages That Are or May Be Experienced By Faculty

Faculty face a potential honors code requirement, where honors codes are not in use, or a substantial policing challenge if notes are not to be used by students while completing electronic Q/E.

Faculty will likely have to spend more time preparing Q/E since previous Q/E are available to new students in electronic formats, which are more easily communicable than are paper and pencil Q/E.

Some faculty may prefer to grade “paper and pencil” Q/E rather than do so on computer screens.

The preceding distinctions are the primary distinctions, which have been observed by the author, between paper and pencil quizzes and exams (Q/E) and electronic quizzes and exams. More observations are likely as features of the Blackboard Learning and Community Portal System™ (Release 6) are implemented.

#### Conclusion

The author’s overriding conclusion from experience gained in applying computers and course information software to enhance student learning is that doing so provides a substantial advantage to most students and faculty.

#### Recommendation

Faculty are advised to carefully consider how experiences related herein relate to their present and possible future course designs. Then, if implementation advantages of specific laptop and/or course management software applications outweigh accompanying disadvantages, develop a phased implementation plan that provides appropriate assimilation time for both students and faculty before subsequent phases are implemented.

#### Epilog

Preparation for this paper included online literature searches of First Search, ERIC, First Article, and Wilson Select Plus for materials that others have published on university uses of laptop

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computers in conjunction with course management software. To the author's surprise, no directly relevant articles were identified.

However, three articles or the topics upon which articles are based that were found may be of interest to some readers. They are:

- The State of Maine's project, begun in the year 2000, to provide middle school students and teachers with Apple iBook laptop computers.
- The Copernicus Project, a project of six Washington state school districts to incorporate laptop computers into the learning process of academics and of computer skills. Fouts, Jeffrey T. and Carol Stuen, "Copernicus Project: Learning with Laptops: Year 1 Evaluation Report," Research in Education, July 1998.
- Siegle, Del and Theresa Foster, "Laptop computers and Multimedia and Presentation Software: Their Effects on Student Achievement in Anatomy and Physiology," Journal of Research on Computing in Education, 34, no. 1, 2001.

In addition, in January the author participated in a survey conducted by Ed Gehringer, North Carolina State University, on the subject of course management systems, e.g., Blackboard and Web CT, for presentation at the 2003 American Society for Engineering Education Annual Conference.

Finally, the author presented a Lawrence Technological University Blackboard Best Practices session entitled "Using Blackboard's Online Gradebook to Apprise Students of Their Course Performance," 6/17/02. A videotape of that presentation is available from the University.

Stan Harris is an Associate Professor of Management in the Engineering Technology Department of the Lawrence Technological University College of Engineering. He has 11 years of industrial experience with General Motors and over 35 years of experience as a faculty member and administrator. He is an educational consultant in manufacturing engineering and manufacturing operations to General Motors.