EVALUATING THE USE OF LAPTOP COMPUTERS IN TEACHING CONSTRUCTION COMPUTER APPLICATIONS AT THE COLLEGE OF TECHNOLOGY, BOWLING GREEN STATE UNIVERSITY

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ABSTRACT

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This study aimed to evaluate the use of laptop computers as an aid in teaching construction computer applications in the Construction Management program at Bowling Green State University (BGSU). The study was conducted during two semesters. A questionnaire was developed and was used as the primary tool for data collection. Two groups of students were identified as participants in the study. One group was enrolled in the CONS 320 *Construction Computer Applications* course and was issued laptop computers by BGSU. The second group of respondents was made up of CONS 320 students that were not issued laptop computers; and a random selection of students from the Construction Management program. Efficacy of the data collection instrument was tested through a pilot study that was conducted during the first semester.

This researcher aimed (1) to evaluate the learning experience of the respondents, (2) to investigate the respondents' vision of the pilot laptop computer initiative in the Construction Management and Technology program, and (3) to draw guidelines for the full implementation of - laptop computers as part of the Construction Program for the College of Technology at BGSU.

The study was limited to construction management students at the BGSU College of Technology. The research suggests that a laptop computer was beneficial to respondents and recommends implementation of the use of laptop computers (henceforth referred to as the "laptop initiative") during the students' junior year of study. BGSU is mandating the CMT students purchase laptop computers. Dedicated to my wife Phyllis and son Amani.

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CHAPTER I. INTRODUCTION

Context of the Problem

In this information age, technology is driving society and it is at the forefront of all education, especially higher education. The use of multimedia as an aid for educators has become the norm rather than the exception, and the media has changed. Power point presentations, online discussions, distance learning, and so forth are a few examples of the ubiquity of the use of technology in classrooms.

The internet has emerged as a powerful communication tool. Wired and wireless access to the internet is common in universities, when only a decade ago, they were not ubiquitous. Access to the internet allows students to receive and submit learning materials from –professors; it offers online test taking options. It has given birth to - virtual group discussions, blogs, and online education that only science fiction writers heretofore envisioned. Increasingly, universities and colleges have required - mobile (aka laptop or other named) computers as a prerequisite for registration. For example, Indiana State University will require that all incoming freshmen - – (autumn2007) use laptop computers (*Tribune-Star*, 2006). Engineering students at Wayne University are required to own or lease a laptop from the school (*Detroit News*, 2006). - Other universities also have mandated the use of laptops.

Laptop computers were introduced into the classroom with the hopes that they would not only be an aid to learning but also that they would become an efficient help for the educator (Beth, A., & Pargas, P. R., 2003). With regards to learning via this new technology, a number of opportunities as well as challenges have been identified. The laptop computer brings about flexibility regarding the physical location of students, thereby allowing learning to take place in varying locations (Beth A., et al. (2003).

1

Laptop computing has been used for decades; however, as pointed out by Beth, A., and Pargas, P. R. (2003), researchers have rarely focused on the use of the laptop for both *teaching and learning*. Rather, the focus has been on hardware, staff training, management of the laptops, and other similar topics. O'Neil and Baker (1994) pointed out that there has been inadequate research and development regarding the assessment of technology in education.

This study was conceived to evaluate the use of laptop computers regarding teaching and learning for construction computer applications, a technology-intensive course in the Construction Management and Technology (CMT) program at BGSU. The researcher asked the question: "What are the benefits of using a laptop computer in teaching construction technology courses in class?" To gain an answer to this query, surveys and interviews were conducted.

Statement of the Problem

The problem of this study was to evaluate the use of laptop computers regarding teaching construction computer applications for the Construction Management and Technology (CMT) program at BGSU.

Significance of the Problem

Increasingly, computer applications are being used in the construction industry. These applications have been used for estimating, scheduling, simulating construction scenarios, operating equipment, and documenting the construction process management. As this industry has continued to grow and along with its projected growth, which indeed must be coupled with continued computer applications, the need for a sustained training of such a workforce exists.

Benefits of the Study

This study shall provide the College of Technology with guidelines for the full implementation of the "student laptop computer initiative". This initiative aims at equipping the

CMT students with laptop computers for use in learning the Construction Computer

Applications. Most of the applications are keyed and can only be accessed at the computer lab. Equipping the students with laptop computers that are loaded with the applications will enable them to access and improve their skills in these applications from any location.

Objectives of the Study

To address the problem of this study, the following research objectives were formulated:

1. To evaluate the learning experience of the students taking the class CONS 320, *Construction Computer Applications* course.

2. To investigate the users' future vision of the laptop computer initiative at the College of Technology, BGSU.

3. To both analyze the data and draw guidelines for the full implementation of the laptop program at the College of Technology, BGSU.

Assumptions of the Study

1. The teaching methods used for the different study groups (i.e. the group with laptops and the one without) were not different.

2. It was assumed that the teaching method of the CONS 320 course would not change during the course of the study.

Study Limitations

The study was limited to students of the Construction Management and Technology (CMT) program at the BGSU College of Technology.

CHAPTER II LITERATURE REVIEW

Introduction

Technology - increasingly has become part and parcel of the learning environment. The inclusion of technology in education - cannot be ignored. The implications that technology has had on teaching and learning has been a subject of intense and often exciting debates - (Haertel & Means, 2003).

Advances in computer technology have been dramatic, especially during the last decade. These advances have been accompanied by lower cost and increased capability for software and hardware (Haertel & Means, 2003).

At the higher education level, many trendsetters at universities and colleges have implemented a number of programs aimed at increasing the role that technology plays in teaching. The most common innovation has been the use of laptop computers as a learning aid for students. The results that have been achieved by the implementation of different programs used for this purpose often have varied.

The varying degrees of success attained by different programs can be attributed to many things, including both the different settings and purpose for which the programs were implemented. In order to successfully evaluate the efficacy of technology in education, key areas must be explored. These, as pointed out by Haertel and Means (2003), include adequacy of the tools that were used and the theories upon which the programs were built. The complexity of fully integrating technology in teaching and learning makes evaluation of the success achieved by people who use such programs a daunting task.

Technology Tools in Education

Technology tools and resources enable people to perform old jobs in new ways. In addition, these tools and resources enable educators and students to achieve new goals (Thornburg, 2000). For example, computers allow students to explore three-dimensional simulations - (consider a three-dimensional simulation of a plant, an animal cell, or a building). The level of detail provided by such simulations has become more than the student would see using past teaching techniques. - In addition to - three-dimensional simulations, computers can be used as powerful tools for data analysis and aids to solving problems. Laptop computers gradually have replaced the every-day use of the paper-and-pencil needs of - students.

A network of interlinked computers is a powerful resource. Usually, networks are - local (i. e., on a small geographical scale) or they can be global. Networks - rapidly have transformed educational systems because they have increased access to information, which has also increased exponentially (O'Neil & Perez, 2003). In addition to increasing the level of access to information, networks promote on-demand learning, anywhere and any time because they can increase students' ability to interact with others and the time of their choice.

O'Neil & Perez (2003), however, pointed out that although technology tools and resources are necessary components in education, students' learning must be the main focus in any programs that applies technology to education. It is therefore important to develop effective tools evaluating students' learning.

Technology and Intelligence Profiles

In order to evaluate students' learning in a technologically enhanced environment, it is important to understand how students learn in general. Howard Gardner (1993) posited that humans are capable of seven independent means of processing information. Any number or all of these means can fall in several categories, which he lists as linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, interpersonal and intrapersonal intelligences.

This multiplicity of intelligences means that different students will perceive and approach education technology in different ways. This, in effect, presents a formidable challenge when an educator attempts to introduce technology to the classroom. Willingness to introduce technology to the classroom as well as a teacher's skills in using technological tools thus becomes a requisite ingredient for successful education. Gardner (1994) pointed out that although individuals may differ regarding particular intelligence profiles, many of the interactive technologies available today can be used to enhance learning. The introduction of technology to the classroom has definite effects. These effects are both positive and negative; additionally, each technology can vary in the in the amount of resultant learning. - The technologies that are introduced in education, therefore, should be assessed with the following goals: (1) to identify technologies that most help students to learn and (2) to make the most of teaching with and through technological processes (O'Neil & Baker, 1994). O'Neil and Baker (1994) further argued that the assessment process affects the technology itself.

Assessment of Technology in Education

Despite the increasing role of technology in education, its effects have been slow in maturing. Reasons for the slow realizations of the effects of technology in education include the structure and organization of education; the backgrounds of education technology developers; and inadequate research and development in assessment of technology in education (O'Neil & Baker, 1994). About the structure and organization of education, O'Neil and Baker (1994) pointed out that even though the role of education institutions has remained unchanged for millennia, these institutions have become increasingly strained by other burdens, such as drug

education and workplace preparation. In addition, they argued that issues ranging from high teacher-student ratios to details such as the physical arrangement of classrooms have created barriers to technology.

Inventors and developers of educational technology have been scientists and engineers who, in many cases, are academics. As a result of such pioneers, O'Neil and Baker (1994) argued that in their attempt to develop technology, the main goals of these scientists and engineers are notably demonstrating a theory, documenting an approach, or designing a prototype. These goals invariably fail to align technology with education. Furthermore, O'Neil and Baker (1994) argued that businesses people who create technology products find little incentive to access the highly structured education market.

Educational research and development has been plagued by a lack of adequate resources. Where research is conducted in this field, it is usually in the form of small projects and, as O'Neil and Baker (1994) argued, it usually attracts people with similar experiences and training, resulting in minor overlap in perspective and development pattern.

The design of the experiment that has been used in assessing the effect that technology has on learning usually takes a pivotal position. The choice of experiment has been the subject of much debate. The approach of randomly assigning a treatment (innovation) to one group enables a researcher to draw conclusions based on results obtained from the experimental and the control groups (Haertel & Means, 2003). This argument is given as the strongest case for the randomized experiment method in hypothesis testing. Moses (2000) drew from experiments conducted in the medical field and gave a number of features that are essential to a randomized experiment. These include random and active imposition of treatment, opposed to observation of treatments that happen to occur; application of treatment at the same time; conducting the experiment in

accordance with predefined principles; application of all factors, apart from the treatment that may affect the experiment, to both the experiment and the control groups; and defining the sample size as the unit of treatment application.

An alternative technology evaluation method that has been advocated is a nonexperimental approach based on understanding of the context in which the technology evolved and is used. This approach, the quasi-experimental method, calls for a consultative and participatory approach through which teachers, administrators, and the evaluators are participants, not recipients, of the evaluation (Haertel & Means, 2003). Proponents of this approach argue that knowledge of the entire process that resulted in "why" a technology (innovation) had its effects in education is essential. This approach is diametrically opposed to the *experimentalists*' emphasis, that of knowing whether or not the technology (innovation) caused the observed effect.

An important question that is raised, any time a project-based assessment approach is implemented to assess the effect of technology in education is, the *effectiveness* of the project. Lovitts and Baker (2003) pointed out that the outcomes of this type of assessment are usually intended at to inform the decision making processes; and generally two different kinds of measurements are derived. The first is a measurement of specific competencies in the use of computers in general or specific computer programs in particular. The second is a measure of competencies that are gained and can manifest themselves in the absence of computers. These measurements are derived from the assessment of identical tasks with identical content. In a different approach, Lovitts and Baker (2003) called for variability in the tasks and content, citing the following three reasons: (1) motivation of participants that comes with performance of individual tasks; (2) opportunity to measure outcomes that require participant initiative; and (3) the ability to fully cover content and skill that are applicable to the project.

Teaching Computer Use and Applications

The teacher's choice of technology together with his or her pedagogical style, are two of the many factors that could affect the outcome of an assessment of a computer project. It is important that the assessor be aware of factors that may affect the assessment of a project. Four potential settings were identified: (1) the technology-intensive teacher with student-centered pedagogy; (2) the technology-intensive teacher with a content–centered pedagogy; (3) a teacher with limited technology use, and a student-centered pedagogy; and (4) a teacher with limited technology use and a content-centered pedagogy (Haertel & Means, 2003). An understanding and definition of the setting is important for drawing conclusions of the assessment.

Computer Applications in the Construction Industry

The growth of computer use in the construction industry has been attributed to many factors. As pointed out by Atalah (2002), the increase-in the use of computer applications is a result of the ease of use of such applications. In addition to the increase in the functionality of the computer applications, they at the same time become user friendly. Atalah (2002) terms this as an *increase in value added* that justifies investment in such computer applications.

Competition and maturity of the computer industry during the past decade have resulted in a reduction in the price of software in general and the construction computer applications in particular (Atalah, 2002). The decrease in price of construction computer applications has resulted in an increase in the use of computer applications in the construction industry. Computer applications are being used in estimating, scheduling, accounting, and in project management. Even though many of these applications can be learned on the job, it is important for institutions of higher learning to provide the construction industry with people capable of adding value to a company - from the beginning of their tenure. The task for these institutions becomes one of identifying and implementing training methods that result in the greatest amount of learning.

Teaching Construction Computer Applications

A number of approaches lend themselves for teaching construction computer applications. Atalah (2002) identified three approaches that are most commonly used. The first approach is that of teaching the students a large number of computer applications that are in use in the construction industry. Through this approach the aim is to give the students a general idea of the operation and use of such applications. The main weakness with this approach, as pointed out by Atalah (2002) is that the students end up not learning much because the amount of time available for learning each specific application is limited. The result of this teaching approach is that the students will need training from their employers in order to boost their competence.

A second approach used by educators is more focused: The educators teach one of the many applications available in each area of the construction industry, for example, managing documents, scheduling, estimating, and so forth. Using such an approach, - educators can focus on core concepts and the use of a specific application. Atalah (2002) noted that this approach will benefits the employer because minimal training is needed if the employer uses the same software applications that the student was exposed to. The second advantage of this method, as noted by Atalah (2002), is that since students gain a deep understanding of the applications that they learn; thus, they can quickly learn to use similar software (e.g., common estimating software packages include similar basic concepts). This approach has been employed in the CMT program at Bowling Green State University.

Some educators teach construction management concepts and rely on employers to further train the graduates on using the needed computer applications (Atalah, 2002). Although this approach helps students to gain an understanding of the basic concepts, the failure to introduce students to computer applications denies them a foundation upon which employer training can build. According to Atalah (2002), construction industry employers concur that teaching construction computer applications is one way of improving students' understanding of both basic construction concepts and problem-solving skills.

Measuring Student Learning

Measuring student learning is a difficult but useful task. Defining specific learning goals is one useful way of measuring learning. Other evaluation procedures that can be used to distinguish student performance include assignments, projects, papers, exams, and so forth.

In project-based experiments such as laptop 'pilot programs', students' learning must be measured on two fronts. The first is a comparison of student learning in the experiment among control groups, comparing student performance for assignments, exams, projects, and other work. This measurement, however, cannot capture a student's initiative and creativity in the use of technology (Haertel & Means, 2003).

An alternative approach is to require the use of a student portfolio. Such a portfolio could contain a number of projects that were undertaken by the student over a period of time (e.g., semester or quarter or more). The projects conducted by each student could be similar in nature (e.g., a scheduling exercise that could be conducted for multiple projects). One challenge that this method presents is in the development of clear learning goals and the defining of a scale that could be used in measuring learning. It is very possible to handle this challenge well, and this

method may be the best to measure students' creativity and initiative regarding the learning a computer application (Haertel & Means, 2003).

Sample Studies on the Implementation of Laptop Programs

A number of universities and colleges have implemented laptop programs for various uses. Many more require that incoming freshmen have laptop computers. This has, in part, been necessitated by the demand for college graduates who have high levels of computer literacy.

For most of the projects that have been implemented by various institutions, the objective usually has been integrating technology in the learning environment to enhance student learning. The use of a specific technology plays a role in the selection of equipment. For the Indiana-Purdue University's (Ft. Wayne) Department of Civil and Architectural Engineering Technology's pilot project, a program employing the use of Tablet PCs was employed. The choice of the Tablet over laptop PC was influenced by the nature of the project. The project was conducted off campus and entailed, among other things, the sketching of existing conditions, and it was felt that the Tablet would be an ideal tool (Unsell, 2004).

At Clemson University, implementation of the pilot laptop program was undertaken with two main reasons: determining the worth of bringing this technology to the classroom and considering the impact that the technology might have on the culture of the university.

Program Implementation

Because of the high cost of integrating technology with the learning environment, the implementation of most of the programs at different colleges and universities was achieved in phases. Moss (2000) gave guidelines for the successful implementation of a pilot laptop program. The first stage as proposed by Moss (2000) was the appointment of a laptop committee, headed by a program manager. The main task of the committee was to develop a pilot program

plan and prepare a proposal for funding. The proposal for funding included the management structure and day-to-day running of the program; system specifications; scholarship for worthy students; advertisement of the program; and a timetable for roll out the program, among other considerations. The program manager was responsible for procuring equipment and services from the right vendor, in addition to the day-to-day management of the program. Moss (2000) stressed the importance of a service agreement provided by the vendor that provided maximum value to the program.

A three-phase approach was adapted by a planning committee at Indiana-Purdue University, Ft. Wayne (Unsell, 2004). The first phase involved the selection of representative courses in various departments at the university that would integrate mobile technology. A *pilot* program was integrated into these courses and an evaluation was performed. The second phase was based on the findings of the first phase, and during this time, the staff integrated the technology in a department or school. In the third phase, the technology was implemented for the entire university.

Assessment Methods

Several tools have been used to evaluate pilot laptop programs. Observation, interviews, and surveys have been successfully used to extract invaluable information from a number of pilot laptop programs. In the pilot program at Indiana-Purdue University, Ft. Wayne, a survey used by Doolen, Porter, and Hoag to measure six areas related to PDA usage was adopted (cited in Unsell, 2004). This survey was designed to measure attitudes toward new technology used in a learning environment, which is an important factor in the assessment of student learning. The six areas included anxiety, confidence, liking, usefulness (in general), usefulness (of the course), and enthusiasm.

The study on the pilot laptop program at Clemson University was conducted through surveys, interviews, discussion, and observation. Surveys were used to obtain information from students who participated in the program, and interviews were conducted with members of the staff in participating classes. Observation was used to assess issues such as class size and attendance.

Effects of the Laptop Programs

Implementation of laptop programs has had both positive and negative effects on students' learning. In the Indiana-Purdue University, Fort Wayne, pilot program, increased student participation and enthusiasm was observed (Unsell, 2004). For the Clemson university pilot program, it was noted that students who participated in the laptop program were more confident about their grades, whereas some students reported that there was no improvement on their grades. Another positive impact is the flexibility that is generated by the use of laptops. Classes are no longer confined to a fixed computer lab. At Clemson University, it was observed that some classes were held in nontraditional classrooms, such as their botanical gardens (Ables, M., Breitmeier, J., Hosey, A., & Mullinnix, J., 2003).

Reduced attention of students in class has been noted as one of the drawbacks of implementing a laptop program (Benton, C., Garner, V., Green, C., Hecker, J. & White, C. 2003). A caveat: Students can spend more time "surfing the web" instead of listening to the professor while in class. Overdependence on the machines was observed at Clemson University as another negative effect of the program. This tended to provide students with excuses whenever they were unable to complete their work.

Program Challenges

Mobile technology, although increasing in use in a number of institutions, is still relatively new. When this technology is adopted, a number of challenges usually surface immediately. Notable among these difficulties is the lack of adequate resources, such as power sources in the classrooms (Ables, M., Breitmeier, J., Hosey, A., & Mullinnix, J. 2003). This is understandable considering that some classrooms are historic and were not designed to accommodate the newest technology. However, this hurdle is usually easy to overcome. In the Clemson University pilot laptop program, improved attendance in some classes was noted when the classrooms were fitted with more power outlets. It is believed that wireless access is a necessity in mobile technology; however, wireless access is not universal at many institutions.

Summary

The review of literature in the previous sections provided verification that student laptop programs have been implemented at various institutions and that varied results have been achieved. Myriad approaches are currently applied to evaluate the affect that such technology has on learning. These methods, too, must be evaluated in light of the results that they will achieve over an extended time with the aim of standardizing evaluation procedures. This will be beneficial for future evaluations of the forecasted increase in technology integration in education.

CHAPTER III. METHODOLOGY

In this chapter, the problem statement is restated, together with the approaches taken to meet the objectives of the study. The design of the study is defined and the data collection tool used in the study is explained.

Restatement of the Problem

The problem of this study was to evaluate the use of laptop computers in teaching construction computer applications in the Construction Management and Technology (CMT) program at the College of Technology, BGSU.

Research Design

The design of the study was based on the statement of the problem. The study was objectively designed to provide solutions to the main problem with the principal aim of achieving the study objectives. The problem of this study was quasi-experimental.

General Characteristics of the Study Population

The population of the study was students in the College of Technology majoring in construction management and technology. A general assumption regarding the population's knowledge of using computers was made. The sample was made up of two groups of respondents:

a) Group 1: Respondents with laptop computers. This group of respondents was composed of total 21 students:

- Sixteen were in their junior and senior years of study that were enrolled in the CONS 320, Construction Computer Applications course, and
- Five graduate students were enrolled in Tech 642 Construction Program Management.

This group of respondents was issued laptop computers. The two courses (i.e. CONS 320 and TECH 642) were computer intensive. A similar group of respondents was used during the pre-testing of the data collection instrument.

b) Group 2: This group was made up of 32 respondents characterized as follows:

- Sixteen respondents were students in their junior and senior year of study that had enrolled in the CONS 320, Construction Computer Applications course. However, this group of respondents was not issued with laptop computers for use in the course. The respondents utilized the desktop computers in the lab in learning the construction computer applications and for homework assignments pertaining to these applications. In addition, they used the computers in the lab for practicing their skills on these applications. A similar group of respondents was used during the pre-testing of the data collection instrument.

- Sixteen respondents composed of randomly selected students majoring in construction management at the College of Technology. The randomly selected group of respondents was included in the study with the objective of obtaining data from a wider population in order to reduce bias in the drawing of conclusions.

Data Collection Instrument, Validity and Reliability

A questionnaire was developed, and this was the primary data collection instrument. The questionnaire was divided into various sections. Questions in each of the sections were aimed at collecting information that provided answers to the problem of the study. The sections follow:

a) General questions

b) Learning experience

c) Future vision of the laptop computer initiative.

The general questions and questions on the future vision of the laptop initiative categories were used to understand the respondents' opinions about the laptop initiative, including optimum technical specifications, and the extent to which the laptop initiative should be implemented. In addition, the respondents were asked to provide information on any hardware and software difficulties that they experienced with the laptop computers while taking the course. Students were also be required to rate the different options available for acquiring the laptop computers in the laptop acquisition question category.

Questions on learning experience were used to gain information regarding the effect that the laptop computer had on a student's learning experience as an individual-and how it helped in class as a group. Finally, the researcher sought information about how the laptop helped regarding the student-teacher relationship. This question category was a multi-pronged tool for evaluating the effectiveness of the laptop computer as an aid in learning, in student-to-student relationships, and in student-teacher relationships while in class. The questions in this section of the questionnaire were modified accordingly to suite the situation of the respondents who were not issued laptop computers.

Pre-testing the Data Collection Instrument

A pilot survey was used to test the efficacy of the data-collection instrument. Students taking the CONS 320 course and who were using the university-issued laptop computers were required to fill out the questionnaire at the end of the course. The questionnaire was modified suitably based on the responses that the researcher received.

Ordinal, quantitative, and nominal data was collected. Nominal data was converted to a binary format. Descriptive statistics were used to analyze the data. Assistance in this area was sought from the BGSU Statistical Consulting Center.

Protection of Human Subjects

All research completed with human subjects was completed within the guidelines set by

Bowling Green University's Human Subject Review Board. The approval letter from the BGSU

Human Subject Review Board can be found in Appendix C.

Timeline for the Study

Table 1 is an outline of the dates that were followed for completion of this study.

Table 1

Timeline for Study

Date	Task(s) to Complete
	•
August 21-November 10	 Prepare Proposal and Survey Instrument
November 15	• Pilot Test Survey
November 21	Proposal to Committee
November 27	Defend Proposal
January 19	HSRB Approval
April 2	Conduct Survey
May 3	Compile Survey Results
May 25	• Chapter 4 and 5 of Thesis Completed
May 28	Thesis to Committee
June 4	Defend Thesis
June 8	• Prepare final copy
June 25	• Submit to graduate college

CHAPTER IV. FINDINGS AND ANALYSIS OF DATA

This chapter presents a review of the data and findings from the study conducted to evaluate the use of laptop computers in teaching construction computer applications at the Construction Management and Technology program in BGSU.

The Data collection Instrument

Two questionnaires were developed and used as the primary tool for data collection. The first questionnaire was developed and administered to the respondents in Group 1. The questionnaire had three sections: general information, learning experience and a section on the respondents' vision regarding the future of the laptop computer initiative. The *learning experience* section of the questionnaire was formulated to collect information on experience of using the laptop computers regarding the CONS 320 or TECH 642 courses.

The second questionnaire was administered to the respondents in Group 2. The respondents in this group were undergraduate students in either their junior or senior year. Sixteen were taking CONS 320 – Construction Computer Applications course that did not receive laptop computers, while the other sixteen were students of the CMT program that were randomly selected. The *learning experience* section of the questionnaire was formulated to collect information on the respondents' experience of using the computer lab with regards to the CONS 320.course for the sixteen respondents that had registered for the course; or computing needs for the other respondents that were not enrolled in either of the courses.

Responses to the statements that were on a five-point scale were interpreted using the adopted approval level as presented on Table 2.

Table 2

Adopted Approval Level for all Statements on the 1-5 Scale

Approval rating	Scale
Strongly approve	15-5
Approve	3.5-4.5
Neutral	2.5-3.5
Disapprove	1.5-2.5
Strongly disapprove	Less than 1.5

Survey Results

Response rate

The total number of students included in this study was 53. Respondents in Group 1 numbered 21 while Group 2 each had 32 respondents. Respondents in Group 1 participated in the pilot laptop program. Sixteen of the respondents in this group were undergraduate students that were taking the CONS 320 course - Computer Applications in Construction, while 5 were graduate students that were taking the TECH 642 Construction Program Management course. Group 2 consisted of 32 students who took CONS 320 and used the computers in the computer lab i.e. without the laptop computers. Respondents in Group 3 were students that were selected randomly from the Construction Management and Technology Program.

Participation in the survey was voluntary. Fifty three questionnaires were given to the respondents during class time. All the respondents filled out and turned the questionnaires to the researcher; therefore, the response rate to the survey was 100%.

Results from the Overall Population

All the respondents responded to 17 statements that were categorized into two sections. The first section collected demographic information while the second collected information regarding the respondents' vision on the future of the CMT laptop computer initiative. The next section explores the survey results of the two sections.

Responses to the Statements in the General Questions Section of the Survey

Demographic information collected pertaining to the respondents' year of study, GPA, level of computer knowledge, computer ownership and the time the respondents spent on the internet is summarized in Table 3.

Table 3

Question	Responses 9	$\mathcal{V}_{0}(n)$		
1. Year of Study:	Junior 39.62(21)	Senior 49.05(26)	Graduate 9.43(5)	
2. University GPA	< 2.0	2.0 to 3.0	3.0 to 4.0	
	4.34(2)	47.83(22)	47.83(22)	
3. Major GPA	< 2.0	2.0 to 3.0	3.0 to 4.0	
	9.43(5)	41.51(22)	49.06(26)	
4. Level of computer knowledge	Savvy	Average	Below av.	
	45.28(24)	52.83(28)	1.89(1)	
5. Own a computer	Yes	No	Laptop	Desktop
-	94.34(50)	5.66(3)	68.00(34)	32.00(16)
6. Time per day working on a computer	<1 hr	1-3 hrs	3-5 hrs	>5 hrs
	8.16(4)	36.73(18)	36.73(18)	18.37(9)
7. Time on the internet:	<0.5hr.	0.5hr-1hr	1-2hr	>2hr
(i) While in class	25.00(12)	29.17(14)	20.83(10)	25.00(12)
		· · ·	· · · ·	

Responses to the Statements in the General Questions Section of the Survey

Forty four of the respondents or 95.76% had a university GPA of 2.0 or higher. The majority of the respondents (52.83%) had an *average* level of computer knowledge, 45.28% rated their computer knowledge as *savvy* and 94.34% reported owning a computer. The researcher noted that responses question number 5 may have been misunderstood because all the respondents of group1 indicated that they own a laptop computer. In future survey, the researcher should clarify owning laptop computer other than the university issued one. The

responses to the statement number 7(i) were unusually high because a normal class session was for a period of two hours.

Table 4 displays various criteria for correlation that were determined regarding the demographic data of the respondents. The study found a strong correlation between the respondents' university GPA and the major GPA (correlation coefficient = 83%). There was however no correlation between the university GPA and the level of computer knowledge. Neither was there any correlation between the respondents' level of computer knowledge and computer ownership.

Table 4

Correlation of Demographic Various Statements

Correlation criteria	Correlation coefficient	
	(r)	r^2
University GPA vs. Major GPA	0.83	0.69
University GPA vs. Level of computer knowledge	- 0.08	0.01
Level of computer knowledge vs. Own a computer	0.21	0.04

Responses to the Future Vision Statements

In this section, the survey was focused on the respondents' vision of the future of the laptop computer initiative. Statements in this section of the questionnaire queried information about the respondents' preferred mode of laptop acquisition, the preferred cost, the preferred technical specifications of these computers, and the extent to which the laptop program should be implemented. Table 5 provides a summary of the responses to the statements.

Table 5

Responses to the Statements in the Future Vision Section of the Survey

No.	Statement	Mean	Std.
			Dev.
28.	I prefer to purchase a Laptop on a payment plan if required by the		
	University instead of leasing a Laptop	3.66	1.45
29.	I prefer to lease a Laptop on a payment plan if required by the		
	University instead of purchasing a Laptop	1.81	1.19
30.	I prefer a lease with option to purchase plan	3.00	1.36
31.	The laptop should be required of all students in the CMT program	3.30	1.29
32.	The laptop should be required of all students in the College of Technology	3.00	1.33
33.	If better and faster computers loaded with all the required software		
	are provided, then the amount I would be able and willing to pay	(see Fig	1
	per semester for leasing a laptop will be: (please select one)	below)	
	a) \$150-200 b) \$200-250 c) \$250-300 d) \$300+	,	
34.	Is it important to have administrative access/ability to install other	1.20	0.02
	programs on the laptop?	4.36	0.83
35.	The laptop should be required of all students at the University	3.54	1.41
36	Construction computer applications will be taught in the courses		
	that teach the background area of knowledge		
	a) This is the best approach	4.17	0.98
	b) I prefer taking a course that is entirely dedicated to teaching		
	construction computer applications	3.74	1.09
37	Indicate the importance you place on the following features of the		
	laptop on scale of $1-5$		
	a) Weight	3.25	1.34
	b) Battery life	4.40	1.01
	c) Processor speed	4.75	0.52
	d) RAM	4.56	0.57
	e) Hard disk	4.18	0.93
	f) Graphics card	3.92	1.08
	g) Others, please state here		



Responses to Question 33(preferred semester payment for laptop computer) for all Respondents

All the respondents approved the statement that they would prefer to purchase a laptop on a payment plan as opposed to leasing one from the university (mean = 3.66). The respondents also approved (mean = 4.36) the statement that having either administrative access or the ability to install other programs on the laptop or both were important. Regarding the possible change in the future about the method of teaching the construction computer application courses, the respondents indicated a preference for learning the applications along with the courses that are used to teach the background area of knowledge of the applications (mean = 4.17). The respondents agreed with the statement that the laptop computer should be required of all students at the university (mean = 3.54) but disapproved the statement that the laptop should be required of all the students in the CMT program.

On the features of the laptop, all the respondents indicated battery life, processor speed, and the computer memory (RAM) as most important. *Other* features that were listed by the respondents were *quality, durability, reliability, and screen size*.

Results by Respondents per Group

Group 1: Respondents with Laptop Computers

There were 21 respondents in Group 1. Sixteen of them were undergraduate students enrolled in CONS 320 – Construction Computer Applications, and five were graduate students enrolled in TECH 642 – Construction Program Management. The respondents were issued laptops for use in these courses, and these courses were considered computer intensive. *Responses to Specific Statements in the General Questions Section of the Survey*

The respondents in Group 1 answered a series of statements that directly related to the laptop computers that they received from the university. This was in addition to the demographic data in the general questions section of the questionnaire that was presented in the previous section. The statements related to the respondents' internet use patterns before and after receiving the laptop computer, and also technical problems that the respondents may have experienced while using the laptop computers. The researcher provided a list of anticipated technical problems. The respondents rated each of the problems on a five-point scale. Table 6 presents a summary of the responses to the statements.

Table 6

Statement	Rating % (n)			
7. Time on the internet:	<0.5hr.	0.5hr-1hr	1-2hr	>2hr
(i) While in class	25.00(12)	29.17(14)	20.83(10)	25.00(12)
(ii) Before receiving the laptop/day	4.76(1)	0(0)	61.90(13)	33.33(7)
(iii) After you received the laptop/day	0.00(0)	4.76(1)	57.14(12)	38.10(8)
8. Time per day:	<1hr.	1hr-3hr	3-5hr	>5hr
(i) Using the university laptop	47.62(10)	38.10(8)	14.29(3)	0.00(0)
(ii) Using a computer before receiving	4.76(1)	52.38(11)	33.33(7)	9.52(2)
the laptop		. ,		
9. General laptop problems reported:	0	1-3	3-5	>5
	9.52(2)	57.14(12)	28.57(6)	4.76(1)

Responses to Specific Statements in the General Questions Section of the Survey for Group 1

Statement	Rating $\%$ (<i>n</i>)			
10. Hardware related laptop problems:	0	1-3	3-5	>5
	52.38(11)	33.33(7)	14.29(3)	0.00(0)
11. Software related laptop problems:	0	1-3	3-5	>5
	52.38(11)	33.33(7)	14.29(3)	0.00(0)
12. Times lost data saved in the laptop:	0	1-3	3-5	>5
	80.95(17)	19.05(4)	0.00(0)	0.00(0)

Approximately 62% of the respondents indicated that they spent 1-2 hours per day on the Internet before they received the laptop. This figure went down to 57.14% after the respondents received the laptop. Eleven (or 52.38%) of the respondents stated that they spent between 1-3 hours per day using a computer before receiving the laptop, whereas eight (or 38.10%) stated that they spent the same amount of time after receiving the laptop. Fifty-two percent of the respondents indicated that they had no hardware or software related problems with the laptop, whereas 80.95% indicated that they did not have any problem of data loss.

Table 7 summarizes the responses on the problems that were associated with the use of the laptop computers. Experiencing a short life for batteries was the most common problem, and it was experienced by the 33.33% of the respondents. Lack of sufficient power outlets in the classroom was a problem for 23.81% of the respondents.

Table 7

List of Anticipated Laptop Computer Problems

Potential problem	%	<i>n</i> = 21
Power cord availability	9.52	2
Power outlets availability in class and power cord safety	23.81	5
Short battery life	33.33	7
Programs that did not work properly	14.29	3
Inability to print from the laptop	14.29	3
Hardware failure	0.00	0
Lack of administrative access	4.76	1
Others (specify)	0.00	0

Responses to the Learning Experience Statements

This section of the survey focused on the learning experience of the respondents during the semester in which the study was conducted. The *learning experience* statements related to the use of the laptop computer. The presentation of the results was broken down into the year of study of the respondents. Both the average score for each statement was provided and the mean score for respondents based on year of study. There were sixteen statements in the learning experience section. Fifteen of the statements were rated according to a five- point scale, and one of the questions required a "yes" or "no" answer. The respondents answered *strongly disapprove* for one statement, *disapprove*-for two of the statements, and approve for three statements; the respondents chose the answer *neutral* for nine. Table 8 summarizes the responses to the statements.

Table 8

No.	Statement	Mean	Std. Div.	Jr.	Sr.	Grad.
13.	The laptop has made it easier for me to spend some time learning the different software taught in class on my own.	3.86	1.35	3.50	3.58	4.80
14.	Using the laptop has enhanced my level of organization, thereby saving me time that I spend on assignments related to the software taught in class.	3.29	1.27	2.75	3.42	3.40
15.	The laptop has become my primary computer for all my class work.	2.19	1.47	1.75	1.83	3.40
16.	My participation in the class using laptop computer is on average, higher than that in other classes not using the laptop computer.	2.86	1.42	2.75	2.92	2.80
17.	After having the laptop computer for one semester as an aid in learning the estimating and scheduling applications:					
	a) My skills in these applications improved	3.86	1.11	3.50	3.75	4.40
	b) I am confident in applying the skills that I learned in class	3.86	0.96	3.25	3.83	4.40

Learning Experience: Mean Results from Group 1 Respondents

No.	Statement	Mean	Std. Div.	Jr.	Sr.	Grad.
18.	The laptop made a positive change on my grade in this class	3.24	1.00	2.75	3.08	4.00
19.	The laptop made my experience in class more enjoyable	3.33	1.20	2.75	3.33	3.80
20.	I learn more by using the laptop computers than in the traditional computer lab environment.	3.05	1.32	2.25	3.17	3.40
21.	I am more knowledgeable and skillful in using computers now than before I received the laptop	2.52	1.36	3.00	2.33	2.60
22.	The laptop computer made it easier for students to interact with and learn from other students who used laptop computers in CONS 320	3.21	1.18	3.00	3.08	4.00
23.	The laptop has enhanced your interaction with the teacher	2.76	1.18	3.25	2.42	3.20
24.	I get more help from the teacher with the laptop computer than in the other classes where I do not use the laptop computer	2.48	1.17	2.50	2.58	2.20
25.	The laptop helps the teacher to be more effective	2.76	1.34	2.75	2.67	3.00
26.	Did you participate in any group project requiring computer use in the CONS 320 class?			0	5	2
27.	If you answered yes in question 1, did the laptop make it easier for you to participate in the group project?	3.00	1.69		2.74	5.00

The respondents agreed with (mean = 3.86) the statement that the laptop made it easier for them to spend time learning the different software taught in class on their own. They also agreed with the statements that their skills in the computer applications improved and that they were confident in applying the skills (mean = 3.86). In addition, they agreed with (mean = 3.86) the statement that their skills in the computer applications had improved.

The respondents neither agreed with nor disagreed with the statement that the laptop enhanced their level of organization (mean = 3.29). The laptop was not the primary computer for

a majority of the respondents (mean = 2.33). The response to the statement asking whether the respondents' participation in the laptop class was higher than in the other classes was neutral (mean = 2.86). The respondents gave a neutral response to the statement that they were more knowledgeable and skillful in using computers, having had the laptop for the semester (mean = 2.52). The laptop did not enhance the respondents' interaction with the teacher (mean = 2.48) and neither did it make the teacher more effective (mean = 2.76)

The researcher observed that for the statements that the students agreed with, the mean response by the graduate students was higher than that of the undergraduates.

Responses to the Future Vision Statements

Table 9 presents summary of the responses of Group 1 regarding the future vision of the laptop program.

Table 9

No.	Statement	Mean	Std.	Jr.	Sr.	Grad.
			Dev.			
28.	I prefer to purchase a laptop on a payment plan if required by the University instead of leasing a Laptop.	3.66	1.69	3.25	3.08	4.40
29.	I prefer to lease a laptop on a payment plan if required by the University instead of purchasing a Laptop.	2.10	1.48	2.75	2.08	1.60
30.	I prefer a lease with option to purchase plan	3.48	1.47	3.50	3.33	3.80
31.	The laptop should be required of all students in the CMT program.	3.19	1.50	2.00	3.17	4.20
32.	The laptop should be required of all students in the College of Technology.	2.67	1.56	2.00	2.50	3.60
33.	If better and faster computers loaded with all the required software are provided, then the amount I would be able and willing to pay per semester for leasing a laptop will be: (please select one) a) \$150-200 b) \$200-250 c) \$250-300 d) \$300+	\$200	(see Fi	ig. 2 bel	ow)	

Future Vision of the Laptop Program: Mean Results from Group 1 Respondents

No.	Statement	Mean	Std.	Jr.	Sr.	Grad.
			Dev.			
34.	Is it important to have administrative					
	access/ability to install other programs on the	4.43	0.68	4.40	4.63	5.00
	laptop?					
35.	The laptop should be required of all students at	2.38	1.41	1.75	2.33	3.00
•	the University.					
36	Construction computer applications should be					
	taught in the courses that teach the background					
	area of knowledge	2.57	1.02	2.25	2.25	1.0
26	a) This is the best approach.	3.57	1.03	3.25	3.25	4.60
36	b) I prefer taking a course that is entirely	2 10	1 17	2.00	2.50	2 (0
	dedicated to teaching construction computer	3.19	1.1/	3.00	3.50	2.60
27	applications.					
31	following fostures of the lotter on goals of 1 5					
	To now ing real uses of the rapidpion scale of $1 - 5$	2 1 4	1 40	2.50	2 75	2 00
	a) Weight.	3.14	1.42	3.50	2.75	3.80
	b) Battery life.	4.48	0.75	4.00	4.58	4.60
	c) Processor speed.	4.71	0.56	4.75	4.67	4.80
	d) RAM.	4.43	0.68	4.50	4.25	4.80
	e) Hard disk.	4.25	0.79	4.75	4.09	4.20
	f) Graphics card.	3.89	1.05	4.25	3.73	4.00
	g) Others (please state here).					

Fig. 2

Responses to Question 33(preferred semester payment for laptop computer) for Group 1

Respondents



The most preferred mode of laptop acquisition was that of purchasing one on a payment plan (mean = 3.66), whereas the least preferred mode was the lease on a payment plan (mean =

2.10). The average response to the statement that the laptop should be required of all students in the CMT program was neutral (mean = 3.19). However, the graduate student respondents agreed with this statement (mean = 4.20). Graduate student respondents would be willing to pay a higher amount to lease a laptop from the university than would undergraduate students.

The respondents approved statement 36a concerning possible changes to the method of teaching the Construction Computer Application courses (mean = 3.57). The respondents would prefer that the construction computer applications be taught in the courses that teach the background area of knowledge of the applications. The respondents disagreed with the statement that they would prefer taking a course that was entirely dedicated to teaching construction computer applications (mean = 3.19). Graduate student respondents strongly agreed with (mean = 4.60) the approach of teaching the applications along with the courses that were used to teach the background area of knowledge. Students agreed with the questions regarding the technical features (processor speed, RAM, battery life, and hard disk space), and they did so with the highest means in that order.

Group 2: Respondents without Laptop Computers

The thirty-two respondents in Group 2 were CMT undergraduate students in enrolled for a junior or senior year. Sixteen were enrolled in CONS 320 – Construction Computer Applications and did not receive laptop computers, whereas another sixteen in the CMT program were randomly selected.

Responses to the Learning Experience Statements

The *learning experience* statements were related to the respondents' use of the computer lab. The following areas were analyzed: convenience of the computer lab, participation in class, skill level, and participation in a group project. An average score for each statement was provided as well as the mean score for respondents based on year of study. There were eight statements in this section of the questionnaire. Seven of the statements were rated on the five-point scale, but one of the questions required a "yes" or "no" answer. The respondents agreed with four statements, disagreed with one, and were neutral about three. Table 10 summarizes the responses to these statements.

Table 10

Ι	earning	Ex	perience:	Mean	Results	from	Group	o 2	Res	pond	lents	'

No.	Statement	Mean	S	Jr.	Sr.
8	The computer lab is a convenient place for me to spend				
0.	some time learning the different software taught in class on my own.	3.19	1.33	3.36	2.80
9.	I use the computer lab for all my computing needs	2.25	1.36	2.36	2.00
10.	My participation in most classes would be enhanced if I				
	had a laptop computer instead of relying on the computers in the lab.	3.38	1.37	3.18	3.80
11.	Having had to rely on using the computer lab to learn the different estimating and scheduling applications:				
	a) My skills in these applications improved.	3.38	1.06	3.13	3.80
	b) I am confident in applying the skills that I learned in class.	3.64	1.05	3.63	3.67
12.	I would learn more if I used a laptop computer than in the current setting where I rely on the computers in the	4.00	1.06	3.82	4.40
	lab				
13.	Did you participate in any group project requiring computer use in class? \Box Yes (8) \Box No (8)				
14.	If you answered yes in question 9, did you find the				
	computer lab an adequate resource for the computing	3.56	1.03	3.50	3.67
	needs of the group project?				
15.	Do you think having a laptop computer would have				
	made it easier for you to participate in the group project?	3.90	0.82	4.00	3.75

The statement that the computer lab was a convenient place for the respondents to spend some time learning the different software taught in class on their own received a neutral response (mean = 3.19). The respondents disagreed with (mean = 2.25) the statement that they used the computer lab for all their computing needs. The respondents agreed (mean = 4.00) with the statement that they would learn more if they used a laptop, and they also agreed with the statement that a laptop would enhance their participation class projects (groups) (mean = 3.90).

Responses to the Future Vision Statements

This section presents the responses to the future vision statements made by the respondents who did not receive laptop computers. The following areas were analyzed: method of acquiring the laptop, extent to which the laptop initiative should be implemented, and respondents views on the technical specifications of the laptop. Table 11 summarizes the responses to the statements.

Table 11

Future Vision of the Laptop Program: Mean Results from Group 2 Respondents

No.	Statement	Mean	S	Jr.	Sr.
16.	I prefer to purchase a Laptop on a payment plan if required by the University instead of leasing a Laptop	3.81	1.33	3.82	3.80
17.	I prefer to lease a Laptop on a payment plan if required by the University instead of purchasing a Laptop	1.63	1.09	1.73	1.40
18.	I prefer a lease with option to purchase plan	2.63	1.31	2.46	3.00
19.	The laptop should be required of all students in the CMT program	3.31	1.35	3.37	3.40
20.	The laptop should be required of all students in the College of Technology	3.19	1.35	3.18	3.20
21.	If better and faster computers loaded with all the required software are provided, then the amount I would be able and willing to pay per semester for leasing a laptop will be: (please select one) a) \$150-200 b) \$200-250 c) \$250-300 d) \$300+	\$150 -200	(see F	ig. 3 bel	ow)
22.	Is it important to have administrative access/ability to install other programs on the laptop?	4.31	0.87	4.73	3.86
23.	The laptop should be required of all students at the University	4.31	1.01	3.82	4.82
24.	Construction computer applications should be taught in the courses that teach the background area of knowledge a) This is the best approach	4.41	0.87	4.60	4.96

No.	Statement	Mean	S	Jr.	Sr.
24	b) I prefer taking a course that is entirely dedicated to teaching construction computer applications	3.69	0.95	3.80	3.50
25.	Indicate the importance you place on the following				
	features of the laptop on scale of $1-5$				
	a) Weight	3.31	1.49	3.36	3.42
	b) Battery life	4.31	1.14	4.64	4.38
	c) Processor speed	4.75	0.45	4.86	4.80
	d) RAM	4.63	0.50	4.64	4.72
	e) Hard disk	4.13	1.09	4.20	3.86
	f) Graphics card	3.93	1.28	3.86	3.92
_	g) Others, please state here				

Fig. 3

Responses to Question 21(preferred semester payment for laptop computer) for Group 2

Respondents



The preferred mode of laptop acquisition for the respondents in Group 2 was to purchase a laptop on a payment plan as opposed to leasing from the university (mean = 3.81), and the respondents preferred to pay the lowest amount (\$150-200), if they could to lease a laptop from the university. Although the respondents gave a neutral response (mean = 3.31) to the statement that a laptop should be a requirement for all the CMT program students, they agreed with (mean = 4.31) the statement that it should be a requirement for all the students in the university. The statement that learning construction computer applications in addition to other required courses that expose students to the background knowledge of these applications was the best approach, and it was agreed with (mean = 4.41) by all respondents. The query whether the students would prefer to take a course that was entirely dedicated to teaching construction computer applications was also agreed to (mean = 3.69). This researcher noted, however, that the respondents who were in their senior year of study gave a neutral response to the second statement. The researcher believes this to be the case because students who are in their senior year of study have taken the courses that teach the background area of knowledge of the construction computer applications. Important technical features of the laptop as indicated by respondents in this group were processor speed, RAM, battery life, hard disk and graphics card (see table for means). Table 11 summarizes the responses to the statements.

Analysis of Variance

Analysis of variance was conducted to determine whether there were significant differences between the responses of the different groups. The respondents were grouped first by whether they received a laptop or not, then by year of study. The analysis of variance was conducted with a probability of error (α) = 0.05.

ANOVA Results from the Overall Population

Responses of the two groups to the *future vision* statements were tested for any significant differences. The analysis was conducted with and without the responses of the graduate students to eliminate the difference among group composition. Table 12 presents the statements that had significant differences in their responses, with graduate students' responses included. Table 13 presents the results of the analysis of the responses of undergraduate students only.

Table 12

Analysis of Variance for Group 1 and Group 2 Responses to Future Vision Statements

No.	Statement	Group 1 mean	Group 2 mean
30.	I prefer a lease with option to purchase plan	3.00	2.63
36.	construction computer applications will be taught in the courses that teach the background area of knowledge a) This is the best approach	4.17	4.41
36.	b) I prefer taking a course that is entirely dedicated to teaching construction computer applications	3.74	3.69

For the above statements, it is noted however that though there is statistical significant

difference in the responses from the two groups, the difference between the means is not so big.

Table 13

Analysis of Variance for Undergraduate Students Responses to Future Vision Statements

No.	Statement	Group 1	Group 2
		mean	mean
32.	A laptop should be required of all students in the College of Technology	2.38	3.19
36.	Construction computer applications should be taught in the courses that teach the background area of knowledge	3.25	4.41
26	a) This is the best approach b) I prefer taking a course that is entirely dedicated to		
50.	teaching construction computer applications	3.38	3.69

ANOVA Results from Group 1 Respondents

The responses to the *learning experience* statements were analyzed and the researcher

determined significant difference between the responses of the graduate students and the

undergraduate students. Table 14 presents a summary of the ANOVA results.

Table 14

Analysis of Variance for Learning Experience Statements

No.	Statement	Undergrad.	Grad.
		mean	mean
15.	The laptop has become my primary computer for all my class work.	1.80	3.40
18.	The laptop had a positive affect on my grade in this class.	3.00	4.00

The TECH 642 course that was taken by the graduate students used a version of Primavera that was only available in the laptop computers that the students were issued. This may explain the significant difference between the responses of the undergraduate and graduate students to statement 15 above.

Summary

This chapter presented the results and analysis of the study conducted to evaluate the use of laptop computers in teaching construction computer applications at Bowling Green State University's College of Technology. The results were categorized into general questions, learning experience questions and questions on the future vision of the laptop computer initiative.

CHAPTER V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

In the previous chapter, both the learning experience and future vision of the laptop initiative of the respondents were reviewed. This was in addition to a review of some general information questions. This chapter presents a summary of the study and conclusions, and it offers recommendations for future studies.

Summary

The problem of this study was to evaluate the use of laptop computers in teaching construction computer applications at CMT at Bowling Green State University. To address this problem, research objectives were formulated. Each of the objectives was addressed. *Research Objective 1: To evaluate the learning experience of the students of CONS 320, Construction Computer Applications.*

To determine the strengths and weaknesses of using laptop computers, a review of literature was completed. The review looked at the assessment of students' learning and pilot laptop programs that have been implemented on other campuses. This review was instrumental in guiding the formulation of relevant questions for evaluating students' learning experience. *Research Objective 2: To investigate the users' future vision of the laptop computer initiative for the College of Technology at BGSU.*

A survey was developed to gather data about students' perspective on the future vision of the laptop computer initiative. The information that the survey sought included the students' preference regarding the mode of acquiring a laptop, technical specification preferences, and the extent to which the laptop should be a requirement.

In addition to the questions relating to the first two objectives, the survey collected general information that included the respondents' year of study, GPA, level of computer

knowledge, and ownership of a computer or computers, and so forth. This information was used as criteria for performing analysis of variance to determine possible relationships.

Research Objective 3. To analyze the data and draw guidelines for the full implementation of the laptop program at the College of Technology at BGSU.

The survey (Appendices A and B) was handed to the respondents during class time, and they were requested to fill and turn them in immediately. This resulted in a 100% response rate. The Statistical Consulting Center at BGSU assisted with the analysis of the data.

Based on the data collected in the survey, a number of observations were made. Key observations, based on the adopted five-point approval scale are outlined below.

General Questions

- Of all the respondents, 9.43% were graduate students, 49.05% were students in their senior year of study, 39.62% juniors while 1.9% did not respond to the statement.
- 94.34% of all the respondents reported they owned a computer. 68.00% of the respondents that owned computers had laptops.
- 52.83% of respondents reported that they had an *average* level of computer knowledge.
- The main problems that were experienced with the university-issued laptop computers included short battery life (33.33%), insufficient power outlets in the classrooms (23.81%), and inability to print wirelessly from the laptop computers to the printers in the computer lab (14.9%), and programs that did not work properly (14.29%).

Additional information on responses to the general questions can be found in Tables 3 and 7.

Learning Experience

The survey collected information on the learning experience of three groups of respondents. Responses to statements in this section of the survey were evaluated on a five-point scale. A summary of the responses to the learning experience statements follows:

- The statement that the laptop made it easier for the respondents to spend some time learning the different software taught in class on their own was *strongly* agreed to by the graduate students (mean = 4.80), but simply agreed to by respondents in their senior year (mean = 3.58). Respondents in their junior year gave a neutral response (mean = 3.50).
- Group 1 (students issued laptop computers.) respondents agreed with the statement that the laptop made it easier for them to spend time learning the different software taught in class (mean = 3.86). They also agreed with the statement that their skills in the computer applications improved after having had the laptop computer for one semester (mean = 3.86). They however disagreed with the statement that the laptop made their experience in class more enjoyable (mean = 3.33).
- The graduate student respondents strongly agreed with (mean = 5.0) the statement that the laptop made it easier for them to participate in group projects. The researcher believes that it was easier for the graduate students to work on group projects together because they spent more time together in the graduate students' office.
- Group 2 (students not issued laptop computers.) respondents gave a neutral response to the statement that the computer lab was a convenient place for them to spend some time outside of class time learning the construction computer applications (mean = 19). These groups however approved the statement that their participation in class would be enhanced if they used a laptop computer. These respondents also approved (mean = 4.0) the statement that a laptop computer would enhance their learning of the construction computer applications. They also agreed with the statement that having a laptop would enhance their participation and performance in group projects in class (mean = 3.90). Tables 8 and 10 provide additional information on the responses to the *learning experience* questions of the survey.

Future Vision

As with the learning experience part of the survey, the questions about the future vision for laptop computer use were evaluated on a five-point scale. The following is a summary of the statements.

- All the respondents approved the statement that they would prefer to purchase a laptop on a payment plan (mean = 3.74), as opposed to leasing one from the university.
- All the respondents were neutral to the statement that the laptop should be required of all the CMT students.
- The respondents indicated that they would be willing and able to pay \$150-200 per semester to lease a laptop from the university.
- All the respondents strongly agreed with having administrative access and the ability to install other software on university-issued laptops.
- The statement that construction computer applications in addition to the courses that offer the background area of knowledge of those applications was approved (mean = 4.43) by all the respondents. It is the researcher's belief that the laptop computer would provide students the flexibility to practice their skills in the construction computer applications outside of class time.
- Processor speed and computer memory were the most important technical features of the laptop for the respondents. These were followed by battery life and storage capacity, in that order.
- The following verbatim statements were provided by some of the respondents for the questionnaire statement: *Other Important Features* of the laptop computer:
- *Quality would be a high expectation*

- Battery life would be most important
- If the programs are legal to use after college
- Quick and durable
- Speed and reliability
- I want it to work
- Thickness and screen size

Tables 6, 8, 10 and 11 and Appendices C and D provide additional information on the responses to the *Future Vision* statements of the survey.

Conclusions

The following conclusions made by the researcher are based on the data collected from the survey, and they reflect the respondents' learning experience and vision for the laptop computer initiative in the CMT program at Bowling Green State University.

Research Objective 1: To evaluate the learning experience of the students of CONS 320, Construction Computer Applications.

The average response to the *Learning Experience* statements was neutral. It is believed that a strong approval rating for these statements would be received if the laptop computers presented fewer problems. Group 1 respondents agreed with the statement that the laptop made it easier for them to spend time learning the different software taught in class. Group 2 respondents gave a neutral response to the statement that the computer lab was a convenient place for them to spend some time outside of class time learning the construction computer applications. Based on these responses, it can be concluded that the laptop computer is a slightly preferred option. Laptop computers with the specifications that the respondents indicated would be an excellent resource for enhancing learning of the construction computer applications outside of scheduled class time.

Sixteen percent of Group 1 respondents spent -one-half to one hour hooked up to the Internet while in class. Of the respondents without laptops, 21.4 percent spent the same amount of time on the Internet while attending class in the computer lab. It can be concluded that the Internet can be distracting from what is being taught in the computer lab, and it does less than a laptop computer- could do. This may be - because even though the desktop is available and connected to the Internet at the beginning of each class, the laptop is turned on when needed. *Research Objective 2: To investigate the users' future vision of the laptop computer initiative at the College of Technology at BGSU.*

For the respondents in their senior year, 34.4% either agreed or strongly agreed with the statement that the laptop initiative should be required for all the CMT program students, and only 15.6% of the respondents in their junior year of study either agreed or strongly agreed with this statement. Comparing the responses of the junior and senior-year respondents, it can be concluded that although both groups of respondents did not approve the statement, the senior-year respondents found the laptop more useful than did their junior counterparts. The reason may be because at the senior year of study, the students are more knowledgeable in estimating and scheduling, which are key background areas of knowledge regarding the construction computer applications.

Research Objective 3. To analyze the data and draw guidelines for the full implementation of the laptop program at the College of Technology at BGSU.

Following the analysis of the data and the various conclusions that were drawn, a number of recommendations were made:

Recommendations

1. The teacher should draw guidelines for laptop use in class. In the sample studies in the literature review, it was found that the teacher had control over Internet access in class. Students were only allowed to open their laptops when they needed to use them. This reduced the problem of Internet distraction in class.

2. Introducing the laptop computers earlier would be more beneficial because some students will learn the background area of knowledge together with the relevant construction computer applications at the same time.

3. This study should be replicated, but the next study should include a larger sample group, and it should continue over a longer period of time, for example, one or two years (two to four semesters).

4. The researcher noted that the respondents approved mandating the laptop university wide but not for all the students in the CMT program. The researcher recommends rephrasing these questions in future studies in order to obtain accurate information.

5. In future studies, additional questions should be added to the survey for respondents who disagreed with or strongly disagreed with the learning *experience* or the *future vision* statements or both. These questions would ask the respondents to report why they either disapproved or strongly disapproved the statements.

6. In future studies, the performance of students who use laptop computers should be compared with that of students taking the same course but do not use laptops. This would be beneficial in finding out whether the laptops have a positive affect on students' performance

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APPENDIX A

QUESTIONNAIRE FOR GROUP 1 RESPONDENTS



Bowling Green State University Construction Management Program Department of Technology Systems College of Technology Bowling Green, OH 43403

Evaluating the Use of Laptop Computers in Teaching the Construction Computer Application Courses at BGSU

Please allow fifteen minutes of your time to complete this survey. This is an effort to maintain and improve the quality of teaching of construction management at Bowling Green State University. Our goal is to evaluate the effectiveness of using laptop computers in the construction courses at the College of Technology, Bowling Green State University. This is an effort to help our students add more value to their employers. This is a university research project and the information collected will not be used for any commercial purposes.

We assure you that this an anonymous survey, and the information that you provide do not affect your grade in any way. If you have any questions about the survey, please contact Dr. Alan Atalah, PE, by phone at (419) 372-8354 or by email to aatalah@bgnet.bgsu.edu. This is a voluntary questionnaire and filling in the survey is considered an informed consent. If you have any questions about your rights, please contact the Human Subjects Review Board at (419) 372-7716.

A: General questions

For the following statements, please select the answer that best describes your opinion or situation

 Year of Study: 	Junior	Senior	Graduate
2. Your university GPA:	2.0	2.0 to 3.0	□3.0 to 4.0
Your major GPA:	□< 2.0	2.0 to 3.0	□3.0 to 4.0
4. My level of computer knowledge	e 🗌 Savvy	Average	below average
5. i) Do you own a computer?	Yes Yes		🗌 No
ii) If yes, is it a	🗌 laptop, or	r	☐ desktop?
6. How much time do you spend pe	er day working o	on a computer?	
a) < 1 hour b) 1.	·3 hours, c) 3-5	hours $d > 5$	hours
7. Time on the internet:			
(i) While in class (a) < 5 minute	s (b) 5-20 min	utes (c) 20- 45	(d) > 45 minutes
(ii) Before receiving the laptop (a) < 30 minutes	(b) 30 minutes	-1hr (c) 1-2hr (d) >2hr
(iii) After you received the lapto	p(a) < 30 minut	tes (b) 30 minu	tes-1hr (c) 1-2hr (d) >2hr
8. (i) How much time did you spen	d per day using	the university is	ssued laptop?
a) < 1 hour b) 1.	3 hours, c) 3-5	hours $d > 5$	hours
(ii) How much time did you spen	d per day using	a computer befo	ore you received the laptop?
a) < 1 hour b) 1-3 hours	s, c) 3-5	hours $d > 5$	hours
9. Please indicate the problems that	t you encountere	ed during this la	ptop experiment
Power cord availability In	ability to print f	rom the laptop	Hardware failure
Power outlets availability in class	ss and power co	rd safety	Lack of administrative access
Short battery life	ograms that did	not work prope	rly Others (specify)
10. How many times did you have	hardware related	d problems with	the laptop?
i) While in class? (a) 0 (b) 1	-3 (c) 3-:	5 (d) >5	
ii) Outside class? (a) 0 (b) 1	-3 (c) 3-3	5 (d) >5	
11. How many times did you have	software related	problems with	the laptop?
i) While in class? (a) 0 (b) 1	-3 (c) 3-:	5 (d) >5	
ii) Outside class? (a) 0 (b)1-	3 (c) 3-	5 (d) >5	
12. How many times did you lose d	lata that you say	ed on the laptor	o?
(a) 0 (b) 1	-3 (c) 3-:	5 (d) >5	
	. /		

B: Learning experience

For the following statements, please indicate your level of approval or disapproval of the statement on scale of 1 -5 where 1 means strongly disapprove and 5 means strongly approve.

		1	2	3	4	5
13.	The laptop has made it easier for me to spend some time learning the					
	different software taught in class on my own.					
14.	Using the laptop has enhanced my level of organization, thereby saving me					
	time that I spend on assignments related to the software taught in class.					
15.	The laptop has become my primary computer for all my class work					
16.	My participation in the class using a laptop computer is on average, higher					
	than that in other classes not using the laptop computer					
17.	After having the laptop computer for one semester as an aid in learning the					
	estimating and scheduling applications:					
	a) My skills in these applications improved					
	b) I am confident in applying the skills that I learned in class.					
18.	The laptop made a positive change on my grade in this class					
19.	The laptop helped to make my experience in class more enjoyable.					
20.	I learn more by using the laptop computers than in the traditional computer					
	lab environment.					
21.	I am more knowledgeable and skillful in using computers now than before I					
	received the laptop					
22.	The laptop computer made it easier for students to interact with and learn					
	from other students who used laptop computers in CONS 320.					
23.	The laptop has enhanced interaction with the teacher.					
24	I accession descent to be the second se					
24.	I received more help from the teacher with the laptop computer than in the					
25	The leaster helps the teacher to be used a first starter.					
25.	The Taptop helps the teacher to be more effective.					
26	Did you participate in any group project requiring computer use in the CONS	320 0	19662			
20	□ No	5200	10551		03	
27	If you answered yes to question 26 did the lanton make it easier for					
27.	vou to participate in the group project?					

C: Future vision of the laptop computer initiative

For the following statements, please indicate your level of approval or disapproval of the statement on scale of 1 - 5 where 1 means strongly disapprove and 5 means strongly approve.

		1	2	3	4	5
28.	I prefer to purchase a Laptop on a payment plan if required by the					
	University, instead of leasing a Laptop.					
29.	I prefer to lease a Laptop on a payment plan if required by the					
	University instead of purchasing a Laptop.					
30.	I prefer a lease with an option to purchase plan.					
31.	The laptop should be required of all students in the CMT program.					
32.	The laptop should be required of all students in the College of					
	Technology.					

33. If better and faster computers loaded with all the required software are provided, then the amount I would be
able and willing to pay per semester for leasing a laptop will be: (please select one)a) \$150-200b) \$200-250c) \$250-300d) \$300 and above

The following statements refer to possible curriculum changes as a result of the full implementation of the laptop program in the future. Please indicate your level of approval or disapproval of the statement on scale of 1 - 5 where 1 means strongly disapprove and 5 means strongly approve.

		1	2	3	4	5
34.	Is it important to have administrative access and the ability to install					
	other programs on the laptop or both?					
35.	The laptop should be required of all students at the University.					
36.	Construction computer applications should be taught in the courses					
	that teach the background area of knowledge, e.g. Timberline and					
	HCSS will be taught in the estimating courses.					
	a) This is the best approach					
	b) I prefer enrolling in a course that is entirely dedicated to teaching					
	construction computer applications.					

For question 37 below, please indicate the importance you place on the following features of the laptop on scale of 1-5 where 1 means not important and 5 means very important.

		1	2	3	4	5
37.	a) Weight					
	b) Battery life					
	c) Processor speed					
	d) RAM					
	e) Hard disk					
	f) Graphics card					
	g) Others, please state here					

APPENDIX B

QUESTIONNAIRE FOR GROUP 2 RESPONDENTS



Bowling Green State University

Construction Management Program Department of Technology Systems College of Technology Bowling Green, OH 43403

Evaluating the Use of Laptop Computers in Teaching the Construction Computer **Application Courses at BGSU**

Please allow fifteen minutes of your time to complete this survey. This is an effort to maintain and improve the quality of teaching of construction management at Bowling Green State University. Our goal is to evaluate the effectiveness of using laptop computers in the construction courses at the College of Technology, Bowling Green State University. This is an effort to help our students add more value to their employers. This is a university research project and the information collected will not be used for any commercial purposes.

We assure you that this an anonymous survey, and the information that you provide do not affect your grade in any way. If you have any questions about the survey, please contact Dr. Alan Atalah, PE, by phone at (419) 372-8354 or by email to aatalah@bgnet.bgsu.edu. This is a voluntary questionnaire and filling in the survey is considered an informed consent. If you have any questions about your rights, please contact the Human Subjects Review Board at (419) 372-7716.

A: General questions

For the following statements, please select the answer that best describes your opinion or situation

1. Year of Study:	Junior	Senior	Graduate
2. Your university GPA:	2.0	2.0 to 3.0	3.0 to 4.0
3. Your major GPA:	□<2.0	2.0 to 3.0	□3.0 to 4.0
4. My level of computer knowledge	Savvy	Average	□ below average
5. i) Do you own a computer?	🗌 Yes		🗌 No
ii) If yes, is it a	🗌 laptop, d	or	☐ desktop?
6. How much time do you spend per	day working	on a computer?	
a) < 1 hour b) 1-3	hours, c) 3-5	5 hours d) > 5	hours
7. On average, how much time did y	ou spend on t	he internet:	
i) Everyday: (a) < 30 minutes	(b) 30 minute	s-1hr (c) 1-2hr	(d) >2hr
ii) While in class (CON 320): (a) < 5 minute	s (b) 5-20 minu	ites (c) 20- 45 (d) > 45 minutes
R. Loarning oxportionco			

B: Learning experience

For the following statements, please indicate your level of approval or disapproval of the statement on scale of 1-5 where 1 means strongly disapprove and 5 means strongly approve. 1 2 2 4 5

		1	2	3	4	Э
8.	The computer lab is a convenient place for me to spend some time					
	learning the different software taught in class on my own.					
9.	I use the computer lab for all my computing needs					
10.	My participation in most classes would be enhanced if I had a laptop					
	computer instead of having to rely on the computers in the lab.					
11.	Having had to rely on using the computer lab to learn the different					
	estimating and scheduling applications:					
	a) My skills in these applications improved.					
	b) I am confident in applying the skills that I learned in class.					

12.	I would learn more if I used a laptop computer than in the current setting				
	where I rely on the computers in the lab.				
13.	Did you participate in any group project requiring computer use in class?	<u> </u>	Zes [No	
14.	If you answered yes in question 9, did you find the computer lab an				
	adequate resource for the computing needs of the group project?				
15.	Do you think having a laptop computer would have made it easier for you				
	to participate in the group project?				

C: Future vision of the laptop computer initiative

For the following statements, please indicate your level of approval or disapproval of the statement on scale of 1-5 where 1 means strongly disapprove and 5 means strongly approve.

		1	2	3	4	5
16.	I would prefer to purchase a Laptop on a payment plan if required by the					
	University instead of leasing a Laptop.					
17.	I would prefer to lease a Laptop on a payment plan if required by the					
	University instead of purchasing a Laptop.					
18.	I would prefer a lease with option to purchase plan.					
19.	The laptop should be required of all students in the CMT program.					
20.	The laptop should be required of all students in the College of					
	Technology.					
21.	If better and faster computers loaded with all the required software are					
	provided, then the amount I would be able and willing to pay per					
	semester for leasing a laptop will be: (please select one)					
	a) \$150-200 b)\$200-250c) \$250-300 d)\$300+					
22.	Is it important to have administrative access and ability or both to install					
	other programs on the laptop?					
23.	A laptop should be required of all students at the University.					
24.	Construction computer applications will be taught in the courses that					
	teach the background area of knowledge					
	a) This is the best approach.					
	b) I prefer taking a course that is entirely dedicated to teaching					
	construction computer applications.					

For question 22, please rate the features of the laptop on scale of 1-5 where 1 means not important and 5 means very important.

25.	a) Weight			
	b) Battery life			
	c) Processor speed			
	d) RAM			
	e) Hard disk			
	f) Graphics card			
	g) Others, please state here			

APPENDIX C

HSRB CONSENT LETTER

) ate Universit	у		Office	of Research Compliance 201 South Hall g Green, OH 43403-0183 Phone: (419) 372-7715 Fax: (419) 372-5916 E-mall: harb@bgau.edu				
RSHIP 97									
HSRB Chair	January 18,	2007							
du M.D.	то:	John Meena Construction	Management						
torp. Ødacor.net	FROM:	Richard Rowl HSRB Admin	ands R^{2}						
ret	RE:	HSRB Project	No.: H07O124GX2						
communication	TITLE:	Evaluating th Teaching CON Course	e Effectiveness of Us NS 320 (Computer Ap	sing Lapto plications	p Computers in in Construction)				
sn., NW Ohio Mu	NW Ohio You have met the conditions for approval for your project involving human subjects. As of January 18, 2007, your project has been granted final approval by the Human Subjects Review Board (HSRB). This								
undations &	recruitment	t and data collec	ction.						
edu on,)r., M.D. Health tu	The final Consistent bearing th version an	approved vers with federal OF e HSRB appro d you <u>must</u> us	ion of the consent IRP guidance to IRB wal/expiration date e copies of the dat	documer s, the cons stamp is e-stamped	<u>at(s) is attached.</u> sent document(s) the <u>only</u> valid document(s) in				
l) rvices edu iey .edu	You are res use only ap activities or please send office. I hsrb@bgnet	ponsible to con proved forms. procedures (in 1 a request for p Please notify t.bgsu.edu) upo	duct the study as ap If you seek to make cluding increases in t nodifications immed me, in writing (n completion of your	proved by any chang the numbe liately to t (fax: 372- project.	the HSRB and to es in your project r of participants), he HSRB via this 6916 or email:				
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ontez Anguiano sumer Sciences			Co.Dept. Construction Manage Phone #	Phone #	2-7716 2-6916				

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APPENDIX D

Table D1

No	Statement	Approval Rating $\%$ (<i>n</i>))	
		1	2	3	4	5
28.	I prefer to purchase a Laptop on a payment plan if	23.8	9.5	9.5	14.3	42.9
	required by the University instead of leasing a	(5)	(2)	(2)	(3)	(9)
	Laptop					
29.	I prefer to lease a Laptop on a payment plan if	57.1	9.5	9.5	14.3	9.5
	required by the University instead of purchasing a	(12)	(2)	(2)	(3)	(2)
	Laptop					
30.	I prefer a lease with option to purchase plan	14.3	14.3	14.3	23.8	33.3
		(3)	(3)	(3)	(5)	(7)
31.	The laptop should be required of all students in	23.8	4.8	23.8	23.8	23.8
	the CMT program	(5)	(1)	(5)	(5)	(5)
32.	The laptop should be required of all students in	38.1	4.8	28.6	9.5	19.1
	the College of Technology	(8)	(1)	(6)	(2)	(4)
33.	If better and faster computers loaded with all the	65.0	25.0	10.0	0	
	required software are provided, then the amount I	(13)	(5)	(2)	(0)	
	would be able and willing to pay per semester for					
	leasing a laptop will be: (please select one)					
	1) \$150-200 2) \$200-250 3) \$250-300 4) \$300+					
34.	Is it important to have administrative	0	0	9.5	38.1	52.4
	access/ability to install other programs on the	(0)	(0)	(2)	(8)	(11)
	laptop?					
35.	The laptop should be required of all students at	33.3	14.3	42.9	0	9.5
	the University	(7)	(3)	(9)	(0)	(2)
36	Construction computer applications will be taught					
	in the courses that teach the background area of					
	knowledge	4.8	4.8	38.1	33.3	19.1
	a) This is the best approach	(1)	(1)	(8)	(7)	(4)
	b) I prefer taking a course that is entirely	9.5	9.5	52.4	9.5	19.1
	dedicated to teaching construction computer	(2)	(2)	(11)	(2)	(4)
	applications					
37	Indicate the importance you place on the					
	following features of the laptop on scale of $1-5$	14.3	23.8	19.1	19.1	23.8
	a) Weight	(3)	(5)	(4)	(4)	(5)
	b) Battery life	0	0	14.3	23.8	61.9
		(0)	(0)	(3)	(5)	(13)
	c) Processor speed	0	0	4.8	19.1	76.2
		(0)	(0)	(I)	(4)	(6)
	d) KAM	0	0	9.5	38.1	52.4
		(0)	(0)	(2)	(8)	(11)

Future Vision: Statement Approval Rating for Group 1 Respondents

No	Statement	Approval Rating % (<i>n</i>)					
		1	2	3	4	5	
	e) Hard disk	0	0	20.0	35.0	45.0	
		(0)	(0)	(4)	(7)	(9)	
	f) Graphics card	0	10.5	26.3	26.3	36.8	
		(0)	(2)	(5)	(5)	(7)	
	g) Others, please state here	0	0	0	25.0	75.0	
		(0)	(0)	(0)	(1)	(3)	

APPENDIX E

Table E1

No	Statement	Approval Rating $\%$ (<i>n</i>))
		1	2	3	4	5
16.	I would prefer to purchase a Laptop on a payment	6.3	13.0	19.0	19.0	44.0
	plan if required by the University instead of	(1)	(2)	(3)	(3)	(7)
	leasing a Laptop					
17.	I would prefer to lease a Laptop on a payment	63.0	25.0	6.3	0	6.3
	plan if required by the University instead of	(10)	(4)	(1)	(0)	(1)
	purchasing a Lapton					
18	I prefer a lease with option to purchase plan	25.0	13.0	38.0	63	13.0
10.	r protor a rease with option to parenase plan	(4)	(2)	(6)	(1)	(2)
19	The lapton should be required of all students in	130	130	19.0	31.0	25.0
17.	the CMT program	(2)	(2)	(3)	(5)	(4)
20	The lanton should be required of all students in	63	(2)	38.0	63	25.0
20.	the College of Technology	(1)	(A)	(6)	(1)	(A)
21	If better and faster computers loaded with all the	(1)	(+)	(0)	(1)	(4)
<i>2</i> 1.	required software are provided, then the amount I					
	would be able and willing to new ner semaster for					
	lossing a lantan will be: (plaga galact and)	67.0	25.0	67		
	(prease select one)	(10)	23.0	(1)		
22	a) $5150-200$ b) $5200-250c$) $5250-500$ d) $5500+$	(10)	(4)	(1)	12.5	075
22.	is it important to have administrative	0	0	0	12.5	8/.5
	access/ability to install other programs on the	(0)	(0)	(0)	(2)	(14)
22		12.0	12.0	10.0	21.0	25.0
23.	I ne laptop should be required of all students at	13.0	13.0	19.0	31.0	25.0
2.4	the University	(2)	(2)	(3)	(5)	(4)
24	Construction computer applications will be taught					
	in the courses that teach the background area of					
	knowledge	0	6.3	50.0	37.5	6.3
	a) This is the best approach	(0)	(I)	(8)	(6)	(1)
	b) I prefer taking a course that is entirely	0	6.3	50.0	19.0	25.0
	dedicated to teaching construction computer	(0)	(1)	(8)	(3)	(4)
	applications					
25	Indicate the importance you place on the					
	following features of the laptop on scale of $1-5$	19.0	13.0	13.0	31.0	25.0
	a) Weight	(3)	(2)	(2)	(5)	(4)
	b) Battery life	6.3	0	13.0	19.0	63.0
		(1)	(0)	(2)	(3)	(10)
	c) Processor speed	0	0	0	25.0	75.0
	-	(0)	(0)	(0)	(4)	(12)
	d) RAM	0	0	0	37.5	62.5
		(0)	(0)	(0)	(6)	(10)
	e) Hard disk	6.3	0	13.0	37.5	43.8
		(1)	(0)	(2)	(6)	(7)

Future Vision: Statement Approval Rating for Group 2 Respondents

No	Statement		Approval Rating % (<i>n</i>)					
		1	2	3	4	5		
	f) Graphics card	6.3	6.3	19.0	19.0	43.8		
		(1)	(1)	(3)	(3)	(7)		
	g) Others, please state here		-	-	-			