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Ubiquitous laptop usage in higher education: Effects on student achievement, student satisfaction, and constructivist measures in honors and traditional classrooms

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ABSTRACT

Three years of graduating business honors cohorts in a large urban university were sampled to determine whether the introduction of ubiquitous laptop computers into the honors program contributed to student achievement, student satisfaction and constructivist teaching activities. The first year cohort consisted of honors students who did not have laptops; the second and third year cohorts were given laptops by the University. The honors students found that their honors classrooms were statistically significantly more constructivist than their traditional (non-honors) classroom. The introduction of laptop computing to honors students and their faculty did not increase the level of constructivist activities in the honors classrooms. Laptop computing did not statistically improve student achievement as measured by GPA. Honors students with laptops reported statistically significantly less satisfaction with their education compared to honors students with no laptops.

1. Introduction

The phenomenon that is often referred to as ubiquitous computing is one of the latest transformational educational paradigms that foster an *anywhere, anytime* learning environment (Dickson & Segars, 1999). Even more recently, there has been a change in the nature of ubiquitous computing. The proliferation of portable electronic devices and wireless networking is creating a change from *e-learning* (electronic) to *m-learning* (mobile) (Lee & Chan, 2005). The emphasis on technology in education is not to imply that the technology is the goal of the educational process; however, a technological learning environment can alter the way students learn and the way professors teach (Culp, Honey, & Mandinach, 2005). A goal for technology in the teaching and learning process is that it becomes transparent and that there are universally available tools that enable students to learn and teachers to teach with greater efficacy and efficiency.

2. Technology and learning

Research has shown that technology integration into the college classroom has not been entirely successful. Some studies have indicated no significant differences between grades of post-secondary students enrolled in computer-mediated courses versus traditional lecture-based course (Brallier, Palm, & Gilbert, 2007; Rivera & Rice, 2002). Other studies have shown that in-class laptop use had a negative impact on student learning; students spent more time multitasking on their laptops and were therefore distracted from the primary lessons (Fried, 2008; Hembrooke & Gay, 2003). These researchers recommend

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that faculty need to effectively integrate laptops into their classroom and set appropriate boundaries for technology use in class by students.

Despite these neutral and negative studies, there are also studies that show improvement in student learning through computer-based courses (Maki, Maki, Patterson, & Whittaker, 2000; Poirier & Feldman, 2004; Saunders & Klemming, 2003). The traditional concept that students learn from computers the same way they learn from teachers is routinely challenged in the constructivist classroom; students are responsible for their own learning by constructing their own meaning from current knowledge. Wen, Tsai, Lin, and Chuang (2004) found that good online constructivist learning environments challenged students' existing concepts when they had to use inquiry learning and reflective thinking. This process was enhanced when students were asked to negotiate their ideas with other students. This type of learning is especially effective to honors students, who are the focus of this study.

Constructivist learning encourages self regulatory strategies and several studies have shown that high ability students have highly developed academic self-regulation strategies; some of these strategies are particularly well suited to learning in a virtual classroom (Bandura & Schunk, 1981; Britton & Tesser, 1991; Ernest, 1995; Zimmerman, 1998). These students take ownership of their education and decide when to study, where to study and how to study. They seek collaborators when appropriate and helpers when needed. Cooper (2001) noted that students preferred the self-regulated pace that often accompanies a technology-intensive course and often tended to be more engaged with the material. Cooper noted that many good students felt impeded by the constraints of a traditional classroom and would rather take control of both the pace and scope of their learning. Kitsantas and Chow (2007) found that students in online courses reported more frequent help seeking behavior and felt less threatened to seek help than students in traditional classrooms. Positive correlations were found between help seeking and academic self-efficacy and performance. Zimmerman (1998) noted that anywhere, anytime learning facilitates many self-regulation strategies.

Applying constructivist learning, including self-regulation strategies, to atypical learners in University Honors communities is most advantageous. These students are atypical because of their high levels of academic achievement and their high ability for making their own meaning and utilizing self-regulation skills (Bandura & Schunk, 1981; Ernest, 1995; Zimmerman, 1998). Gerrity, Lawrence, and Sedlacek (1993) suggested that coursework needs to be specifically designed for academically talented students.

University Honors classrooms are, generally, constructivist in nature. The classes are smaller, the faculty is handpicked, and the curriculum is more challenging. Faculty is encouraged to provide formative and summative assessment. The faculty is reminded that teaching is not telling and that "the learner does not merely record or remember the material to be learned. Rather, he or she constructs a unique mental representation of the material" (Schuell, 1996, p. 743), the classroom is student-centered.

3. Constructivist teaching

Constructivism is a learning theory where individuals construct meaning from their own current knowledge. It is a way of attending to teaching that allows for a multiplicity of alternatives; it is a concept that is broad enough to allow for a great deal of variation but specific enough to provide guidance to practitioners. Many educational psychologists and curricular specialists have created lists of the traits that they expect to find in a constructivist classroom (Brooks & Brooks, 1993; Jonassen, 1991; Jonassen, 1994; Murphy, 1997; Partlow & Gibbs, 2003; Savery & Duffy, 1995; Wilson & Cole, 1991) A comparative analysis of these traits revealed ten general patterns that seem to be common to constructivist classrooms. They are:

1. Learning is collaborative and cooperative. Students work in groups or task-based ad hoc teams. These types of groups help students recognize the role of social contracts in the learning process.
2. Students have control and responsibility for their learning. Self-regulation strategies are encouraged. The teachers are more interactive and act as mediators, coaches or translators.
3. There is an acceptance of multiple perceptions of reality and students' opinions are valued and actively sought by the teacher. Students are asked how they feel about a topic; they are not told what to feel about any topic.
4. Students' learning is embedded in authentic, real world scenarios and problems are posed as actual situations. When possible, original data are provided to the students.
5. Instructional goals are negotiated not imposed. Students' questions are valued and sought, and they control the pace and direction of much of the classroom activity. Instructors allow ample time, after posing questions, for students to frame answers. While these goals are often disparate, the solution is negotiated.
6. Assessment is both formative and summative. Grades are based (either in whole or in part) on portfolios, presentations and other forms of knowledge display. Formal examinations are not eliminated; however, their use is heavily supplemented by these other assessment media.
7. Learning is active. Teachers stress understanding rather than rote memorization. There is an emphasis on the integration of learning and life; students are urged to discover the interrelatedness of concepts and their application to the real world. Students are implored to explore alternative understandings and applications of the classroom concepts.
8. Classes are not highly structured. Topics emerge and meaningful digressions are permitted. Students are pushed to derive alternative outcomes for problems and to see conflicting points of view.

9. Teachers are the guides on the side; this often gives rise to the notion that the teacher is a co-learner. They pose problems and engage students in dialogue; they often give advice on how to find an answer to a problem but never directly provide a solution for the problem at hand. Their role is to help the students understand the task, not provide the solution.
10. The students are urged to become self-reflective and to aid their student colleagues in their self-reflection.

Constructivism has altered the roles of professors and students. However, the roles of professors and their students have been slowly changing over time. A key catalyst for this change began in the 1960s when rebellious students on college campuses challenged existing social traditions (Oldenquist, 1983). Students found themselves being treated as peers and participants in many college-governing activities (Joughin, 1968). In 1968, the American Association of University Professors and the Association of American Colleges issued a Joint Statement on Rights and Freedoms of Students. This document stated that students should be consulted on all educational matters and defined them as the immediate consumers of college educations (Joughin, 1968).

4. Students as consumers: student satisfaction

Since the middle of the twentieth century, students' roles slowly changed from receivers to choosers of their education. The element of choice transformed students into consumers and professors into service providers. Students were officially granted the status of *consumer* in 1975 by the Federal Interagency Committee on Education (Stark & Terenzini, 1978).

Despite the apprehension of many post-secondary educators, the student consumer metaphor is still prevalent and seems to be gaining popularity among students, parents and funding sources (Baldwin & James, 2000; Berg & Roche, 1997; Demb, Erickson, & Hawkins-Wilding, 2004; McCormick, 2003; Mooney & Bergheim, 2002; Ritzer, 1996; Stark & Terenzini, 1978; Taylor, 1988; Tovote, 2001; Tucker, 1991; Zemsky, 2000). The consumer label helps better identify roles and define responsibilities; this is now more important than ever because of the increasing public demand for accountability from colleges and universities.

Given that the current operational paradigm for students is that of consumer, it is imperative that student satisfaction be addressed. Student satisfaction can be measured using the same type of instruments that are commonly used in other customer satisfaction market research. One type of customer satisfaction measure, called "*disconfirmatory*," is the most popular (Devlin, Dong, & Brown, 1993; Rust, Zahoric, & Keiningham, 1994). The disconfirmatory scale measures the performance of the service provider by comparing it to the a priori expectations of the consumer. Consumers assume that their expectations will be met and if they are, the service encounter is satisfactory and non-exceptional. However, if these expectations are not met, the encounter is deemed not satisfactory because the a priori expectations are not met. Disconfirmatory scales have many advantages because they combine both consumer expectation and consumer perception into one measure (Parasuraman, Zeithaml, & Berry, 1991).

5. The laptop initiative

To provide better customer service to our students and to make the honors program technologically rich, laptop computers were issued to incoming business freshmen (Honors Laptop Implementation Committee., 2002). Our Business honors classrooms are constructivist in nature, which our administration believed would complement laptop usage. Our honors program hoped that honors students would be more satisfied with their educational experiences after the introduction of ubiquitous laptop computing; it was also hoped that honors students would become more proficient learners as measured by their GPA.

The proposal called for phasing in laptops until all Business honors students would be laptop equipped. All incoming students were provided with laptops by the Business school, but laptops were not provided to the existing students. This led to the emergence of two cohorts of honors students, students with laptops and students without laptops. Because both the laptop and non-laptop cohorts were subjected to the same admissions criteria and are subject to the same retention criteria, they are very similar; this presented an ideal opportunity to study the effects of ubiquitous computing.

The Business School has been at the forefront of technological innovation at the university for more than 10 years. Technology has been one of the five main foci of the Dean's strategic plan for the school. This is evidenced by the fact that the School has had an associate dean for technology for many years. A study of the rate of adoption of the blackboard course management system at the University, which began in March 1999 when blackboard was first installed, shows that the Business School faculty was by far the quickest and most pervasive adapters of the new technology (Feeney, 2001, p. 91).

The Faculty chosen to teach in the first two years of the laptop honors program was selected for their teaching ability and their reputations as early-adopters of technology. Honors faculty taught 1–2 sections of a course per semester in this program. By the end of two years from when the laptop initiative began, there were 12 business honors courses. In the first year of the laptop program eight courses were converted to laptop courses. During the second year four more courses were converted. Honors business courses focused on the following areas: accounting, finance, economics, computer information systems, marketing, human resources, risk & insurance management, legal, and real estate.

6. The research questions

This research was designed to answer four questions. The goal of collaboration and highly interactive constructivist honors classrooms were the basis for the first two research questions; the goal of constructivism to improve student learning and satisfaction formed the basis for the last two questions.

- Question #1: Are the honors classrooms more constructivist than the traditional (non-honors) classrooms?
- Question #2: Has the introduction of ubiquitous laptop computing increased the level of constructivist activities in the honors classrooms?
- Question #3: Has student achievement, as measured by GPA, improved since the introduction of laptop computers?
- Question #4: Have reported levels of student satisfaction increased since the introduction of laptop computers?

7. Methods

7.1. Sample

7.1.1. Students

Data were collected from three graduating cohorts of honors business students in a large urban university. The groups were similar in composition. To be admitted to the honors program, members of both the laptop and non-laptop groups had to meet exactly the same entrance criteria. Admission to the program is limited to students (either true incoming freshmen or transfers) who have high GPAs and strong letters of recommendation. Qualifying students are identified at the time of admission and invited directly into the program. There are no special application procedures. If incoming students feel that they should be a part of the honors program but have not been invited to join, they may interview with the program administrators and request admission to the program. All honors students take honors as well as traditional classes. To remain in the honors curriculum, students must maintain a cumulative GPA of at least 3.00 and continue to enroll in honors level courses on a regular basis. These requirements are the same for both the laptop and non-laptop cohorts.

The three groups were of similar size, 27 subjects for the first two graduating cohorts and 33 subjects for the last cohort. The median age at graduation for all three groups was 22. The first cohort had more females than males (9 males, 18 females); the other two groups were almost evenly divided by gender.

7.1.2. Faculty

The faculty sample was chosen based on their teaching and technology expertise. Data were collected from 10 honors faculty that participated in the laptop honors program. Eight of the 10 faculty had more than 16 years of teaching experience; the other two members had less than 10 years of experience. The faculty's average confidence level of working with computers was an 8 on a scale of 1 to 10 (1 = low, 10 = high). Of the 10 faculty members, most used word processing (80%), presentation software (80%), spreadsheets (70%), and databases (70%) for their own work activities. The entire faculty used the Internet in their work. Nine of the ten faculty noted that their computer skill development was primarily self-taught. Half of the faculty further developed their computer skills by attending seminars or workshops. For this particular laptop honors project, 7 of the 10 faculty stated they received no specific training. The other 3 faculty reported attending a three day intensive workshop focused on *Computer Enhanced Learning for Faculty*. These three faculty participants had access to course design specialists who provided insights into strategies others had used to design their laptop-intensive courses. Each participant left the workshop with specific course proposals designed to utilize the laptop in his/her teaching. Overall, 7 of the 10 faculty members reported that the nature of their course content fit very well or well with the use of technology, 2 of 10 were neutral regarding technology fit for their course and 1 of 10 noted that the use of technology did not fit well with the course content.

7.2. Procedures

7.2.1. Laptop distribution

The first graduating cohort of the honors business group was not issued laptop computers. The University's Business School Implementation Committee purchased IBM ThinkPad laptops and issued laptops to honors faculty and to honors business students in the second and third graduating cohorts.

7.2.2. Data collection

Data were collected over a period of six semesters, specifically in the fall and spring semesters across a three year period. Graduating members of the honors program were given a packet that contained the Constructivist Classroom Inventory and Student Satisfaction Survey during their last semester of school before graduating. If the honors students chose to participate, they returned the completed packets of information to the honors office. The honors staff entered the students' actual

GPA from the University system into the packet of information. The honors staff assigned each student packet an arbitrary identification number that was not traced back to the student, meaning that the actual student identification was destroyed once the arbitrary identification number was assigned to each packet. The packets were then given to the researcher for analysis, and all information became completely anonymous to the researcher.

7.3. Instruments

7.3.1. Constructivist classroom inventory

The constructivist classroom inventory was designed to measure the students' perceptions of constructivist classroom activity in both their honors and non-honors classrooms. The Constructivist classroom inventory was created for this study to measure all of the ten basic constructivist principles noted in the literature review above. Three questions were created for each of the ten major tenets of constructivism. For example, "Students worked in groups," "Performance was measured a number of different ways," "Professors gave guidance to problem solving but finding the answer was up to the student." The instrument consisted of 2 sets of 30 identical questions. Therefore, of the 60 total questions, 30 questions were asked about honors classrooms and the same 30 questions asked about non-honors classrooms. The responses were scaled on a four point Likert scale (i.e. always, sometimes, hardly ever, never). Positive and negative statements were used to address response bias.

A panel of three experts assessed the structure of the instrument. Each evaluator has conducted broad research in the area of survey construction. The instrument was examined by this group to gather their evaluation as to the presentation of the items within the instrument and to deem in their expert opinion that the structure and form of the items were appropriate. Additionally, two other experts also commented on the content of the items. All members noted in their expert opinion that the content of the instrument was acceptable.

The instrument measured the honors students' perceptions of constructivist classroom activity in two different venues; their honors and non-honors classrooms. The coefficient alpha for the 30 honors items was .84 and the coefficient alpha for the 30 non-honors items was .86. The coefficient alpha for the entire instrument was .84.

7.3.2. Student satisfaction survey

The Student Satisfaction Survey measured the students' perceptions of their satisfaction with university professors, assessment polices, university polices and overall satisfaction with the University. This survey was modeled from discriminatory scale instruments where respondents are asked to consider a particular aspect of consumer service and compare their actual experience to their a priori expectations of that experience; in other words, they simply rated the service with respect to their own expectations (Danaher & Haddrell, 1996). The literature shows that disconfirmatory scales is a preferred method for measuring customer satisfaction because it shows better validity and reliability than other customer satisfaction scales (Danaher & Haddrell, 1996; Devlin et al., 1993; Rust et al., 1994). The primary reason for the popular use of disconfirmatory scales is that it correlates positively with consumer retention (Rust et al., 1994).

A three member expert panel assessed the content validity of the instrument. Each evaluator has conducted broad research in the area of consumer satisfaction and survey construction. The panel was asked to comment on the form, format, structure and content of the instrument to deem it acceptable.

The Student Satisfaction Survey contained 20 items. Items were related to either professors (e.g. "With regard to fairness and impartiality, my professors were. . ." or "My professors seemed to be well prepared for class"), to assessment policies and procedures (e.g. "My grades were based on objective standards that were easily understood" or "workload expected was. . ."), to university policies (e.g." When it came course scheduling and roster selection, the course offerings were. . .") or to general measures of satisfaction (e.g. "Would you choose this University again?"). The responses were scaled on a four point Likert scale (e.g. absolutely, close, not nearly, absolutely never). Since all of the items are related to consumer (student) satisfaction, it was expected that there should be a high degree of correlation among all items. The Cronbach Alpha for all twenty items was .89.

7.3.3. Business honors laptop student assessment survey

Business honors students who had received laptops completed an open-ended assessment survey after one semester of being in the laptop program. Sample survey questions asked about (a) benefits and/or drawbacks of program, (b) whether the physical layout of classroom provided for optimal learning, (c) whether laptop program promoted interactions with student and faculty, (d) advantages/disadvantages of working in a multitasking environment (e.g. computers used for email, IM, surfing net, taking notes, online in-class activities), and (e) whether the semester met their expectations. The students completed the survey using Microsoft Word and emailed the survey to an administrative assistant. The assistant then compiled the surveys discarding student names into one file. The file was sent to the researcher for analysis, and all survey responses became completely anonymous to the researcher.

Qualitative analysis of students' open-ended responses was made using the constant comparative method (Merriam, 1998). The responses were repeatedly read by an independent researcher (not a faculty participant of the honors laptop program) and initial content codes (e.g. laptop distraction, access to information, etc.) were created from content found from the responses. These initial content codes from the responses were documented on a hardcopy of students' open responses. The initial content codes were then analyzed to determine how they were related to support or reflect a general theme or topic.

Furthermore, a code mapping analysis procedure of students' responses was documented. According to Anfara, Brown, and Mangione (2002) code mapping is part of an audit trail that provides readers with disclosure of the responses process and adds to the trustworthiness of the analysis. Four themes were found: (1) Readily available access to information, (2) Enhanced interactions with students and faculty, (3) Laptop distraction in class, and (4) Poor physical layout of classroom.

7.3.4. Faculty business honors laptop survey

After full implementation of the laptop honors initiative, a teaching and computer usage survey was administered to the faculty. The survey consisted of 21 questions that focused on the nature of teaching, confidence of computer usage, computer skill development, and types of computer usage.

8. Results

8.1. Laptop usage and activities

All faculty reported that student laptop usage was used mostly for individual work, projects, and e-communication. Faculty reported using the laptops less for authentic situations and for group work. Laptops were rarely used, if ever for quizzes and tests. Table 1 shows the faculty percentage of how students were asked to use their laptops.

8.2. Question #1

According to honors students, are honors classrooms more constructivist than their traditional (non-honors) classrooms?

A paired t-test showed that honors students reported that their honors classrooms ($M = 3.10$, SD = .211) were statistically significant more constructivist than their traditional classrooms ($M = 2.68$, SD = .283), $t(4.19, p < .001)$ (Effect size, $r^2 = .390$).

8.3. Question #2

Has the introduction of ubiquitous laptop computing increased the level of constructivist activities in the honors classrooms?

An ANOVA showed no significant differences in all constructivist activities (i.e. total score from constructivist classroom inventory) by the introduction of the laptop computer ($F = .107$, $p = .898$). A microanalysis of each item in the constructivist classroom inventory was performed to see if the introduction of the laptop computers impacted some specific classroom activities. A one-way ANOVA was performed using the individual items as the dependent variable and the use of laptop computers as the independent variable. Significant differences between the laptop and non-laptop cohorts were found in five specific areas. Table 2 presents these results.

Ironically, the introduction of laptops, when it did make a difference, reduced the amount of constructivism in the classroom. This finding was supported by items on the faculty survey that indicated only 4 of 10 faculty thought that the introduction of laptops made learning more student-centered and changed their nature of teaching. Two of the 4 faculty indicated a change in their nature of teaching just by using more technology for class work. Only two faculty reported an increase in their constructivist teaching noting that the laptops allowed them to give their student more comprehensive and advanced assignments.

Only one item was positively influenced by ubiquitous computing. This item "honors professors posted problems, student find answers," can be supported by student responses from the Student Assessment Survey. The qualitative analysis showed that students felt they had readily available access to information when needed. Student response examples are as follows:

- "The fact that I have information on demand is most astonishing, a professor can ask for a stock quote and I can have it within a few minutes and gives more meaning to the lecture."

Table 1
Percentage of faculty requiring student assignments using computer software

Computer software	Faculty requests of usage (%)
Word processing	90
Spreadsheet	70
Database	40
Multimedia/Presentation	40
Internet	100
Subject specific	30
Tutorial	20
Problem solving	40
Writing papers	50
Research	60
Note taking	30

Table 2
The One-way ANOVA of individual items on the constructivist classroom inventory

Item	*F*	*p*	Laptop	*N*	Mean	SD
Honors opinions important	7.243	.009	No	27	3.52	.509
			Yes	59	3.19	.541
Honors grades on many assignments	6.197	.015	No	27	3.52	.580
			Yes	59	3.19	.572
Honors professors gave real authentic data for analysis	4.170	.044	No	27	3.30	.542
			Yes	59	3.05	.506
Honors professors focused on applying concepts not memorizing	4.238	.043	No	27	3.78	.424
			Yes	59	3.53	.568
Honors professors posed problems, students find answers*	5.280	.024	No	27	2.85	.456
			Yes	59	3.09	.427

* The only item that was statistically significantly positively influenced by ubiquitous laptop computing.

- "I don't feel like I'm missing out on the world around me when I am in class. Having the computer in front of me allows me to check other facts in the Internet when I'm not sure about a topic."
- "Anytime I need to get information about what the professor is teaching, all I do is search the Internet."
- "It was very helpful in accounting, because it provided a hands-on source to solving many of the financial problems."

Although the constructivist classroom inventory and faculty survey indicated that group work was not stressed, the student assessment survey showed that the laptops enhanced communication among students and faculty. Eighty two percent of student responses noted positive student and faculty online interactions. Examples of student responses are as follows:

- "Students can help one another on projects, teachers can provide faster communication to their students, web links can go beyond the regular curriculum of a textbook and make greater learning possible."
- "The laptop program has allowed me to get to know my professors/classmates on a personal level... Information can be transferred on a faster rate. I learn about opportunities and meetings that I would not have know about if it was not for the email/blackboard.
- The online portion made it possible to work around schedules and weather in order to get work done.
- "If there are any questions about class, I could email the professor. The laptop encouraged communication because of people asking each other about how to do things on the computer."

8.4. Question #3

Has student achievement, as measured by GPA, improved since the introduction of laptop computers?

In addition to the total GPA, two sub-scores were calculated and considered for student achievement. Student quantitative skills and student writing ability were examined independently. Grades in courses that were identified by the University as *Writing Intensive* were combined to create the Writing GPA. Quantitative courses such as, Accounting, Economics, Statistics, Mathematics, and the Natural Sciences were identified and those scores were computed into a Quantitative GPA. Overall GPA scores were higher for the laptop cohorts than for the non-laptop cohort, but not statistically significantly different which is reported as follows: (a) Total GPA ($F = .905$, $p < .409$), (b) Writing GPA ($F = .802$, $p < .452$), and (c) Quantitative GPA ($F = .114$, $p < .892$). See Table 3 for the mean GPA scores. Interestingly, although there were no significant differences in GPA between the laptop and non-laptop groups, the laptop group rated an increase in their computer skill level since entering the honors laptop program. Students in this group rated their average computer skill level before entering the

Table 3
The mean GPAs by graduating cohort

		Mean	SD	*N*
Total GPA	Year one (non-laptop users)	3.55	.273	27
	Year two (laptop users)	3.63	.217	26
	Year three (laptop users)	3.60	.247	32
GPA for quantitative courses	Year one (non-laptop users)	3.42	.362	27
	Year two (laptop users)	3.55	.314	26
	Year three (laptop users)	3.50	.393	32
GPA for writing	Year one (non-laptop users)	3.57	.310	27
	Year two (laptop users)	3.59	.293	26
	Year three (laptop users)	3.60	.341	32

Laptop Program at 2.74 (1 = low to 5 = high); after a semester of being in the laptop program their mean skill level increased to 3.63.

8.5. Question #4

Have reported levels of student satisfaction increased since the introduction of laptop computers?

The raw scores on all twenty items on the student satisfaction instrument were summed to create a summary variable labeled *Total Satisfaction*, with the total maximum score equal to 80. This score was analyzed for the laptop and non-laptop cohorts. In general, all honors students were generally satisfied with their academic education; however, laptop users ($n = 60$) ($M = 62.20$, SD = .7.46), reported statistically significant ($p = .048$) less satisfaction when compared to the non-laptop cohort ($n = 26$) ($M = 65.80$, SD = .8.10).

The qualitative analysis indicated that all the student who used laptops felt that in general their schooling met their expectations because they believed they learned a great deal; however many students were dissatisfied with two aspects of their laptop learning. Seventy eight percent of the students noted that the laptops were a distraction in class. In general students found the temptation of Internet activities too great to control their behavior in class. Students got over-involved in Internet activities and were inattentive to teacher lectures. Examples are as follows:

- "I feel I learned a lot from having this laptop but at the same time I am sometimes distracted by how easy it is to lose track of class by going on here and doing other stuff."
- "I must say that it is enticing to do some of these (computer-related) activities rather that listen to the professor. Sometimes it is distracting and I miss bits and pieces of important notes."
- "The laptop environment was beneficial to learning in the classroom, but it did have its drawbacks. It was often hard to pay attention when you knew that you could email your friends to talk to them online while you were in class."
- "It is distracting. Some of the classes are boring. . .so the temptation to use the computer for entertainment purposes is too great."
- "I think students also should not be allowed to use chat rooms during the class. That should be made as clear as possible."

Half of the student respondents also noted that the physical structure of the laptop classroom was not conducive to learning. In general, most students were not content with the visibility of the whiteboard and blackboard. Some students were also not satisfied with the seating arrangements. Examples of student comments regarding the seating arrangement are as follows:

- "Placement of seats in rows is not conducive towards a collaborative environment. Also, encourages nonacademic activities during class (email) as the positioning of the students does not allow the instructor full view of the laptop screens."
- "The laptop classroom, however nice, doesn't allow for interaction between the instructor and the students, which at times can be crucial to the lecture."
- "Right now people behind the 3rd row see only backs of students in the first and second row."

Examples of student comments regarding the boards are as follows:"

- "The boards and screens are in an awkward position, they tend to reflect the light causing a glare, or the lights have to be out where it is hard to see. The windows in the back also place a glare on our individual screens.
- "It is sometimes hard to see the boards on the side with the glare from the windows."

9. Discussion

Results showed that honors students reported more constructivist teaching in their honors classrooms when compared to their traditional (non-honors) classrooms. This finding reinforces the purpose for having honors classrooms. First, honors classes are smaller than traditional classes. Our honors classes are limited to between 20 and 25 students. Smaller classes feel friendlier and there is likely to be increased interchange between students and professors. Second, our honors classes are taught by some of the best and most experienced professors in the school. Most of these faculty members have been teaching for many years and have finely honed teaching skills. Comfortable, confident professors (in small classes) are more prone to discuss the material as opposed to lecture about the material. Third, honors students generally take as many of their honors classes as possible with other known honors students. This increases their classroom comfort level allowing them the opportunity to be more involved in classroom activities. Lastly, honors classes allow for more formative evaluation of projects, papers and other major assignments than non-honors classes.

According to the constructivist classroom inventory and faculty survey the introduction of ubiquitous laptop computing did not impact the level of constructivist activities in the honors classrooms. At times there was a significant decrease in

constructivism in the honors classroom. Additionally only 2 of 10 faculty members reported an increase in constructivist teaching due to the introduction of laptops.

Although technology can be a medium to catalyze constructivist learning, it is not particularly easy for all faculty to do so in higher education. Salinas (2008) suggested that there needs to be major changes both in the way faculty view technology and the classroom for successful technology integration to occur in higher education. Salinas created a model to help faculty become more constructivist in their teaching, but noted that for this type of constructivist model to be implemented, a change in the traditional teaching culture must change. He supported our study stating that currently faculty are not trained for these new constructivist roles. Hannafin, Orrill, Kim, and Kim (2005) noted that faculty have mainly used technology to support their conventional long-established teaching approaches and pedagogical transformation has been limited in post-secondary institutions. Patten, Sanchez, and Tangney (2006) contended that with each new technological device, faculty would need to broaden their pedagogical perspective to create new innovative learning opportunities for their students.

Although the overall survey results in this study indicated that there was not a significant increase in constructivist activities in the laptop honors classrooms, students' open-ended responses revealed that constructivist learning was happening. The students appreciated having readily available access to information when professors posted problems, making their learning more meaningful. Also, most students took advantage of the e-communication that the laptops provided them; this augmented positive student and faculty online interactions.

When honor students were given unfettered access to laptops, they reported an increase in their computer skills, and their GPAs did slightly increase, but the GPA increase failed to reach statistical significance. Nevertheless, all the subjects in this study are highly competent students with very high GPAs. This finding is supported by Broad, Matthews, and Mcdonald (2004) that found no conclusive evidence that honors accounting students' performance increased due to the implementation of an integrated virtual learning environment. Specifically, there were no significant differences in accounting grades between those students who used the virtual learning environment and those students who did not use the web-based learning and teaching materials. Wilson (2000) found that the same types of students who do well in traditional classroom also do well in computer-mediated communication classrooms and that these types of students generally have high achievement or high aptitude characteristics. However, technology is changing and new mobile devices may prove to provide exceptional students with better learning tools that can positively affect their performance. Chen, Chang, and Wang (2008) found that students with cell phones and PDAs logged into the academic reminder system twice as much as those with desktop or laptops, and students in the top 10% of their class using cell phones and PDAs significantly increased their test scores over the top 10% of students using desktops and laptops.

The introduction of the ubiquitous laptop computers actually lowered the mean academic satisfaction scores reported by honors students. The largest drop in satisfaction was in the first year of the program. This could be accounted for the students having to learn new computer tasks experiencing a learning curve with the new technology. Rivera and Rice (2002) found that undergraduate students in web-based courses versus traditional courses were less satisfied because not all students had the necessary knowledge and skills to work comfortably with computers. Kay (2008) found that undergraduate students who were enrolled in an integrated laptop program were more happy, less anxious and less angry as their computer knowledge increased over time. Saunders and Klemming (2003) found that with the introduction of computers to undergraduate cohorts, there were less student worries in the second year from the first year as students became generally increasingly familiar regarding the use of learning with computers.

Additionally, it appears from student responses that two reasons contributed toward their dissatisfaction: (1) laptop multitasking distraction in class, and (2) poor physical layout of the laptop classrooms. Students too easily got distracted using the laptop for Internet activities instead of being attentive to the professor. Other studies support this finding and suggest that faculty need to set boundaries for technology use in class (Fried, 2008; Hembrooke & Gay, 2003). In our study, we found student responses that recommended faculty set limitations by requiring students not to use their laptops during class for nonacademic tasks. Student respondents also noted that the physical structure of the laptop classroom was not conducive to learning. In general, most students were not content with the visibility of the whiteboard, blackboard and laptop screens mostly due to sun glare. This physical dissatisfaction is a lesson learned for our administration. It is recommended that any school that is looking to infuse technology into their classroom, properly plan for a physical layout that is most conducive to learning.

Other studies suggest low student satisfaction due to hardware problems. Rivera and Rice (2002) found that undergraduate student satisfaction was lower in web-based courses versus traditional courses due to hardware and software problems. Demb et al. (2004) noted in their laptop study that hardware problems still plagued the best of technology and that over 60% of their undergraduate student sample felt that the laptop was too heavy to carry around easily. Although several student responses in our study did express dissatisfaction due to hardware problems, it did not emerge as an overriding theme in our qualitative analysis.

Lastly, only 30% of our faculty reported technology integration training specifically for this Laptop Program. Just 40% of faculty thought that the introduction of laptops made learning more student-centered. Having faculty properly trained to effectively integrate technology into their lessons is vital in having students feel satisfied with their education. Studies have shown that students were satisfied with their laptops but were less satisfied with their mobile courses (Collins, Easterling, Fountain, & Heather, 2004; Demb et al., 2004). Demb et al. (2004) found that there was a high correlation between students' perception of the value of their laptop to their academic success to the success of laptop teaching and learning integration activities facilitated by their faculty. Milliken and Barnes' (2002) study indicated that when technology lessons

are well integrated by faculty, business students had good perceptions of the course as well as the teaching and learning. Newhouse and Rennie (2001) found that although laptop computers may be a valuable tool for students, most of the teachers had inadequate experience using computers to support student learning, despite the teachers' enthusiasm and years of teaching experience. Students of these teachers believed teachers needed more computer integration training before they would make the effort to bring their computers to class. Newhouse and Rennie noted that fundamental acceptance of student-centered constructivist learning activities was needed to implement good use of portable computers in the classroom.

10. Conclusion

The ubiquitous laptop initiative did not significantly improve the business honors program; however, the program in general has a successful curriculum. The students were generally satisfied with their education, the classrooms were usually constructivist in nature and the students are performing at very high levels. Honors students perform at such high levels of competency that it can be difficult to show statistical significant improvement in their performance. Thus, future research regarding university honors communities would be more efficacious if it used non-honors students as a control or baseline against which to measure the performance of the honors community. Furthermore, we recommend that technology training for all faculty be scheduled for any academic technology initiative.

Research studies suggest effective computer-classroom integration training is still needed for faculty. Concole, Dyke, Oliver, and Seale (2004) developed a progressive model that used different learning theories, from behaviorist to constructivist, that could support faculty's diverse pedagogical approaches to e-learning. However, as technologies move towards an m-learning environment, faculty will need to apply appropriate learning strategies for students to take advantage of this instant access to data. Although there is some disagreement on whether laptops are truly m-learning versus e-learning devices, there is no doubt that the recent technologies, such as PDAs, MP3 players and mobile phones are forerunners in m-learning devices (Caudill, 2007). Handheld device studies show that m-learning extends the flexibility of anytime, anywhere learning (Motiwalla, 2007) and that collaboration, contextualization, constructionism and constructivism are the most important educational philosophies for effective use of these devices (Patten et al., 2006). Hannafin and Land (2000) noted that the post-secondary culture still supports the *sage on the stage* teaching technique. However as technologies change, more pressure will be on faculty to integrate these new tools in productive ways for student learning, and faculty training in using technology in constructivist ways will be a most important factor.

Appendix A. Constructivist classroom inventory

While answering these questions, try not to think of any one honors professor or honors class, try instead to think of an average of all of your professors or classes in the honors program. Please circle your response.

1. My honors professors asked for student questions.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

2. We worked in groups in the honors classes.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

3. In my honors classes, we often had to find the information that we needed for homeworks and projects on our own.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

4. I felt comfortable asking questions when I was confused or having trouble with some topic in my honors classes.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

5. My honors professors acted as if they were pleased when students asked questions.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

6. My grades in the honors classes were based entirely on tests and quizzes.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

7. I felt that my opinions were important to my honors professors.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

8. In the honors classes, we were graded on portfolios, class presentations and many other things.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

9. Teamwork was encouraged in the honors classes.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

10. Things other than tests and quizzes were used to compute my grade in the honors classes.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

11. I was required to memorize many facts in my honors classes.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

12. My honors professors walked around the room, called us by name, and asked for our contributions to the class.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

13. My honors professors wanted me to understand the topic, not just memorize things about the topic.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

14. In my honors classes, students were permitted to work together on projects and homework.
a. Always

b. Sometimes
c. Hardly Ever
d. Never

15. As new topics emerged in our classes the honors professors would discourage it and remind us to keep to the syllabus.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

16. My honors professors talked with us not at us, they valued our input.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

17. The honors professors asked for our thoughts about the subject matter being discussed.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

18. The honors professors gave us real data from the original source to work with.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

19. My honors classes were interesting because the honors professors would allow the classroom conversation to drift to other related topics.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

20. In the honors classes, we never had to go find our own information – everything we needed to know was given to us.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

21. The honors professors thought it was more important to be able to apply a concept than it was to simply remember it.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

22. The honors professor lectured from the podium – he/she moved only to write something on the board.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

23. My honors professors gave advice and guidance when it came to problem solving – but, finding the answer was totally up to us.
a. Always

b. Sometimes
c. Hardly Ever
d. Never

24. In the honors classes we were given the opportunity to resubmit assignments to get better grades.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

25. I felt that I could express my opinion in the honors classes.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

26. My honors classes were highly structured, the professor lectured from his/her notes and left no time for questions.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

27. My honors professors were very structured, they lectured directly from their notes or textbook and would not allow very much classroom discussion.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

28. My honors professors posed problems and described scenarios for us, then we had to go and find the solution to the problem.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

29. My honors professors preferred to give us a simple straight answer instead of making us go find the information for ourselves.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

30. My honors professors would often give advice and evaluation through out a project instead of making us wait until the end to see what our grade would be.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

Now, while answering these questions, try not to think of any one of your non-honors professors or non-honors classes, try instead to think of an average of all of your non-honors professors or non-honors classes. Please circle your response.

1. My non-honors professors asked for student questions.
a. Always

b. Sometimes
c. Hardly Ever
d. Never

2. We worked in groups in the non-honors classes.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

3. In my non-honors classes, we often had to find the information that we needed for homeworks and projects on our own.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

4. I felt comfortable asking questions when I was confused or having trouble with some topic in my non-honors classes.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

5. My non-honors professors acted as if they were pleased when students asked questions.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

6. My grades in the non-honors classes were based entirely on tests and quizzes.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

7. I felt that my opinions were important to my non-honors professors.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

8. In the non-honors classes, we were graded on portfolios, class presentations and many other things.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

9. Teamwork was encouraged in the non-honors classes.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

10. Things other than tests and quizzes were used to compute my grade in the non-honors classes.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

11. I was required to memorize many facts in my non-honors classes.
a. Always

b. Sometimes
c. Hardly Ever
d. Never

12. My non-honors professors walked around the room, called us by name, and asked for our contributions to the class.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

13. My non-honors professors wanted me to understand the topic, not just memorize things about the topic.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

14. In my non-honors classes, students were permitted to work together on projects and homework.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

15. As new topics emerged in our classes the non-honors professors would discourage it and remind us to keep to the syllabus.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

16. My non-honors professors talked with us not at us, they valued our input.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

17. The non-honors professors asked for our thoughts about the subject matter being discussed.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

18. The non-honors professors gave us real data from the original source to work with.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

19. My non-honors classes were interesting because the non-honors professors would allow the classroom conversation to drift to other related topics.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

20. In the non-honors classes, we never had to go find our own information – everything we needed to know was given to us.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

21. The non-honors professors thought it was more important to be able to apply a concept than it was to simply remember it.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

22. The non-honors professor lectured from the podium – he/she moved only to write something on the board.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

23. My non-honors professors gave advice and guidance when it came to problem solving – but, finding the answer was totally up to us.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

24. In the non-honors classes we were given the opportunity to resubmit assignments to get better grades.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

25. I felt that I could express my opinion in the non-honors classes.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

26. My non-honors classes were highly structured, the professor lectured from his/her notes and left no time for questions.
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c. Hardly Ever
d. Never

27. My non-honors professors were very structured, they lectured directly from their notes or textbook and would not allow very much classroom discussion.
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b. Sometimes
c. Hardly Ever
d. Never

28. My non-honors professors posed problems and described scenarios for us, then we had to go and find the solution to the problem.
a. Always

b. Sometimes
c. Hardly Ever
d. Never

29. My non-honors professors preferred to give us a simple straight answer instead of making us go find the information for ourselves.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

30. My non-honors professors would often give advice and evaluation through out a project instead of making us wait until the end to see what our grade would be.
a. Always
b. Sometimes
c. Hardly Ever
d. Never

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