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Educational technology behaviors and expectations of students entering three dental programs : a bi-coastal study

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The University of San Francisco

EDUCATIONAL TECHNOLOGY BEHAVIORS AND EXPECTATIONS OF STUDENTS ENTERING THREE DENTAL PROGRAMS; A BI-COASTAL SURVEY

A Dissertation Presented

to

The Faculty of the School of Education

Learning and Instruction Department

In Partial Fulfillment

of the Requirement for the Degree

Doctor of Education

by

Gwen Essex

San Francisco

May 2009

This dissertation, written under the direction of the candidate's dissertation committee and approved by the members of the committee, has been presented to and accepted by the Faculty of the School of Education in partial fulfillment of the requirements for the degree of Doctor of Education. The content and research methodologies presented in this work represent the work of the candidate alone.

Gwen Essex	5/20/09
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Table of Contents

List of Figures

List of Tables

Chapter One

Introduction to the Study

Statement of the problem

There is a need to understand how dental students use educational technology in order to best support their learning of complex health-science curriculum content. It is known that undergraduate students report heavy use of technology in their education (Salaway, Caruso, Nelson, & Dede, 2007; Salaway, Katz, Caruso, & Kvavik, 2006), yet there has been little formal inquiry into the behaviors of dental students as they relate to methods of digitally supported study. With many options for the delivery and management of digital learning materials available, insight into how students accept and utilize educational technology is necessary to ensure the selection of methods that provide the maximum benefit to students, and thereby support more efficient and complete learning. If undergraduates use technology, it follows that entering dental students do as well, and further, that they are likely to bring expectations of technology with them to dental school. A descriptive study based on the Technology Acceptance Model (Davis, Bagozzi, & Warshaw, 1989) that gathered information regarding educational and personal technology use behaviors, preferences, and expectations for technology in dental school was conducted. This study also compared dental student technology behaviors to data previously collected by EDUCAUSE (2007) on U.S. and Canadian undergraduates. The resulting data can be used in curriculum development and deployment to increase the efficacy of learning, and in turn the mastery of complex professional health science content such as dentistry. This information potentially benefits students and their patients, the end-users of health-science education.

Background and need

Undergraduate use of educational technology.

Throughout North America, undergraduate institutions are finding students enthusiastic about incorporating technology into their education. Studies done to assess student acceptance of varied methods of instruction have found a strong student preference for hybrid course content delivery (Beard, Harper, & Riley, 2004; Rivera & Rice, 2002). A hybrid course is one that combines more traditional, in-person class meetings and activities with online course components. This is no surprise as more and more undergraduate students have taken courses that utilize a Course Management System (CMS), such as BlackBoard or Moodle, to deliver course materials at a student's convenience. A nationwide survey of undergraduate students found that two-thirds of respondents have used some type of a CMS (Richard Katz, 2006). The preference for a course that is supported by online learning materials makes sense, since the vast majority of responding students expect course-related web resources to be a benefit to their education (Frederico, 2001). Those students who have used a CMS are overwhelmingly enthusiastic about the benefits (Salaway et al., 2006) which include convenient access to course materials and ease of communication (Eynon, Perryer, & Walmsley, 2003; Hendricson et al., 2006; MacPherson & Brueckner, 2003; McLean & Murrell, 2002). Very few students, less than 5%, express negative or extremely negative opinions regarding CMS use in undergraduate courses (Salaway et al., 2006). These few who do, often report avoidance of technology in general (Salaway et al., 2006).

The message from students is clear, while there is a small number who desire an exclusively technology-mediated education, and a small minority that would prefer no technology (Salaway et al., 2006), most students express the greatest satisfaction with courses that utilize technology to a moderate level (Richard Katz, 2006). Classes that incorporate technology, but retain elements of a traditional course, such as in-person class meetings are reported to be preferred by students that have been studied (Beard et al., 2004; Rivera & Rice, 2002; Sanders & Morrison-Shetlar, 2001). Throughout the literature, there are examples of students responding positively to the incorporation of educational technology into their courses: the opinion of current students is that access to learning materials at anytime, from anywhere, is not a luxury but an essential component of their education (Eynon et al., 2003; Grimes, 2002; Hendricson et al., 2006; Link & Marz, 2006; MacPherson & Brueckner, 2003).

Much of the research that has been done around e-learning and educational technology has been focused on understanding student reactions to technology implementations. Students are overwhelmingly in favor of making learning material accessible through a CMS or other web-hosting mechanism (Eynon, Perryer & Walmsley, 2003; Grimes, 2002; Hendricson, et al, 2006; MacPherson & Brueckner, 2003; Mclean & Murrell, 2002; Rajab & Baqain, 2005; Walmsley, White, Eynon & Somerfield, 2003). Students have supported the continued use of such curriculum delivery technology when given the opportunity to voice an opinion (Gupta, White & Walmsley, 2004; Morss & Fleming, 1998; (Grimes, 2002; Salaway et al., 2006).

Contemporary students' use of technology.

There is a rich databank available on the use of technology by U.S. undergraduate students. For many years, the EDUCAUSE Center for Applied Research (ECAR), the research arm of EDUCAUSE, has conducted an annual survey of students to gain an evolving understanding of how they use various types of technology. The result is a comprehensive view of how undergraduates incorporate technology into their personal and academic lives. Technology use for personal applications often goes hand in hand with its use for educational or professional purposes (Salaway et al., 2006). That contemporary students desire a technological aspect to their education is a direct reflection of their personal relationship with technology. There has never before been a generation of students so accustomed to technology integration throughout their academic and personal lives. Not only do 98.8% of responding college students utilize technology to complete course assignments (Katz, 2006), they use it to facilitate communication, personal organization and recreation (Salaway et al., 2006). In 2006, EDUCAUSE reported that 99.9% of undergraduate students send email, 80% use Instant Messaging (IM), and 28.6% report creating web pages (Katz, 2006).

This comfort with technology begins early for current students. An investigation into the technological attitudes and abilities of high school students in Iowa found that of the 1,006 who responded, 87% indicated that they considered their computing skills to be "average or greater," and a full 28.5% of the surveyed students rated themselves as "very capable" when provided with learning opportunities (Houtz & Gupta, 2001). More recently, a survey of college freshmen found that only 1.4% reported having no access to the Internet, and only 16% reported that they had not created and manipulated a digital

image within the last year (Kennedy, Krause, Judd, Churchward, & Gray, 2006). One in 5 students use a smart phone (Katz, 2006), and 45.5% of them would like to use a mobile phone to access the web and send email (Kennedy et al., 2006).

Unlike previous generations, the current generation, often termed "Millennials," born between 1985 and 2002 (Tapscott, 1998), has always known, and has thus come to expect, technology solutions. On the other hand, baby boomer and generation-X faculty may appreciate these tools, but they do not consider them essential (Mangold, 2007; Oblinger, 2003). Further, millennial students have grown up in a multi-tasking environment (Oblinger, 2003); it is not at all unusual for students to be engaged in studying, instant messaging (IM), and listening to music simultaneously. Some researchers have postulated that due to their technology-rich environment, contemporary student has fundamentally changed how they learn (Barnes, Marateo & Ferris, 2007). These students have a greater expectation of involvement and immediate feedback or gratification (Barnes, Marateo, & Ferris, 2007). Understanding the expectations of these students as they enter dental school is essential to selecting the most efficacious educational technology tools for implementation. Evidence that our students have different expectations and learning habits than students in the past, requires educators to ensure that the delivery of the complex health-science curriculum reflects these changes. In health science professional education, better student learning results in better patient care.

Millennial students were raised in an environment that provided half of them access to a computer by age 11, with fully 96% having used one by age 18 (Link & Marz, 2006). By age 21 these students have spent 220,000 hours interacting with technologies

such as video games, cell phones, and computers and less than 5,000 hours reading traditional books (Barnes et al., 2007). The comfort with which millennial students interact with technology is illustrated by the opinion shared by subjects in a study by Morss and Fleming (1998). This study of university students found 33% did not consider reading on-screen more laborious than reading a traditional text (Morss & Fleming, 1998.) A recent study of Kindergarten through 12th grade students found that 63% of respondents reported using a desktop computer weekly (Salaway et al., 2006). The same study reported that as many as 16% of students in grades 6 to 12 use personal digital assistants (Salaway et al., 2006). Students are technology-savvy and are likely to continue to become more sophisticated. To remain competitive for high-achieving students, and ensure educational efficacy, health-science education must follow.

Dental student characteristics.

Dental school admissions are very competitive. In the 2004-05 admissions period, there were 4,612 enrollment opportunities offered to a selection of the 9,433 applicants, leaving 51% of the applicants without a seat in the admitted class nationwide (ADA, 2006). The average pre-dental GPA of the dental class admitted nationally in 2004-05 was 3.47 overall, with a science average of 3.40 (ADA, 2006). Eighty-four percent of the admitted students held bachelor's degrees, and 5% held master's degrees (ADA, 2006) with fewer than 10% entering dental school having met admissions requirements without having earned a degree. The gender balance swings slightly from year to year, but the 2004-05 class was 57.7% men and 43.8% women.

One can speculate that first-year dental students may posses characteristics similar to those reported by college seniors, such as those participating in the annual technology

study conducted by EDUCAUSE (Salaway et al., 2006). The available data on the technology usage of college seniors shows an increase in the use of academically focused technology and Internet use, as well as an increased use of the advanced features of software applications (Salaway et al., 2006). It appears that the recreational technology abilities of freshmen college students mature to a more academic skill set by senior year (Salaway et al., 2006). Dental students are accomplished students going to professional school having succeeded academically to get there. In general, they have learned to use technology throughout their education. In turn, dental educators need to be prepared for the expectations of this technology-savvy, high-achieving student body. Dental students, and therefore dental patients, are best served by a curriculum that reflects the reality of the contemporary dental student.

Climate of dental academia.

Dental education is in the midst of curricular change. Educational technology is becoming more prevalent throughout dental schools across the United States and Canada, and it will only continue to increase in both utility and demand. Eighty-seven percent of North American dental schools participated in an investigation into current and planned curricular changes in 2003 (Kassebaum, Hendricson, Taft, & Haden, 2004). Of the schools responding, 86% reported curricular revision involving the increased utilization of computers and web-based education (Kassebaum et al., 2004). Further strengthening dental education's informal collective commitment to technology, 82% of the responding schools reported that they planned to increase the integration of educational technology within the next 3 years (Kassebaum et al., 2004).

To appreciate this national wave of expected change, it is necessary to describe the current state of technological adoption within North American dental schools. During the academic year of 2002-03, 57% of the 65 dental schools in North America indicated that 10% or less of their curriculum was managed within a web-based CMS (Kassebaum et al., 2004). The most frequent technology employed was reported to be email communication between faculty and students, however only 20% of responding schools indicated that more than 67% of their courses met this communication objective (Kassebaum et al., 2004). Currently, dental educators are beginning to incorporate technology to greater degrees with some making significant commitments to technology. In 2002-03, 25% of the 65 dental schools in the study by Kassebaum et al. (2004) were identified as major technological innovators with at least a third of their courses supported by web-resources, as well as a third of their faculty trained in the relevant educational technology and the presence of an instructional technology center on campus. While this represents an important commitment and a great deal of innovation, there is still a large portion of the dental curriculum, even in these innovative schools, that have yet to incorporate technology as recently as six years ago.

Why should dental schools be concerned with the technology use of the student body? From an institutional standpoint, student technological abilities, preferences, and expectations are important to understand for many reasons. First, there are learning implications and the subsequent patient care outcomes associated, but additionally there are student recruitment and faculty shortage issues that are entwined with dental academia and the implementation of curricular technology.

Many undergraduate campuses use technology as a means of attracting students (Salaway et al., 2006). Students coming from campuses where broadband connectivity, wireless classrooms and online course support is well established will likely have similar expectations of their professional schools. While scholarship, reputation, financial considerations, and geography will continue to be important, it is not unreasonable to project that the availability of expected technology will become a decision factor for students deciding which dental school to attend.

It is also important to understand how this student body relates to technology to ensure that the technology tools selected, are efficacious and likely to be adopted. With an understanding of how students use technology, educators can implement technology that supports current student practices rather than opposes them, greatly increasing the likelihood that students will use the technology, and benefit through increased learning, resulting in more competent patient care. Knowing how students use technology allows us to plan more effective curriculum delivery.

Another factor that underlies the importance of obtaining an institutional understanding of how technology supports students is the current national shortage of dental faculty. This shortage is a well-documented phenomenon (Haden, Morr & Valachovic, 2001; N.K. Haden, Weaver & Valachovic, 2002) and to date, there has been no solution identified. At the 2007 American Dental Educator's Association Annual Meeting, there was discussion of the increased utilization of web-based learning and learning materials, and specifically the advantages of the use of virtual reality to extend the contributions of the dwindling number of professionals entering careers in dental academia (Simonsen, Brown, Herbranson, Hasel & Goodacre, 2007). Maintaining the

ability to adequately prepare new dentists with a shortage of faculty is a challenge. One possible solution is to use educational technology to help bridge the gap. Technology can prepare students and support them in making the best use of the class time with the faculty (Eynon et al., 2003; Masiello, Ramberg & Lonka, 2005).

An incomplete picture.

As scholars in the field have proposed, there is a gap in the collective knowledge of dental educators relative to educational technology (Hendricson, et al, 2004). The literature contains studies concerned with computer literacy, student and/or faculty reactions to implemented technology, or examples of courses utilizing various technological innovations. Recently, there is information from a study entitled Institutional Readiness for Electronic Curriculum (Hendricson et al., 2004), but to date there is nothing published focusing on dental student behaviors relating to their use of technology in support of their education. In addition, there is no research available describing the general technology behaviors of dental students. While there are a few well-designed and well-executed studies of undergraduates, such as that conducted annually by EDUCAUSE, there is still a great need for more research in this area to gain an understanding of how students use and integrate technology into their education (Saadé, Nebebe & Tan, 2007).

What is necessary to shape technology decisions is a clear understanding of the needs of the students. With an accurate understanding of student needs, educators can adapt content delivery to the relevant skills and desires of the student body, which is likely to result in student learning improvements, and ultimately result in better patient care. In academic institutions, the people who make decisions regarding educational

technology do not share the experience or background of the students with perspectives on technology that differ from the Millennial student. It is quite possible that despite the best attempts of faculty, administrators, and staff, they do not make the best technology decisions for the end-users, the students. Dental education is currently unable to answer the question of the *actual use* of technology among dental students. Therefore it is unknown how dental students study with technology, or how they use, or do not use, digital learning materials. In consideration of ubiquitously limited resources of both money and time, it is most prudent to expend those resources on technologies that most efficiently meet student-learning needs. This descriptive study seeks to understand how dental students use technology in support of their education. This information is vital for dental educators and administrators to inform and shape technological innovation and in turn, support dental student education. Without a clear understanding of where dental student use of educational technology is currently, the task of planning and using technology toward the improvement of student learning is difficult to achieve.

Theoretical Rationale

For the purposes of this investigation, the Technology Acceptance Model (TAM) (Davis et al., 1989) guided the study's implementation. The TAM was developed in 1986 by Davis, and then revised in 1989 by Davis et al. Since that time, the TAM has been used to assess determining factors in the adoption behavior of the end-users of technology. Initially developed for business applications, the TAM was most recently used in an educational context to guide a study of undergraduate business students and was found to be a valid model when applied to e-learning (Saadé et al., 2007).

Adapted from Fishbein and Ajzen's theory of reasoned action (Fishbein & Ajzen, 1975), which examines effects of attitudes and norms on behavior, the TAM is more specific than the theory of reasoned action as it was developed expressly to examine behavior related to technology. Like the theory of reasoned action, the TAM poses that there are external influences on an individual's perception of the ease of use and usefulness of technology. These influences help shape an individual's subjective *attitude*, which forms their intention to use, and their *actual use* of technology (Figure 1).

Figure 1 illustrates the relationship between a subject's perceptions of technology and the subject's intended and *actual use* of the technology. For greatest readability, the TAM model has been adapted from the original article by omitting the use of abbreviations. Each aspect of the model is described in the paragraphs following figure 1.

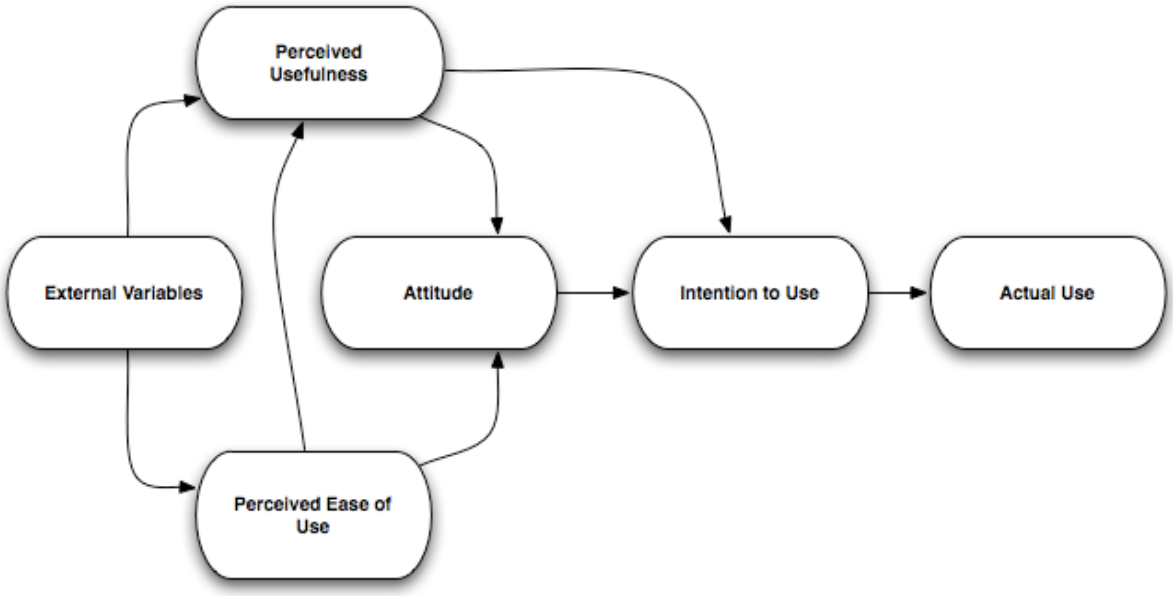

Figure 1. Technology Acceptance Model (TAM), adapted from Davis et al (1989).

Davis' (1989) model begins with the assertion that there are *external variables* that influence an individual's opinion of a given technology. *External variables* include two components. The first component includes aspects of the technology itself that might affect a user's acceptance of the technology, such as icons, input devices, menus, age, and condition of an electronic device, Internet connection speeds, and other aspects of a technological user interface. A student trying to download a lecture-cast via a dial-up Internet connection is an example of the potential influence exerted by *external variables*. Such a task would take such a long time and it is unlikely that the student would form a positive opinion for making lectures available on the web. The second component envelops personal beliefs or attitudes relative to the technology in question. An example of a personal belief or experience that would influence an individual's perception of usefulness and ease of use of technology would be someone who has always enjoyed conversing with bank tellers. This individual is more likely to perceive automated teller machines as not very useful, and less easy to use, compared to someone who views in-person banking transactions to be a chore. *External variables* connect indirectly to *attitude*, as they influence personal opinion and reaction to technology, by shaping the interaction of a user. For example, if the input device for a particular technology is cumbersome and faulty, it is unlikely that the user will adopt a positive *attitude* toward that technology. In this study, *external variables* were measured with the five survey items: 1 - 4, and 20.

In contrast to the theory of reasoned action, which proposes an indirect relationship between *external variables* and *attitude*, the TAM specifically includes the direct influence of *external variables* on both *perceived usefulness* and perceived ease of

use. This relationship allows researchers to examine the effects of specific aspects of technology on a subject's perceptions of usability and usefulness (Davis et al., 1989). This distinction is an important difference as it can provide valuable, directed feedback on elements of technology design and delivery, which can then be optimized for maximal acceptance.

Perceived ease of use represents an individual's opinion of how accessible the technology in question is. Depending on many personal variables, a subject could find technology to be daunting and cumbersome, or intuitive and efficient. Individuals view new technology through the lens of their previous experiences. If a person has positive experiences utilizing a similar technological interface, for example, it is expected that he/she would perceive the new technology to be easier to use than if they had not encountered the previous technology. Conversely, if a subject has low self-efficacy related to the use of technology, it is expected that he or she will approach new technology with an expectation of struggle. "Perceived ease of use" is a personally held opinion directly influenced by *external variables*. This study does not measure *perceived ease of use*. The desire to compare the entering dental students to the data available on undergraduates from ECAR was considered essential to this study. The survey necessary to do the comparison did not address perceived ease of use and it was considered important to make as few alterations to the original survey tool as possible.

Perceived usefulness relates to an individual's assessment of how technology will help or hinder the achievement of their goals. If a subject views the technology as being essential to success, it is expected that he or she will therefore perceive the technology to be very useful. It is important to note the connection between perceived ease of use and

perceived usefulness, as opinions held regarding the effort necessary to employ technology could increase or decrease the perception of usefulness. If a subject finds the technology quite difficult to use, this will negatively affect the subject's opinion of its usefulness. Ultimately, how the technology supports an individual's progress towards their goals, regardless of the context, is a key factor in whether or not technology will be adopted. This study evaluates *perceived usefulness* with two survey items: 25 and 28.

Attitude is influenced by both *perceived usefulness* and perceived ease of use in the TAM model. How much an individual expects a particular technology to assist him/her in reaching a desired goal, as well as how easy or difficult the technology is to use, combine to form an individual's *attitude*. If a proposed technology appears simple to use, and would greatly enhance one's performance, it follows that one's *attitude* toward adoption would be quite positive. Of course, the contrary also holds. If someone views the technology as complicated or redundant to current practices, his/her *attitude* is likely to be very poor. *Attitude* has a direct effect on one's intention to use technology. This study examines participant *attitude* with eight survey items: 21, 24, 27, 29, 30, 32, 34, and 38.

Intention to use is more complicated than simply a product of one's *attitude*. Davis (1989) asserts that while *perceived usefulness* influences *attitude*, it also contributes directly to an individual's intention to use technology. It is thought that if an individual believes that technology will greatly assist them, then this belief furthers the intention to use technology directly. This remains true even if perceived ease of use is somewhat low, thereby fostering a less positive *attitude*. If the technology is perceived as highly useful, then intention to use will be high. This is because in most cases, usefulness

will be seen as more important than ease of use**,** and thus usefulness will guide behavior. It could be said that the anticipated end result fuels an individual's motivation to adopt technology. This study does not measure this variable for several reasons. First, differentiating between the intention to use and the actual use of technology is difficult to measure, particularly in a study with only one data collection point as opposed to a study that follows up with subjects later. Second, in order to allow for the comparison of the entering dental students to the undergraduates studied by ECAR it was desirable to make as few changes to the original ECAR assessment tool as possible.

Finally, the TAM model terminates at the *actual use* of technology. It is important to note that both intention to use and *actual use* have a place in the model, as there are often differences between intentions and actual adoption. This distinction can be particularly useful: by delineating the two separately, it is possible to isolate them and perhaps gain insight as to why someone with a high intention to use technology may not actually adopt it to the level anticipated. This study measures *actual use* with 18 survey items: 5 - 19, 22, 26, and 31.

This study postulates that the benefit of educational technology is improved learning outcomes, and to accomplish this outcome, the educational technology must be adopted. To illustrate this connection, this study suggests an extension of Davis' TAM model to indicate a relationship between *Actual use* and Improved Learning Outcomes, as depicted in the proposed Educational Technology Acceptance Model (eTAM), (Figure 2).

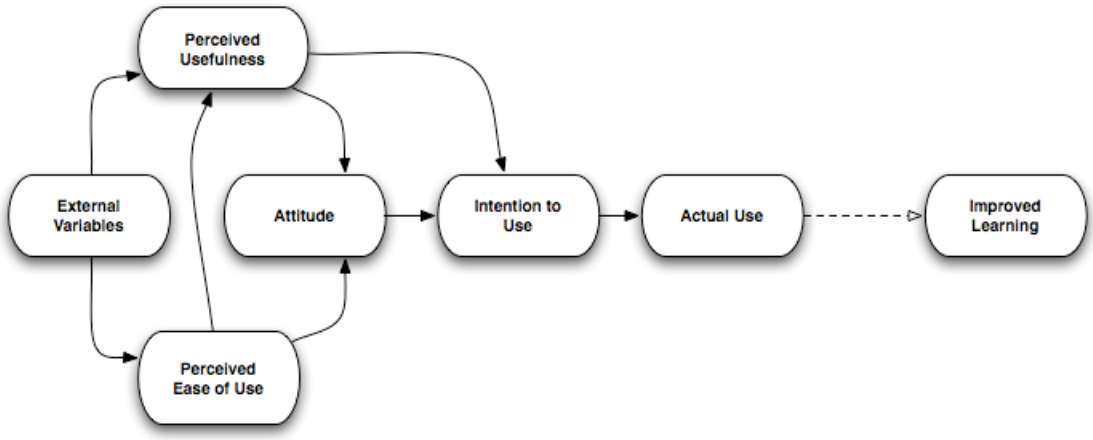

Figure 2. Educational Technology Acceptance Model (eTAM), proposed by Essex, adapted from Davis et al (1989).

Research Questions

The TAM variables measured in this study were *external variables*, *perceived usefulness*, *attitude*, and *actual use*. These variables were included in this study as they easily lend themselves to participant self-report. Whereas both perceived ease of use and intention to use can be difficult to differentiate from *perceived usefulness* and *actual use*, respectively, the included variables are more concrete. Likewise, regarding *external variables* and *attitude*, how a participant feels about an electronic device or the age of their equipment can be reported more directly. This study takes advantage of a modified version of the annual ECAR survey, which measures four of the six TAM variables. The goal of this inquiry is to understand how incoming dental students have used educational technology tools in their undergraduate education and what types of technology they expect to be integrated within their dental education. The information obtained was compared to the data previously collected by ECAR (2007) on U.S. undergraduate students. The question of whether or not past academic experiences with educational

technology influence student future expectations of technology in professional school is also of interest, and can directly inform institutional implementation decisions. These goals were used to generate the following research questions:

1. What is the *actual use* of educational technology by incoming dental students?
2. What is the *actual use* of general technology by incoming dental students?
3. What are incoming dental student expectations of educational technology within their dental program?
4. How do incoming dental students compare with undergraduates participating in the 2007 ECAR Technology survey in their *actual use* of personal and educational technology?

Significance of the Problem

The TAM was applied to the study of incoming dental students, their practices, and their perceptions regarding educational technology. In turn, it is possible to identify the extent of the utilization of technology and influences that make students use or not use, or expect different technologies than those currently employed in the dental curriculum. With this information, dental educators can choose to create and utilize educational technology that will better serve the intended goal of facilitating and improving student learning with the ultimate outcome of quality patient care.

Operational Definition of Terms

For the purposes of this proposed study the following definitions will be used:

Actual use – subject self-report of the frequency of use of a technology tool. This variable is measured with the following 18 survey items: 5 – 19, 22, 26, and 31.

Attitude – the personal opinion formed by a user regarding technology influenced by *external variables*, *perceived usefulness*, and perceived ease of use. The following nine survey items measure this variable: 21, 24, 27, 29, 30, 32, 33, 34, and 38.

Educational technology – software, hardware, and web-based applications used in the delivery or study of materials relevant to the dental curriculum. Examples include software such as PowerPoint used to give a case presentation; hardware such as a notebook computer employed to take notes; and BlackBoard, a web-based curriculum content delivery program used to post a presentation for later access and study.

Educational technology behaviors – activities a subject engages in during his or her studies involving technology tools. For example, editing an image file, or accessing a course web page are behaviors that may be reported by an incoming dental student. Eight survey items measure this variable: 5, 6, 8, 9, 13 - 18, 22, 26, 31, and 38.

External variables - includes hardware and user interface devices such as icons, menus, and input devices, as well as aspects of personal beliefs relative to technology. Five survey items measure this variable: 1 – 4, and 20.

Hardware – desktop computers, notebook computers, personal digital assistants, tablet PCs, MP3 players, smart phones, and other digital components used by students.

Personal technology – technology tools used for reasons other than academic, such as gaming devices.

Perceived ease of use – an individual's opinion of how easy to use and accessible a particular technology is or will be. Influenced by *external variables* such as user-interface devices or previous experiences.

Perceived usefulness – how helpful, or useful, the individual expects the technology to be. Two survey items measure this variable: 25 and 28

General technology behaviors – activities involving technology tools for reasons other than academic, either recreational or other. Examples include downloading a movie rental or managing personal finances with a software package. Three survey items measure this variable: 10 - 12.

Software – programming media specialized for use for various academic applications, includes such programs as Microsoft Word or KeyNote.

Technology tools – comprises individual components of educational technology, (hardware, software or web-based tools) used in the delivery or study of curricular content.

Technology expectation – attitude held by a student regarding the technology tools they feel will, or should be, employed in an academic situation. This variable is measured by survey item 23.

Web tools – web-based applications, such as browsers, and web sites, for example, The National Institute of Health, that are utilized or visited during the course of study by dental students.

Summary

Dental academics are increasing utilization of educational technology for many reasons. Both student expectation and shifting faculty populations create an environment filled with opportunities to implement technology that college students commonly use

and have come to expect within the dental curriculum. To date, there is little known about how incoming dental students use technology tools. It is essential to understand student perception and behavior to maximize the inclusion of technology designed to enhance learning within the dental curriculum toward the goal of improving student experience, learning outcomes, and ultimately patient care.

Chapter Two

Review of the Literature

Whether referred to as Digital Natives, Millennials, Y Generation, or Net-Gen, students born after 1985 are of great interest to educators as they begin their academic careers. These students have had unprecedented interactions with technology throughout their early academic experiences and are generally described as having both a seamless experience with technology and great expectations of technological integration in education. Gaining an understanding of how factual these descriptions are is of great interest to researchers in higher education. A useful way of viewing the relevant research is to consider how it contributes to understanding of students and their relationships with technology. There are five sections within this review of the literature: studies that contribute to the understanding of how undergraduate students interact with technology; studies that share information regarding allied health students and technology; studies that give light to methods of curriculum delivery and technology integration in dental education; literature that supports the TAM theoretical model; and a summary of the chapter.

Student use of technology.

The technological abilities and preferences of undergraduate students have been an active area of study for the past several years. Within this section, publications concerning student use of both general technology and educational technology will be discussed. An overview of included studies is outlined in Table 1.

Table 1

Overview of Studies Investigating Student use of Technology

Including Subjects, Sample Sizes, and Research Focus

Authors(s)	Published	Subjects	n	Location	Method	Focus
ECAR	2005	Undergraduates	332	Jordan	Survey	Technology use
Salaway, Katz, Caruso & Kvavik	2007	Undergraduates	27,864	U.S.	Survey/interview	Technology use/literacy
Kennedy, Judd, Gray & Krause	2008	Freshmen	2,000	Australia	Survey	Technology pref/use/access
Barnes, Marateo & Ferris	2007	Undergraduate	na	U.S.	Lit review	Technology use/net-gen
Houtz & Gupta	2001	High-school students	1,006	Nebraska	Survey	Technology literacy
Oblinger	2003	Undergraduates	na	U.S.	Lit review	Net-gen
Morss & Fleming	1998	Undergraduates	199	Nebraska	Survey	Response to online material
Frederico	2001	Naval postgraduates	234	U.S.	Survey	Response to online material
Beard, Harper & Riley	2004	Undergraduates		Florida	Survey	Response to online material

Of particular note is the work done by researchers associated with EDUCAUSE, a non-profit association of colleges, universities, and other educational organizations as well as corporations that serve education. Since 2004, ECAR, the EDUCAUSE Center for Applied Research, has undertaken an annual investigation into the technology utilization and literacy of undergraduate students in the United States (U.S.). Beginning with roughly 4,500 freshmen in 2004, the study has grown considerably. By 2007, it included data from over 27,000 students at 103 institutions of higher learning (ECAR, 2007) and included both quantitative survey data as well as qualitative student interview data. This growing databank is giving educators a clear look at the undergraduate student body in the U.S. and how they use the technology.

A 2007 investigation by ECAR (Salaway et al., 2007) provides a longitudinal view on undergraduate students in the U.S., being the fourth year the study has been conducted. Even without the ability to track change in technology trends, the annual study is a tremendously rich source of information on reports of student behavior. The enhanced analysis now available makes this growing body of research highly valuable to educators.

During the spring of 2007, undergraduate students at 103 EDUCAUSE member institutions of higher learning received invitations to participate and complete a web-based survey instrument. Following the collection of the survey data, 50 students from four Midwestern schools took part in one-hour focus groups held on their home campus. In all 27,846 students took part in the study with 4,752 responding to at least one open-ended question in addition to the multiple-choice questions. The large number of

respondents and the great degree of homogeneity seen in the responses across geographic regions underscores the importance of the information shared by the subjects.

Students participating in the study are highly comfortable with electronic communication. The number of students reporting the use of email was essentially 100% (Salaway et al., 2007). The use of Instant Messaging (IM) was also very high with 84% of students reporting its regular use. However, students were very clear in the qualitative interviews that there is desire to maintain a separation between personal communication means, such as IM, and more academic communications, which are strongly preferred by email (Salaway et al., 2007).

Undergraduates report being highly mobile, electronically well-equipped and showed a tremendous preference for portable devices such as notebook computers, wireless Internet connections, and smart phone technology. All of these technologies appear to be on the rise. Since 2007, notebook computer ownership has grown 23%; reports of wireless connectivity has risen 12%; and the student use of smart phones has increased 9% (Salaway et al., 2007). Overall student ownership of electronic devices is also increasing, with 55% reporting ownership of four or more devices (Salaway et al., 2007). In 2005, only 37% of respondents reported owning a portable digital music device, such as an iPod. By 2007, the percentage had risen to 74% (Salaway et al., 2007).

How do students use all of this technology? Most are spending a good deal of time on the Internet. On average, students reported 18 hours a week online, with just under 7% reporting spending 40 hours or more online (Salaway et al., 2007). Academically, 94% of students report accessing institutional resources, 91% are creating

electronic presentations, 83% are making spreadsheets, and 83% report using their course management system (Salaway et al., 2007). Technology is also a preferred means of recreation for contemporary students. While more prevalent with younger students, downloading music and video files was reported by 78% of respondents, as was computer or video gaming, and 81% report regularly logging-on to a social networking site such as Facebook.

It is very important to note however, that even with the high levels of technology these students rely upon every day, they do not want an education devoid of human contact or "extensively" comprised by technology (Salaway et al., 2006). Over 59% of responding students report that they prefer "moderate" technology use in their courses, and students participating in focus groups confirmed this by stating that interaction with other students and faculty face-to-face is of high value to their education (Salaway et al., 2006). These points are of great importance, and should provide reassurance to faculty who fear being replaced by technology.

The ECAR reports, especially the latest work from Salaway et al., provide a good road map for further research. Most recently researchers in Australia have sought to replicate aspects of previous ECAR studies. In fall of 2006 at the University of Melbourne, 2,120 incoming students completed a four-page questionnaire inquiring about access to technology, use of technology tools and the educational use of technology (Kennedy, Judd, Gray, & Krause, 2008). Many of the key findings were similar to those in the ECAR reports.

Preference for high-speed Internet connections was reported to be high, with all but 14% reporting unrestricted access to connections at broadband speeds (G. Kennedy et

al., 2008). Likewise, high percentages of students reported using digital means of communication on a daily basis. The students in the Australian study reported that all but 0.6% had unrestricted access to either a desktop or notebook computer and 70.5% reported access to both (G. Kennedy et al., 2008).

Data involving time spent on a computer indicate that students spend their time word processing, creating electronic presentations and spreadsheets, in addition to use for recreational purposes. A full 93% of responding students reported using the computer for study purposes (G. Kennedy et al., 2008).

In addition to adding to the body of evidence developing from the work done by ECAR, the study conducted by Kennedy et al. also identified what appear to be areas of new growth in technology use for undergraduate students. Blogging in particular was reported by almost 35% of the subjects, with an additional 58% indicating that they regularly read blogs (G. Kennedy et al., 2008). However, use of RSS feeds (really simple syndication – feeds that automatically update users of changes or additions to a web page) and contributions to wiki sites (web-based collaboration sites that allow contribution and editing by users) is reported by a smaller number, with just under a 25% indicating use of either type of technology (G. Kennedy et al., 2008).

The comparisons of data between the studies conducted by Salaway et al. and Kennedy et al. exhibit many areas of commonality. Access to computers and high-speed Internet connections are reported at very high levels. Time spent using technology for academics were reported in the same categories and at similar rates of utilization. Integration of technology into student life is reported similarly despite the geographic, and potential cultural differences between American and Australian students.

Barnes, Marateo and Ferris (2007) conducted a literature review regarding perceived differences in millennial students. Within this work were representations of the stereotypical millennial student – namely a multi-tasker connected wirelessly who values community service and collaborative learning, and who has spent more time looking at some type of monitor than a book (Barnes et al., 2007). A lack of patience has also been noted. Student needs for interactivity and instant gratification were specifically reported traits that are potentially of interest and concern to educators. A different expectation of education held by millennial students is anecdotally discussed a great deal in academia. Works cited by Barnes et al. (2007) supported the assertions that methods of curriculum delivery and engaging students used previously did not have the same success with students entering higher education today.

This may be due to the fact that students have access to more technology earlier than ever before. Houtz and Gupta (2001) conducted a survey of 1,006 Nebraskan high-school students to determine the extent of technology utilization and found nearly as many respondents reported comfort with both PC and Mac operating systems, 41%, as reported being comfortable on a PC only, males 46%, and females 47%. It was noted that this occurred despite the fact that 10% or less reported having access to both computing platforms at school (Houtz & Gupta, 2001). When asked how the students spent their time when using a computer, the greatest number reported using a word processor followed by conducting Internet searches and playing games (Houtz & Gupta, 2001).

Oblinger (2003) conducted a review of the literature as a means of introducing the millennial student to higher-education faculty. Recurring themes consisted of a preference for group activities, a trusting relationship with older generations, and an

ethnically diverse experience and outlook. A large number of students considered technology to be essential for education and communication. A majority of students have used email for both personal and school communication.

In general, undergraduate student responses to educational technology are favorable. Morss and Fleming (1998) conducted two studies at Creighton to assess student reactions to the use of Web CT as a web-based support for a group of 20 courses offered during the 1997-98 academic year. Data from students reported strong support for continued integration of technology in their education (Morss & Fleming, 1998). Eighty-four percent of respondents advocated the continuation of Web CT support for courses, and 75% further suggested that it be expanded to other courses (Morss & Fleming, 1998). Quite interestingly, 92% of participants indicated that they believed experience with computer technology such as Web CT to be important educational experiences (Morss & Fleming, 1998), and specifically that it added value to their education.

Frederico (2001) studied Naval postgraduate students for their *attitude* regarding the inclusion of network or web-based, education. The students responded with high expectations of educational technology. Students indicated that they expected network supported courses to be "educationally rich", and in general reported a highly positive *attitude* (Frederico, 2001). Specifically, respondents reported expectations of network-based learning to support graphics, illustrations and other media that they believed add a great deal to their education (Frederico, 2001). The provision of individual feedback and the general ease of personal communication were also reported as recognized benefits of such instruction and were positively received by responding students (Frederico, 2001).

Students enrolled in a teacher training program in the Southern U.S. were surveyed after completion of two courses that were adapted from traditional in-person class formats to web-supported courses with optional attendance (Beard et al., 2004). Student satisfaction reports were very high for both courses. In particular, students responded that they appreciated the ability to work at their own speed, and the flexibility the optional attendance allowed them (Beard et al., 2004). However, written comments were strongly in support of the value added when learning took place in-person within groups (Beard et al., 2004). Students also reported that they felt they had learned as much with the online course format as they would have had the course been entirely traditionally taught (Beard et al., 2004).

Health sciences student use of technology.

There is not a large volume of literature available concerning dental student utilization of technology. It may be useful to view data from studies of medical students, and other health professionals relating to technology literacy when considering how dental students may compare to the behaviors of undergraduate students. An overview of the literature is provided in Table 2.

Table 2.

Overview of Studies Investigating Allied Health Student use of Technology

Including Subjects, Sample Sizes, and Research Focus

Author(s)	Published	Subjects	n	Location	Method	Focus
Rajab & Baqain	2005	Dental students	332	Jordan	Survey	Technology use
Link & Marz	2004	Medical students	1232	Austria	Survey	Technology literacy
Mangold	2007	Nursing students	na	U.S.	Lit review	Net-gen students
Walmsley, White, Eynon & Somerfield	2003	Dental students	145	U.K.	Survey	Technology use
Grimes	2002	Dental hygiene & assisting students	13	Vermont	Interview	Response to online course
Boberick	2004	1st yr dental students	123	Philadelphia	Survey	Response to online material
Gupta, White & Walmsley	2004	3rd yr dental students	65	U.K.	Survey	Response to e-learning
McLean & Murrell	2002	Medical students	200	South Africa	Survey	Curriculum delivery
Link & Marz	2004	Medical students	1232	Austria	Survey	Technology literacy
Mangold	2007	Nursing students	na	U.S.	Lit Review	Net-gen students
Massiello, Ramberg & Lonk	2005	1st yr Medical students	54	Sweden	Survey	Response to online material

Jordanian dental students from the second-through fifth-year of dental school participated in a survey intended to assess skill and utilization of information technology (Rajab & Baqain, 2005). The survey response rate was 81% (n = 332) with nearly 74% reporting access to a computer at home in addition to the those available on campus (Rajab & Baqain, 2005). Ninety percent of respondents reported using email, but overall more males than females reported high levels of confidence using the computer in general (Rajab & Baqain, 2005). Even so, 95% of all participating students reported a desire to access to course materials via the Internet, with only 11% indicating that such access might negatively influence class attendance (Rajab & Baqain, 2005).

In 2006, Link and Marz surveyed first-year medical students in Austria to determine levels of computer literacy and access. Ninety-four percent of respondents indicated that they had access to a personally owned computer, with only 5% relying on computer labs (Link & Marz, 2006). Also similar to the undergraduate students, 97% reported using Internet searches relating to their studies (Link & Marz, 2006).

A recent literature review conducted by Mangold (2007) provided a synthesis of the literature concerning millennial undergraduate students in nursing education. The students coming into health-science programs bring with them different expectations. Student perception of technology was that it was an essential part of the environment rather than an accessory, as many faculty members may perceive it to be (Mangold, 2007). This group of students demonstrated collaborative and interactive learning, and was more process-oriented than outcomes-oriented (Mangold, 2007). All of the points addressed toward nursing education in the paper echoed issues Oblinger et al (2003) have

shared regarding undergraduate education – that students used technology to great degrees and have expectations of the integration of technology in their nursing education.

Dental academics are engaging in what could be termed "learning by doing" (Kassebaum et al., 2004). While the move to innovation with technology progresses, the need for student input is clearer. What do incoming dental students expect regarding the integration of technology in their curriculum? How can dental educators best support the educational technology needs of the current study body? How can dental academia make the best use of technology to maximize student learning and quality patient care?

Walmsley, White, Eynon and Somerfield conducted a study of dental student use of the Internet with students from all 3 years of the clinical program in Birmingham, U.K. (2003). The inquiry assessed both student and faculty use of the Internet and student response to web-support in one course in their curriculum (Walmsley, White, Eynon, & Somerfield, 2003). Students were found to access the Internet for pleasure more frequently than for dental information, which was in complete contrast to the self-reports of the twenty-two faculty members studied who used the web almost exclusively for professional-related inquiry (Walmsley et al., 2003) highlighting the generational differences inherent in the relationship with technology. Students reported use of the Internet for dental topics about once a month, whereas faculty most frequently reported using the Internet for dental topics once a day (Walmsley et al., 2003). When asked about the use of the web to support courses, 79% of students were enthusiastic about having access to course lectures and other material, however 45% of the faculty in the study reported hesitancy when asked about allowing such material to be posted on the Internet (Walmsley et al., 2003). Further, when asked about the potential for a decrease

in course attendance, 74% of students reported that access to course materials would not affect their attendance, whereas 91% of faculty believed such access would influence a decline in attendance (Walmsley et al., 2003).

A small qualitative study conducted with thirteen dental hygiene and dental assisting students enrolled in hybrid, both online and in-person, dental terminology course showed positive student attitudes, especially relating to convenient access to course materials (Grimes, 2002). While other aspects of the online course were cited as beneficial, such as the ability to work at an individual pace, the overall convenience of web-access was emphasized among the study participants (Grimes, 2002). There were some negative aspects reported, particularly technical issues such as slow downloading of course files, however most respondents indicated that these problems were greatly minimized by the use of a pre-course web-orientation that was offered (Grimes, 2002).

Across these studies, students indicate that the convenience of having access to curricular materials via the web or other means was a greatly desired, even expected aspect of education (Eynon et al., 2003; Hendricson et al., 2006; G. Kennedy et al., 2008; MacPherson & Brueckner, 2003; Rajab & Baqain, 2005; Salaway et al., 2007). Dental students have also cited other benefits to the integration of technology into their curriculum, such as interactivity, ease of communication and provision of feedback.

First-year dental students have been assessed for their reactions to an interactive instructional manual used in a restorative techniques course (Boberick, 2004). Within the web-based manual were links to video segments detailing specific techniques that allowed the students to view material outside of class (Boberick, 2004). The support for the online manual was strong (Boberick, 2004). Of particular note, 73% of the

responding students indicated that the provided video was an acceptable replacement to live demonstrations of techniques taking place in the laboratory (Boberick, 2004). The ability for almost three quarters of the class to obtain demonstration instruction on their own could be significant when faculty numbers are few. This aspect of technology, the efficiency of instruction, in addition to the student benefits, may be an important bridging measure as dental academia continues to face a lack of faculty.

Web-based interactivity with instructional material or dental techniques also appealed to third-year dental students in the United Kingdom (Eynon et al., 2003; Gupta, White, & Walmsley, 2004). Students were positive, with 79% expressing support for continuing the site as a resource to the curriculum (Gupta et al., 2004). The ability to access additional material including clinical animations, course notes and self-assessment tools were cited as specific benefits of the supplementation of the course with technology (Gupta et al., 2004).

Roughly 200 South African medical students have been surveyed to understand their use of Web CT in training (McLean & Murrell, 2002). The study had a weaker response rate of just below 48%. However, the responding students shared the same opinions found in the literature. Of particular note are the passionate statements of support for course material access (McLean & Murrell, 2002). The enhanced access to information was cited as being especially useful when students were out of their normal learning environment such as when they participated in community events (McLean & Murrell, 2002).

In Sweden, 54 first-year medical students elected to participate in an observational study of the integration of a web-based support platform for a microbiology

course (Masiello, Ramberg, & Lonka, 2005). Results of the investigation indicated that use of the web platform did not tax the technology skills of the students. Following the course only 28% of participating students indicated an increase in familiarity with electronic communication and other aspects of the web platform, indicating that the majority of technology skills needed to access the course platform were previously learned by the majority of the students (Masiello et al., 2005). While the pre-course survey indicated that students anticipated convenience to be the best aspect of the web platform, they also indicated that learning via the web might be a way to more actively participate in their education compared to traditional lectures. Difficulty with the specific software program were cited as negative aspects about the web platform following the course (Masiello et al., 2005). Specifically, participants harshly criticized features of the user interface of the program that hosted the course. The inability to change the size of the text window was found annoying, as was the lack of an equivalent to a browser back button when navigating within course material (Masiello et al., 2005). The authors indicated that there were significant technical difficulties experienced. This type of disconnect highlights the necessity of gaining student input to technology tools educators intend to integrate and supporting tools appropriately, as well as illustrates the influence of *external variables*, as defined in the TAM. Despite the difficulties the majority of participants recognized the benefit of web-based course support as a supplement to in-person courses activities (Masiello et al., 2005).

Technology learning outcomes in the health sciences.

The efficacy of educational technology is a point of tremendous interest in recent research. Health-science researchers have investigated the comparison of student performance in courses with a traditional lecture format to courses utilizing differing degrees of technology to evaluate student performance. The impact of technology on other outcomes aside from course performance, such as the impact on information seeking behaviors is also an area investigative inquiry. An overview of studies of technology learning outcomes in the health sciences is presented in Table 3.

Table 3.

Overview of Studies Examining Technology Learning Outcomes in the Health Sciences

Including Subjects, Sample Sizes, and Research Focus

Author(s)	Published	Subjects	n	Location	Method	Focus
McFarlin	2008	Phys students	658	Houston	Course data	Comparison of traditional and hybrid course
Goldberg, McKhann	2000	Neuroscience students	40	Baltimore	Quasi-exp	Comparison of virtual and traditional learning environments
Kerfoot, Conlin et al.	2007	Med students & residents	640	Boston	Ran ctrl trail	Web course learning outcomes
Kerfoot, Baker, Jackson et al.	2006	Med students	210	U.S.	Ran ctrl trial	Web course learning outcomes
Farrell and Rose	2008	BSN students	76	Australia	Quasi-exp	PDAs in clinical nursing education
White, Allen et al.	2005	BSN students	na	Duram	Descriptive	PDAs in clinical nursing education
Miller, Shaw-Kokot et al.	2005	BSN students	82	Portland	Quasi-exp	PDA influence on information seeking
Wilkes & Howell	2006	Med students	na	Davis	Descriptive	ePortfolios

Health-science student learning can be positively impacted by the inclusion of technology in education. In 2008, McFarlin shared results of a large study on the impact of a hybrid course format on physiology student final course grades. Students enrolled in the hybrid version of the course received the same lecture information as the traditional course in the form of narrated PowerPoint files, and could review material at their convenience. Final course grades for 658 students, 346 enrolled in a traditional format, and 312 enrolled in a hybrid format, found that the hybrid students earned final grades nearly 10% higher, with 83% of the difference attributed to higher exam scores (McFarlin, 2008). While the researcher acknowledges that the time necessary to create the narrated lectures for the hybrid course was extensive, the increase in students achievement and the ability to use class time to better advantage was seen as worthwhile (McFarlin, 2008).

Goldberg and McKhann expressed a similar opinion resulting from their study comparing a traditional method of teaching neuroscience with a virtual learning environment (VLE) presentation of the same course. In the VLE course, the lectures were provided ahead of the class meeting in a narrated format given by the same faculty member who gave the traditional lecture to the students not enrolled in the VLE (Goldberg & McKhann, 2000). The authors expressed the position that utilizing technology in this way allowed for a redefinition of the role of the educator. Specifically, the VLE format allowed for class time to be spent on the more challenging aspects of the material rather than on the transmission of introductory material (Goldberg & McKhann, 2000). In addition, the students in the VLE course earned final grades five points above those earned by students in the traditional course, and 70% of them expressed a positive opinion of the course format (Goldberg & McKhann, 2000).

Medical students have also been shown to benefit, as measured by course scores, from the inclusion of technology in their education. In a randomized, controlled, crossover study 640 medical students and residents showed significant learning when given course material via a web-delivered module (Kerfoot, Conlin, Travison, & McMahon, 2007). Students were randomly assigned to one of two groups and given the same pretest, midtest, and posttest. All students showed similar pretest scores and all students demonstrated statistically significant learning on posttests (Kerfoot et al., 2007). Additionally, participants indicated that they found the web-based modules to be an acceptable and appropriate means of learning (Kerfoot et al., 2007).

Previously, Kerfoot led a similar investigation into the efficacy, durability, and efficiency of web-based learning modules in medical education involving four medical schools and 210 students. The results of this multi-center, randomized, controlled study showed statistically significant learning, p .001, resulting from the completion of self-paced web-modules given to students during their urology rotation (Kerfoot et al., 2006). One of the four study sites performed an efficiency study in addition, as the structure of the rotation at that site allowed for each student to serve as their own control during the one-week rotation, and found that the use of the web-based modules in addition to the structured clinical rotation resulted in a three-fold increase in learning efficiency (Kerfoot et al., 2006). The durability of the learning measure was also favorable. Fifty-one of the study participants volunteered to take the posttest measure a second time 4.8 months after the conclusion of the urology rotation. Results for participants who had received the web-based modules in conjunction with the clinical rotation were found to have meaningfully higher scores on this repeated measure with a Cohen's d of .55, representing a

medium effect size (Kerfoot et al., 2006). This study confirms that there is an advantage to supporting health-science student learning with technology.

Nursing educators are also interested in the potential benefits of incorporating technology in health-science education. Most recently, Farrell and Rose (2008) extended the study of technology on course outcomes by investigating the influence of the use of personal digital assistants (PDAs) during the clinical rotations of 76 nursing students. Pretest scores of the students in the study group that were given the PDAs for use during their clinical rotations were comparable with those of the students in the control (Farrell & Rose, 2008). Assessments completed at the end of the term found that students who had used the PDAs scored double their mean course score over the students who did not have access to the PDAs (Farrell & Rose, 2008). Students with access to the PDAs reported consulting them up to 15 times during a clinical rotation (Farrell & Rose, 2008). Further, the researchers conducted follow-up interviews with the students in the study who shared that they felt there were many applications for the PDAs other than those used in the study, leading the authors to predict that the PDA will "become as essential as the stethoscope" in the future of clinical practice (Farrell & Rose, 2008).

PDA technology has also been investigated as a means of increasing the utility and accuracy of narrative course outcomes. At Duke University researchers have described the integration of PDA technology into their nursing program. In this implementation students are required to complete daily assessments of their clinical rotations on their PDA and beam them to attending faculty at the end of the rotation (White et al., 2005). This collection of student performance data in real-time allows for the timely assessment of student needs and progress as well as providing accurate and necessary faculty feedback as required (White et al., 2005). Not

only does this use of technology provide richer narratives of student ability, it also models the daily use of technology, a skill associated with increased efficiency and patient safety (White et al., 2005).

Final course performance is one measure of learning outcomes, but it is not the only area of interest or importance to health educators. Successful practice requires the development of life-long learning behaviors, and the ability to seek information and evaluate the credibility of the resource. Several nurse educators and researchers have investigated how handheld computing technology can influence the development of these essential behaviors.

Miller et al. (Miller et al., 2005) investigated the impact of PDA technology on the information seeking behaviors of nursing students. Students in the group that integrated PDAs into their training program (n=38) reported valuing the credibility of a resource over the convenience (Miller et al., 2005), demonstrating an appreciation for the need to evaluate the quality of information. In comparison to 39% of the control students, 59% of PDA students reported a reduced reliance on seeking faculty input to answer questions (Miller et al., 2005), demonstrating a greater confidence in their own ability to seek answers to clinical questions.

The ability to stimulate self-reflection is also important to health educators. Wilkes & Howell studied the use of technology as a means of prompting and evaluating medical student self-reflection using e-portfolios in 2006. The researchers describe the ability to self-assess as essential to the quality of practice (Wilkes & Howell, 2006). By requiring on-going student reflection, evidence can be collected of student abilities to identify individual learning needs and develop plans to address those needs (Wilkes & Howell, 2006). Using the ability of technology

to increase transparency of the learning process allows for more specific faculty input and support of students in a more timely fashion than ever before (Wilkes & Howell, 2006).

The impact of technology on health-science education goes beyond course grades. Technology can be employed to provide timely feedback, to promote self-reflection, access current resources, and promote the development of self-regulated information seeking in health-science students. When considering the demonstrated student preference for, and increased learning efficiency with technology tools, it is easy to understand the movement of professional programs to develop and implement technology within health-science curricula.

Dental curriculum delivery.

Gaining an understanding of the technology used by students is important given the tremendous growth and innovation in education, including health-science education. Curriculum delivery in dental education is innovating specifically by the incorporation of greater degrees of technology. The information is limited but relatively recent. An overview of studies investigating technology use in dental curricula is presented in Table 4.

Table 4.

Overview of Studies Investigating Dental Curriculum Delivery and Technology Integration

Including Subjects, Sample Sizes, and Research Focus

Author(s)	Published	Subjects	n	Location	Method	Focus
Hendricson et al.	2004	Dental schools	66	North America	Survey	Technology implementation
Kassebaum, Hendricson, Taft & Haden	2004	Dental schools	48	North America	Survey	Planned curricular innovations
Wrzosek, Warner, Donoff, Howell & Karimbux	2003	Dental schools	55	U.S.	Survey	Technology management
Haden, Weaver, & Valachovic	2002	Dental schools	54	U.S.	Survey	Unfilled faculty positions

During the academic year of 2002-03 a questionnaire entitled the "Electronic Curriculum Implementation Survey" was distributed to administrators in all 66 U.S. and Canadian dental schools (Hendricson et al., 2004); 100% of schools responded. Among the technology implementations investigated was the use of a computer requirement for incoming dental students. Twenty-one percent of the schools reported either requiring students to meet established computing guidelines, or had school-based leasing programs that provided notebook computers configured to specifications (Hendricson et al., 2004). Examples of established guidelines included minimal acceptable data processor speeds, hard-drive capacity and wireless connectivity specifications. The use of these guidelines was intended to ensure compatibility with campus technology systems as well as to allow students sufficient computing capacity and power to manage the technology incorporated into the four years of their dental training. The number of schools reporting that they were considering instituting computing requirements was 64% (Hendricson et al., 2004). Such a large segment of the dental education community considering equipping their student body with specific computing capacity is a clear indication of the intention to incorporate technology into dental education.

However, it was also important to note that schools that have led this charge have experienced difficulty with smooth implementations. Hendricson et al. (2004) reported that when asked about barriers to implementation of technology, all of the responses involved faculty adoption. Whether it was lack of time or knowledge necessary to develop material for new methods of delivery, or lack of interest in changing current methods, the majority of dental faculty had not joined the movement to technological innovation of the dental curriculum (Hendricson et al., 2004).

Regardless, the movement to incorporate technology has gained momentum. In 2004, a study investigating plans for curricular innovation within North American dental schools was conducted showing that the most frequently planned curricular innovation was to increase the use of technology-supported education, either via computer or the Web (Kassebaum et al., 2004).

This commitment to technology was also found in another survey of dental schools specifically investigating models of technology implementation. Eighty-three percent of dental schools responded to an electronic survey from Harvard School of Dental Medicine (Wrzosek, Warner, Donoff, Howell, & Karimbux, 2003). Seventy-two percent reported using some type of instructional technology within their curriculum. The implementation of various technologies was split almost evenly between schools that reported implementation throughout the curriculum and those reporting technology implemented on a course-by-course basis (Wrzosek et al., 2003). Whether using curriculum-based DVDs, or a course management system such as BlackBoard, dental schools were seen to be making greater strides to incorporate technologies into the curriculum.

The need to continue to innovate in the area of technology integration has been highlighted by Haden, Weaver and Valachovic (2002). At the time of the survey, there were fifty-four dental schools and 100% responded (Haden, Weaver, & Valachovic, 2002). This survey was designed to assess the number of faculty throughout the schools, specifically the number of unfilled positions. In 2002, the number of unfilled dental faculty positions was reported to be 344, a mean of 6 for every dental school. One in four responding schools reported 10 or more open faculty appointments (Haden et al.,

2002). Further, 29% of these unfilled positions had been so for over a year (Haden et al., 2002). When considering upcoming faculty retirements, and the impact they might have on the existing shortage of faculty, it is apparent that dental academia is facing teaching a new generation of learners with fewer educators. In this situation, investigation into economies of instruction becomes of great importance to academic dentistry. If students utilize electronic media to prepare and make better use of class time, and use new strategies to do things like minimize the need for lengthy in-class demonstrations (Boberick, 2004), faculty can focus on activities that require their expertise and limited time.

Technology acceptance model.

The Technology Acceptance Model (TAM), presented in Figure 3, proposes five variables that influence user adoption of technology: *external variables* such as aspects of a technology's user interface, subject perceptions of usefulness of the technology, subject perceptions of ease of use, personal attitudes relating to the technology, personal intentions to use the technology and *actual use* (Davis et al., 1989) This study focuses on four aspects of the TAM: *external variables*, *perceived usefulness*, *attitude* and *actual use*.

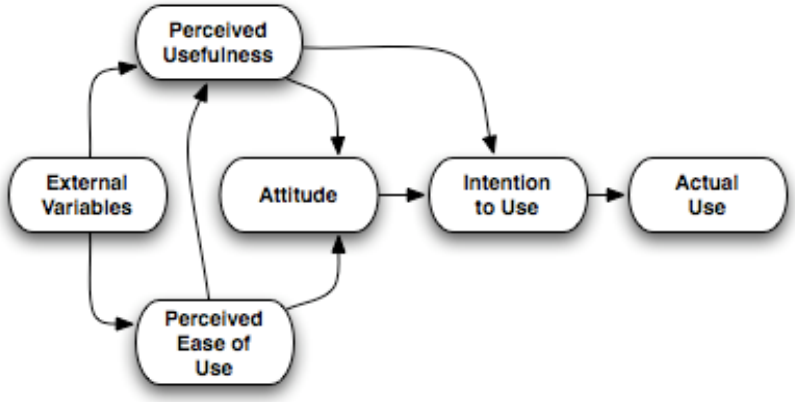

Figure 3. Technology Acceptance Model (TAM), adapted from Davis et al (1989).

The TAM is a well-established means of assessing *perceived usefulness* and ease of use as these perceptions relate to adoption of technology. TAM has been compared by Davis et al. (1989) to its parent theory, the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975) and tests of reliability, validity and discrimination were conducted. As recently as 2007, investigators have found the TAM to be a valid instrument when applied to educational settings (Saadé, Nebebe, & Tan, 2007). An overview of the literature reviewed relating to the TAM is provided in Table 5.

Table 5.

Overview of Studies Utilizing the Technology Acceptance Model (TAM)

Including Subjects, Sample Sizes, and Research Focus

Authors(s)	Published	Subjects	n	Location	Method	TA M variables measured	Focus
Davis, Bagozzi, & Warshaw	1989	MBA students	107	Michigan	Survey	Perceived usefulness, ease of use, intention to use, attitude	Prediction of user acceptance of technology/Comparison of the TAM to the Theory of Reasoned Action
Adams, Nelson & Peter	1992	Technology users in private industry	118/73	North America	Survey	Perceived usefulness, ease of use, actual use	Validation of TAM
Hendrickson, Massey & Cronan	1993	Undergraduates	51/72	Midwest	Survey	Perceived usefulness, ease of use	Test-retest reliability of TAM
Szajna	1994	MBA students	47	Texas	Survey	Perceived usefulness, ease of use	Predictive validity of TAM
McDonald, McPhail, Maguire & Millett	2004	Law students	na	Australia	Case study	Perceived usefulness, ease of use, intention to use, attitude	Student acceptance of curriculum CD
Saade, Nebebe, & Tan	2007	Undergraduates	362	Canada	Survey	Perceived usefulness, ease of use, intention to use, attitude	Extension of TAM to multimedia /e-learning

The first replications of studies on the model were done in 1992 (Adams, Nelson, & Peter, 1992). Using the TAM to assess user responses to voice mail and e-mail, Adams et al. measured *perceived usefulness* and *perceived ease of use* and found instrument validity to be high, as was discriminate validity (Adams et al., 1992). Reliability was also high with Cronbach's alpha reported above .90 for usefulness and above .80 for ease of use for both voice mail and email (Adams et al., 1992). The second study conducted in the investigation assessed user responses to three popular software programs and yielded similar results; TAM was shown to be reliable at the .88 to .94 level (Adams et al., 1992). This study measured two of the six TAM variables.

In 1993, Hendrickson, Massey and Cronan examined *perceived usefulness* and *perceived ease of use* in regards to the test-retest reliability of the TAM with undergraduate students. Two student samples were studied: one using a spreadsheet program, n = 51, and another using database management software, n = 71 (Hendrickson, Massey, & Cronan, 1993). Both groups were given a Likert-like response survey instrument based on the TAM twice, with a three-day interval between administrations (Hendrickson et al., 1993). Again, the model was found to be reliable with Cronbach's alpha coefficients between .89 and .96 (Hendrickson et al., 1993). This study measured two of the six TAM variables.

Szajna (1994) also studied *perceived usefulness* and *perceived ease of us*e and further tested the TAM model with 47 MBA students. Subjects evaluated six database management programs and demonstrated one of the six to the class (Szajna, 1994). Even with potential for bias due to familiarity with the programs, the Cronbach's alpha

coefficients were found to be .95 for both ease of use and usefulness (Szajna, 1994). This study measured two of the six TAM variables.

McDonald, McPhail, Maguire and Millett (2004) used the TAM, and measured *perceived ease of use* and *perceived usefulness.* McDonald et al (2004) focused on the responses from law students receiving CD-based course materials instead of more traditional print materials. Eighty percent of the students participating and 100% of the faculty involved with the test course supported the continued inclusion of the technology. This study measured two of the six TAM variables.

Saade, Nebebe & Tan (2007) studied validity of the TAM as applied to multimedia learning systems (MLS) in a study with 362 Canadian undergraduate students. A five-response, Likert-like scale was used to assess the *perceived usefulness* and *ease of use* of the MLS as well as student *attitude* regarding the MLS (Saadé et al., 2007). A positive strong relationship was reported between *perceived usefulness* and *perceived ease of use* as well as between *perceived usefulness* and student *attitude* (Saadé et al., 2007). In particular, *perceived usefulness* was shown to be very influential on student *attitude* regarding the MLS (Saadé et al., 2007). Overall, this most recent investigation utilizing the TAM continues to build on the consistent reliability and validity data for the model. This study measured three of the six TAM variables.

While there are several published studies utilizing TAM, the application of TAM to dental students had not yet been done. Within the dental school environment time is always in short supply. In order to assure compliance with the population of incoming dental students at the schools agreeing to participate, it was necessary to ensure that the data collection be concise. Each of the previous studies used quite lengthy instruments

that were unacceptable to administrators at the studied schools. To correct for this, a survey instrument assessing educational and general technology use was adapted based upon the electronic survey utilized in the 2007 ECAR study conducted by Salaway et al. The adaptations were made to allow for efficient collection of data restricted to technology with academic applications. By using the ECAR assessment tool the ability to compare reported undergraduate data with that obtained from the entering dental students in the current study was also possible.

Summary

The evidence that is available to date, suggests that students are enthusiastic about efforts made by educators to include technology in their education. There are barriers, such as a need for faculty development, but these challenges would be inherent with any innovation. The evidence to date establishes educational technology as an efficacious method of teaching that can have positive impacts on student learning, efficiency, and retention. The collective community of dental academia appears to be following the trends seen in undergraduate institutions and working to integrate more technology into teaching. College students appear to display the connectivity and affinity for technology they are purported to possess, and efforts made to adapt curricular material to digital formats have been met with predominately positive responses and calls for more. The theoretical model proposed for this study is a well-studied model that has been shown repeatedly to be a valid and reliable model possessing a high degree of both discriminate and convergent validity.

Significant learning outcomes have been found with the web-delivery of content for medical students and residents (Kerfoot et al., 2007). There is reason to believe the

same may be true for dental students. Nursing education researchers have found particular technology devices efficacious for nursing students (Farrell & Rose, 2008). Such a specific technological implementation may also be advantageous to dental students. In addition, faculty have concerns about changes to traditional curriculum delivery (Walmsley et al., 2003) that may be assuaged with more evidence. Finally, the TAM has been used successfully to evaluate technology use behaviors, *attitude*s, and perceptions in other educational situations (McDonald et al., 2004; Saadé et al., 2007), but the application to dental academics has not yet been done.

This study seeks to gain a baseline understanding of dental student educational technology use behaviors, preferences, and expectations, as well as a view of entering dental students in comparison to undergraduate students. Results of the investigation can be used to guide curriculum development and delivery, and can begin to fill the current void in understanding of dental student educational technology use, toward the outcome of improved student learning and patient care.

Chapter Three

Methods

This descriptive study used the results of an electronically delivered survey instrument hosted on Survey Monkey to gain an understanding of incoming dental student technology use and expectations. Incoming dental students scheduled to matriculate into three participating dental schools in either summer or fall of 2008 were asked to participate in the study. Each entering student was invited to respond to the survey regarding technology tools they own and/or use; frequency of use of various technologies; their perceptions of the usefulness of the educational technology tools used in their undergraduate college courses; and their expectations regarding the inclusion of technology in their dental education.

Operational Definition of Terms

For the purposes of this proposed study the following definitions will be used:

Actual use – subject self-report of the frequency of use of a technology tool. This variable is measured with the following 18 survey items: 5 – 19, 22, 26, and 31. (n=18.)

Attitude – the personal opinion formed by a user regarding technology influenced by *external variables*, *perceived usefulness*, and perceived ease of use. The following nine survey items measure this variable: 21, 24, 27, 29, 30, 32, 33, 34, and 38. (n=9.)

Educational technology – software, hardware, and web-based applications used in the delivery or study of materials relevant to the dental curriculum. Examples include software such as PowerPoint used to give a case presentation; hardware such as a notebook computer employed to take notes; and BlackBoard, a web-based curriculum content delivery program used to post a presentation for later access and study.

Educational technology behaviors – activities a subject engages in during his or her studies involving technology tools. For example, editing an image file, or accessing a course web page are behaviors that may be reported by an incoming dental student. Eight survey items measure this variable: 5, 6, 8, 9, 13 - 18, 22, 26, 31, and 38. (n=14.)

External variables - includes hardware devices and user interface devices such as icons, menus, and input devices, as well as aspects of personal beliefs relative to technology. Five survey items measure this variable: 1 – 4, and 20. (n=5)

Hardware – desktop computers, notebook computers, personal digital assistants, tablet PCs, MP3 players, smart phones and other digital components used by students.

Personal technology – technology tools used for reasons other than academic, such as gaming devices.

Perceived ease of use – an individual's opinion of how easy to use and accessible a particular technology is or will be. Influenced by *external variables* such as user-interface devices or previous experiences.

Perceived usefulness – how helpful, or useful, the individual expects the technology to be. Two survey items measure this variable: 25 and 28. (n=2.)

General technology behaviors – activities involving technology tools for reasons other than academic, either recreational or other. Examples include downloading a movie rental or managing personal finances with a software package. Three survey items measure this variable: 10 - 12.

Software – programming media specialized for use for various academic applications, includes such programs as Microsoft Word or KeyNote.

Technology tools – comprises individual components of educational technology, (hardware, software or web-based tools) used in the delivery or study of curricular content.

Technology expectation – *attitude* held by a student regarding the technology tools they feel will, or should be, employed in an academic situation. This variable is measured by survey item 23.

Web tools – web-based applications, such as browsers, and web sites, for example The National Institute of Health, that are utilized or visited during the course of study by dental students.

Research Questions

The survey instrument focuses the inquiry on four of the six TAM variables as applied to a variety of technology tools and behaviors. As explained in the theoretical rationale, two of the six variables were not suited to this particular study because the chosen survey instrument did not measure them. The importance of having the ability to compare the entering dental students to the ECAR undergraduates was prioritized over measuring all six of the TAM variables. Previous studies that have utilized the TAM model have also limited the focus to a subset of variables within the overall model, as illustrated in the literature review. The four TAM variables measured in this study are *external variables*, *perceived usefulness*, *attitude*, and *actual use*. The goals of this inquiry include understanding how incoming dental students have used educational technology tools in their undergraduate education; comparing the reported use of technology to data previously collected on U.S. undergraduate students; and discovering

the level of technology expectations these students hold for their dental school education. These goals were used to generate the following research questions:

1. What is the *actual use* of educational technology by incoming dental students?
2. What is the *actual use* of general technology by incoming dental students?
3. What are incoming dental student expectations of educational technology within their dental program?
4. How do incoming dental students compare with undergraduates participating in the 2007 ECAR Technology survey in their *actual use* of personal and educational technology?

Research Design

This study is descriptive and utilizes student self-reports of technology behaviors, preferences, and expectations. To gain insight into entering dental student perceptions and behaviors relating to their use of educational technology tools, the study included students who were expected to matriculate to one of three U.S. dental programs, two in Northern California, and one in New York. Each incoming dental student at the three schools had an opportunity to participate in an electronic survey distributed by email.

The initial electronic assessment was designed to capture quantitative data using Likert-like response scales. Areas of quantitative inquiry include electronic devices owned and used by the subjects (*external variables*), perceptions of usefulness, *attitude*, as well as *actual use* behaviors relative to personal and educational technology tools.

By asking students about their undergraduate usage of technology, it is possible to form an understanding of the homogeneity between the undergraduates previously

studied by ECAR and matriculating dental students examined in this study. Inquiring about the degree of expectation the incoming dental students may have for technology in their professional education, in combination with examining past academic experiences with technology, provides dental educators with an opportunity to understand the study habits and abilities of dental students. This understanding can provide a road map of potentially efficacious technology teaching methods, and move dental education further toward the goals of meeting student learning needs.

The decision was made to use an adaptation of the ECAR survey as much of the instrument addresses factors that influence *actual use*, and doing so allows for the rich comparison of the subjects of the proposed study to the large databank of responses from the ECAR study. Guided by the TAM, the adapted survey instrument examines four of the variables that have been identified as valid influences on the adoption of technology that were measurable given the study design, as well as gathers basic subject demographic information. All survey items retained from the original ECAR instrument for which results were available, were used for comparison. The remainder of the research questions are addressed by the survey items as outlined in Table 6. The survey items addressing demographics, (35, 36, 37), and one new item addressing *external variables* (3) are not represented in the table.

Table 6.

Technology Survey Items Categorized by Research Question

	Educational use	General use	Expectation of use	Comparison to undergraduates
Survey item	5, 6, 8, 9,13 - 18, 21, 22, 26, 31, 38	10 - 12	23	1, 2, 4, 6, 9 - 18, 20 – 22, 24 – 34

Participants

All students matriculating to two Northern California and one New York dental program in the summer and fall of 2008 were asked to participate in the study. Agreements were made between administrators at each school and the researcher to allow for the link to the online survey to be distributed to the first-year classes at each school via email. At one of the sites in Northern California, students were reminded to complete the survey, if they wished to participate, with a follow-up email sent a week after the initial invitation to participate. One Northern California school did not require follow-up because it had already achieved 100% participation, in part due to the distribution of the email invitation during the initial technology set-up meeting with new students. All three participating programs grant the Doctor of Dental Surgery degree.

Protection of Human Subjects

To ensure the safety and ethical treatment of the research subjects, the study has received necessary human subjects approval from all three participating dental program

home universities. The University of San Francisco Internal Review Board granted final approval. Informed consent was obtained before the collection of data.

To meet the criteria necessary for informed consent, the survey was distributed with a cover page (Appendix A), explaining the voluntary nature of the research and the elements necessary for the protection of human subjects allowing participants to give proper consent.

Instrumentation

The survey instrument that has been developed for the study is an adaptation of the 2007 version of the electronic survey used by ECAR (Appendix B), the research arm of EDUCAUSE, for the annual technology survey of undergraduates in the U.S. that they have conducted since 2004 with as many as 27,000 research subjects. As the annual ECAR undergraduate inquiry is descriptive, no psychometrics were completed. The majority of the changes made to the instrument were to limit the length of the survey by eliminating items that were not pertaining to educational uses of technology. These edits were made after consultation with three recognized educational technology experts. Each of the three content experts has received recognition at the University of San Francisco for their innovative use of technology in their courses. The consultants were asked to review the entire ECAR survey instrument, which contains 89 items, and rank the applicability of each item to the focus of the proposed investigation. Items that were considered to be extremely pertinent were ranked "1", and items considered to be somewhat related were ranked "2." The consultants were asked to eliminate items not considered related to education. To create the current survey, the researcher consolidated the rankings of the three consultants. Any item receiving a "1" from all three of the

consultants was included, as was any item that received a "1" from two consultants and a "2" from the third. Items that were eliminated by any one of the consultants were not included in the adapted instrument (Appendix C). This selection process identified 36 of the original 89 ECAR survey items to be included in this study.

One other alteration to the original ECAR survey instrument was the change of the grammar-tense of the survey item inquiring about specific technology used in a course. This study was planned for students who may have be on academic break at the time of the data collection, so the words "during your most recent quarter or semester" were added for clarity.

Two additional items were included in the instrument. In addition to inquiring about the age of the subject's computer and whether it is a desktop or laptop, an item asking the type of computer operating system used most often was included. This item was seen as essential to gaining a view of the possible importance of operating system on the influence of technology behavior. The second addition to the instrument examines expectations students may hold for the inclusion of specific technologies in their dental education. Using the same item stem as the original question inquiring on specific technologies participants have used in previous courses, the new item asks about future expectations for use of each technology. This item allows for examination of the influence on previous use on expectation for future use. The distribution of survey items to TAM variables studied are presented in Table 7.

Table 7.

Technology Survey Items Categorized by TAM Variable

	External Variables	Perceived Usefulness	Attitude	Actual Use
Survey Item	1 – 4, 20	28, 25	21, 24, 27, 29, 30, 32 – 34, 38	5 – 19, 22, 26, 31

Efforts have been made to maintain the overall structure of the survey instrument as it was used in the ECAR study. To achieve this goal, the survey instrument contains a variety of question formats including multiple choice, pull-down menu options, and question stems with multiple response items. The final survey instrument contains 38 items, several of which contain multiple response items.

Procedures

After obtaining Institutional Review Board (IRB) approval from the researcher's home institution, filing a letter of permission from the Dean of School A and a Cooperative Agreement with IRB of Schools B and C, data at each site was collected. An invitation to participate in the research study was emailed to each incoming dental student, containing a web-link to the survey, hosted by Survey Monkey.

Pilot

The survey instrument underwent pilot testing during May 2008. Graduate students in a School of Education and School of Nursing located in Northern California were asked to complete the survey instrument to determine the length of administration and check for instrument clarity. A total of 33 subjects participated in the pilot. Aside

from minor typographical errors, which were subsequently corrected, there were no areas of the survey instrument identified as problematic.

Data Analysis

Quantitative data analysis was conducted primarily with Excel, with one question being evaluated with SPSS. Descriptive statistics for each of the items was calculated for the sample of dental students and compared against a national sample of undergraduates. The statistical measure that allows for comparison of the reported percentages of actual and expected technology use is an effect size measure developed by Jacob Cohen (Cohen, 1988) known as *Cohen's h*. *Cohen's h* provides a descriptive measure of the differences between two proportions. The *Cohen's h* measurement uses the difference between arcsin transformed proportions to give results in terms of an effect-size measurement. Cohen provided general guidelines for interpretation of the magnitude of a *Cohen's h* measure. Results between .2 and .49 are considered small effect sizes, results between .5 and .79 are considered medium effect sizes, and results of .8 and above are considered to be a large effect sizes. A descriptive analysis was done to examine personal technology use and educational technology use of the dental students, as well as their reported expectations of future use of educational technology during their time in dental school. Effect size measurement was conducted to compare the entering dental students' responses to those of the participants in the 2007 ECAR Technology Survey (Salaway et al., 2007).

Summary

A descriptive study was conducted to gain knowledge relating to the educational technology use of incoming dental students during their undergraduate education, as well

as their expectations for technology during dental school. Self-reported frequency of use data was collected to gain an understanding of the technology use by the incoming class of two Northern California and one New York dental programs. Student perceptions of the usefulness of educational technology and expectations for the implementation of educational technology in dental education were examined. Comparisons between entering dental student data and that from undergraduates were also explored.

Chapter Four

Results

Results pertaining to the use of both educational and general technology, expectations of technology in dental school, as well as comparisons between participating entering dental students and undergraduate students participating in the 2007 ECAR Technology Survey Data (Salaway et al., 2007) are presented. Data for each research question is considered individually, with survey items grouped by TAM variable where possible, for ease of evaluation.

Each table of data will be preceded by a short introduction associated with the specific table, and each will present data beginning with the highest frequency of report in descending order, where practical. Explanatory text with highlighted findings follows each table. All reported percentages have been rounded up when they were reported to be .5 or higher, occasionally resulting in total percentages of 99 or 101. Research questions are presented in order, following a description of the sample demographics. Detailed data tables are located in appendices associated with each research question.

Demographics

A total of 271 freshmen dental students are included in the study. These students were just entering, or had been attending dental school for less than one quarter at the time during which they participated in the online survey. Respondents ranged in age from 20 to 40 years old. Data on participant reports of age are presented in Table 8.

Table 8.

Age Ranges Reported by Participating

Entering Dental Students

Age	Count	Percentage
20	10	4%
21	21	9%
22	43	17%
23 - 25	99	40%
26 - 30	50	20%
31 - 35	20	8%
36 - 40	4	2%
Total	247	

Gender reports from participants illustrate a sample that is roughly even. Gender data of the participants are provided in Table 9.

Table 9.

Gender Reported by Participating Entering Dental Students

Gender	Count	Percentage
Male	128	51%
Female	121	49%
Total	249	

Three U.S. dental programs are represented in the sample. Freshman dental students from two programs from Northern California and one from New York

participated in the study. Enrollment data for participating entering dental students are displayed in Table 10.

Table 10.

Dental School Enrollment and Percentage of Student Participation by Entering Dental Students at Participating Programs

Dental Program	Study invitations sent	Percentage of students responding	Total study response percentage n =271
A	157	100%	
B	88	76%	
C	250	18%	
Total	495		56%

A majority of respondents, 58%, reported attendance at the School A, located in Northern California. The next largest group reported enrollment School B, also in Northern California comprising 25% of the sample. School C, located in New York, accounted for 17% of participants.

While this was a descriptive study, it is helpful to provide a general academic picture of the admitted dental students. The average pre-dental GPA of the dental class admitted nationally in 2004-05 was 3.47 overall, with a science average of 3.40 (ADA, 2006). Eighty-four percent of the admitted students held bachelor's degrees, and 5% held master's degrees (ADA, 2006) with fewer than 10% entering dental school having met

admissions requirements without having earned a degree. The gender balance swings slightly from year to year, but the 2004-05 class was 57.7% men and 43.8% women. Due to the research design of this study, among and between groups differences are irrelevant, the participants are treated as part of the one group, entering dental students.

Research Question One

Research question one, "What is the *actual use* of educational technology by incoming dental students?" includes data from the following 15 of 36 survey items: questions 5, 6, 8, 9, 13– 18, 22, 21, 26, and 31. Survey items measuring this question relate to the TAM variables *attitude* and *actual use*. Student reported *attitudes* toward educational technology are presented within the first variable

Attitude toward educational technology.

Students were asked to share their *attitudes* regarding the extent of intructional technology (IT) they preferred to have in their courses. Respondents were free to choose one answer from a Likert-like range from exclusive IT to no IT. Specific data regarding the preference for information technology in courses are presented in Table 11.

Table 11.

Preferences for Information Technology Use in Courses

Reported by Entering Dental Students

Response	Count	Percentage
Moderate IT	130	49%
Extensive IT	99	38%
Limited IT	25	10%
Exclusive IT	6	2%
No IT	3	1%
Total	263	

When asked how much information technology the student prefers within their courses, 89% reported that they preferred moderate levels or more. A majority of these respondents, 49% report a preference for moderate use of information technology in their courses. The next larger group, 38%, reports a preference for extensive information technology in courses. The number of students preferring limited information technology in courses was found to be 10%, and 1% reporting a preference for no information technology in courses. It is important to acknowledge the subjective nature of the use of the terms “exclusive,” “extensive,” “moderate,” and “limited.” The survey instrument did not explicitly describe how a subject should interpret each choice, for example by giving a range of hours of IT use in a course for each descriptor. The definition of each category was left entirely to the subject’s personal interpretation. There may be some added variability in subject responses due to a lack of a common definition.

Actual use of educational technology.

The *actual use* of educational technology was measured with survey items requesting frequency of use reports from participants relating to various types of technology use behaviors. For example, how often a student uses an electronic device to complete coursework was presented to participants, with possible responses ranging from several times a day to never. All of the items in Table 12 were items for which the subject responded to a scale which included the following options: "never, " "once a year," "once a semester/quarter," "monthly," "weekly," "several times a week," "once a day," and "several times a day." For comparison purposes across different questions, response options have been collapsed into "weekly or more," "less than weekly, but more than once a year," and "never." Table 12 reports on the percentage of people who responded engaging in each specific behavior once a week or more.

Table 12.

Technology Behaviors Entering Dental Students Reported Using Weekly or More

Technology Behavior	Percentage	Total Responding
Use of an electronic device for course work	86%	264
Access to university email	84%	261
Access to a course management system	63%	262
Taking a Laptop to class	61%	242
Access to library electronically	40%	267
Creation of spreadsheets	34%	266
Creation of digital presentations	20%	266
Creation of graphics	16%	266
Creation of Audio/Video	3%	264
Creation of Web pages	3%	264

A majority, 86%, of entering dental students reported using an electronic device for coursework weekly or more often, leaving 14% that reported this behavior less than once a week. University email access is another frequently reported behavior, 84% report checking their university email account at least once a week. Sixty-three percent of respondents reported access to a course management system (CMS) at least weekly, just slightly more than the 61% who reported taking their laptops to class at least once a week. The remainder of the technology behaviors investigated were reported once a week or more by less than the majority of respondents.

Actual use of technology in courses.

Students were asked to specify technologies that had been used within their courses, as opposed to those used for personal or occupational reasons, during the most recent pre-dental semester or quarter. An overall view of the technology used within courses during the most recent pre-dental semester or quarter by entering dental students is presented in Table 13.

Table 13.

Technology Responding Entering Dental Students Report Using in Courses at Least Once During the Most Recent Semester or Quarter

Technology	Percentage	Total Responding
Email	95%	255
Presentations	87%	252
Course website	78%	250
Course management system	76%	254
Spreadsheets	70%	250
Podcasts	35%	255
Social networks	27%	254
Instant messaging	19%	255
Graphics	18%	254
Webcasts	17%	254
Discipline-specific	14%	253
Blogging	13%	252
Audio/visual	12%	253
Eportfolio	7%	253
Programming languages	6%	254

Ninety-five percent of respondents report using email within their most recent pre-dental courses. The majority of respondents reportedly used presentations,

spreadsheets, course management systems, and course websites in the most recent pre-dental semester or quarter. Less commonly reported technology within courses include in descending order: podcasting; social networks; instant messaging; graphics creation; webcasts; discipline-specific software; blogging; audio/visual creation; e-portfolio use; and programming languages.

Summary

Research question one examined various aspects of academic technology use. The responses to this question were broken down into the following categories: *attitude* toward educational technology; *actual use* of educational technology; and *actual use* of technology in courses during the most recent pre-dental semester or quarter.

Entering dental students were found to most often express preference for moderate use of IT in courses. Use of electronic device for coursework and university email access are reported weekly or more by a majority of respondents. Technology reported by a majority as used in courses during the most recent pre-dental semester or quarter include: email, presentations, course website, course management system, and spreadsheets.

The data illustrates that entering dental students are using technology in their courses, and provides educators with a student perspective on the use of various technologies during undergraduate education. This is useful information for dental educators as it gives a means of understanding how students have used technology during their studies before entering dental school. This knowledge can inform dental faculty of the abilities and previous academic technology habits of dental students.

Research Question Two

The second research question, "What is the *actual use* of general technology by incoming dental students?" examines items relating to technology not directly associated with education. This research question relates to the TAM variables *actual use* and *external variables*, and is measured by four of the 36 survey items: 4, 10, 1l, and 12. As with question one, this question included survey items with several similar themes, in this case, *actual use* of general technology, and *external variables* - electronic devices. The first topic presented is the *actual use* of general technology.

Actual use of general technology.

To determine how often a student reports checking his or her general email account subjects responded to a scale which included the following options: "never, " "once a year," "once a semester/quarter," "monthly," "weekly," "several times a week," "once a day," and "several times a day." For comparison purposes across different questions, response options were collapsed into "weekly or more," "less than weekly, but more than once a year," and "never." Responses are reported for those who responded to performing the behavior once a week or more. An overview of personal technology use behaviors reported by study participants weekly or more is provided in Table 14.

Table 14.

Personal Technology Use Behaviors Reported Being Used Once a Week or More by Responding Entering Dental Students

Technology Use	Percentage	Total Responding
Access to general email	99%	265
Social networking	83%	265
Blogging	17%	265

A majority, 99%, of students report of checking general email account once a week or more. Social network participation is reported at least once a week by 83% of respondents. Blogging is less frequently reported, with 17% indicating they blog once a week or more.

As a point of comparison, Figure 4 below illustrates the difference subjects report in the frequency of checking their general versus university email accounts. The time period reported was once a week or more. There may be some question as to whether or not subjects were able to discriminate between personal and university accounts when answering survey items regarding email accounts. The data suggests that students were able to make the distinction between the two types of accounts, as there is a 15% difference reported.

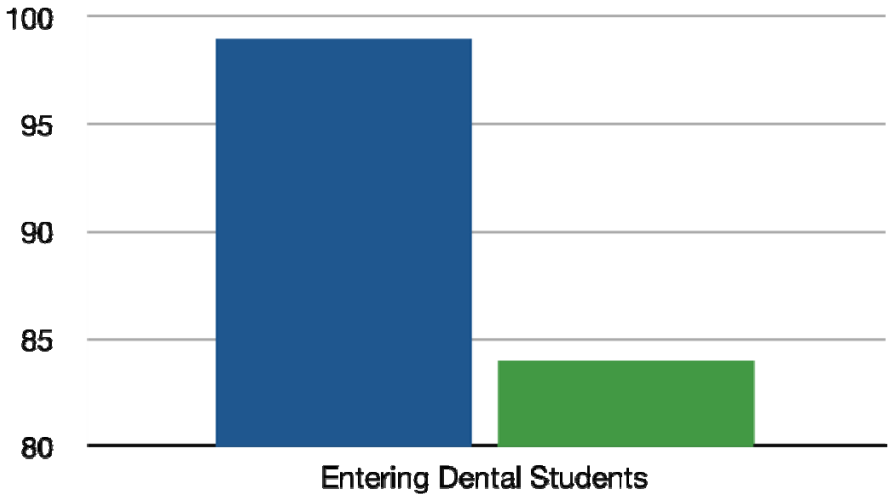

Figure 4: Comparison of reported rates of access to email accounts

External variables - electronic devices.

The TAM describes *external variables* as aspects of hardware or software that influence a subject's *attitude* as well as their perception of the usefulness of the technology. In this study, the experience students have with various categories of hardware, and the quality of their Internet connection, are examples of *external variables* that have the potential to influence subjects in their acceptance to new technology.

An overview of electronic device ownership reported by study participants is provided in Table 15, which is followed by more detailed presentations of the data.

Table 15.

Overview of Electronic Devices Owned by Responding Entering Dental Students

Electronic Device Owned	Percentage	Total Responding
MP3 player	82%	264
Simple cell phone	77%	264
Gaming device	38%	257
Smart phone	32%	257
PDA	18%	247

A majority, 82%, of respondents indicates they own an MP3 player. A simple cell phone is the next most frequently reported electronic device, with 77% of respondents indicating they ownership. Gaming devices and smart phones are owned less frequently, 38%, and 32% respectively. Personal digital assistants (PDA) are owned by 18% of respondents.

Summary

Entering dental students reported on their use and ownership of various technologies not associated with education in response to research question two. The categories of items associated with the non-academic use of technology *actual use* of general technology and *external variables* - electronic devices.

Students overwhelmingly report checking their personal email account at least once a week, with a response of 99%. Social networking is reported by 83%. MP3 players are owned by 82% of participants, and more have simple cell phone than do gaming devices, smart phones or PDA devices.

Participating entering dental students report high levels of general technology use in their personal lives. Not only do entering dental students use academic technology, they also frequently use technology outside of school. These students are accustomed to technology as a part of their daily lives; furthering the understanding of the relationship entering dental students have with technology overall.

Research Question Three

Research question three, "What are incoming dental student expectations of educational technology within their dental program?" investigates the educational technology expectations the entering dental student participants are bringing with them to dental school, and is measured by one of the 36 survey items.

Student expectation of technology in dental school.

Research question three asked participants to view the same list of technologies they had seen when asked about technology use in the most recent pre-dental semester or quarter and indicate whether or not they expected to use the technology while in dental school. An ancillary analysis that gives more meaning to the data on the expectation of technology within dental school is a comparison for effect size to the reported *actual use* of technology in the most recent pre-dental semester or quarter presented in research question one.

The statistical analysis that allows for comparison of the reported percentages of actual and expected technology use is an effect size measure developed by Jacob Cohen (Cohen, 1988) known as *Cohen's h*. *Cohen's h* describes differences between two proportions in terms of an effect-size measurement. These resulting effect-sizes can be

interpreted using Cohen's suggested general guidelines. Guidelines for interpretation of *Cohen's* h suggest that differences of .20 or more represent a small effect size measurement; .50 is associated with a medium effect size; and results of .80 or more are considered large effect sizes. In this report, small effect sizes will be denoted within tables with as "*", medium effect sizes with as "**", and large effects sizes with as "***."

An overall view of the expected technologies compared to technology used in the most recent pre-dental semester or quarter is presented with effect size measures in Table 16.

Table 16.

Expected Use of Technology in Dental School Compared to Technology Used in Most Recent Pre-dental Semester or Quarter Reported by Entering Dental Students

Technology	Used in undergrad	Expect in dental school	*Cohen's h*
Webcasting	17%	57%	.86***
Graphics	19%	54%	.75**
Social Networks	27%	62%	.72**
Eportfolio	7%	33%	.69**
Podcasting	35%	66%	.63**
Blogging	14%	41%	.62**
Instant messaging	19%	47%	.61**
Audio/visual	12%	37%	.60**
Discipline-specific	14%	40%	.60**
Programming language	6%	19%	.41*
Spreadsheets	70%	83%	.31*
Course website	78%	88%	.27*
Presentations	87%	92%	.16
Course management system	76%	82%	.15
Email	95%	95%	0

* Indicates a small effect size

** Indicates a medium effect size

*** Indicates a large effect size

A large majority, 95%, of respondents indicated they expect email in their courses in dental school. Ninety-two percent indicate they expect to use presentations in courses in dental school. Course management systems and course websites were reported as expectations of 88% of respondents. Spreadsheet use was reported as expected by 83% of participants. Podcasting was an expectation of the majority, 66%, as was social networking, 62%. Webcasts are a reported expectation of 57% of respondents. Fifty-four percent expected to use graphics in courses in dental school. Fewer than the majority of respondents expected the remaining technologies: instant messaging, discipline-specific technology, blogging, audio/visual software, e-portfolios, and programming languages.

Effect size differences were found between the *actual use* of technology during the most recent pre-dental semester or quarter and the reported expectations for use in dental school for 13 of the 15 technology variables. In each case, entering dental students reported that they expected to use the particular technology more in dental school than they reported having used it in their most recent pre-dental courses. A large effect size was found between the *actual use* and expected use of webcasting (*Cohen's h = .86*). Medium effect size measurements were associated with the following technologies: graphics software (*Cohen's h = .75*), social networks (*Cohen's h = .72*), eportfolios (*Cohen's h = .69*), podcasting (*Cohen's h = .63*), blogging (*Cohen's h = .62*), instant messaging (*Cohen's h = .61*), audio/visual software (*Cohen's h = .60*), and discipline-specific software (*Cohen's h = .60*). Small effect size measurements were found for programming languages (*Cohen's h = .41*), spreadsheet software (*Cohen's h = .31*), and course websites (*Cohen's h = .27*).

Summary

Research question three examined expectations held by entering dental students regarding the use of specific technologies while attending dental school. Participants were given the same list of technologies they had previously evaluated for use in the most recent pre-dental semester or quarter and asked if they expected that technology in dental school.

Technology expected by 50% or more respondents included: email, presentation software, course management systems, course websites, spreadsheet software, podcasting, social networking, webcasting, and graphics software. Fewer than 50% of responding entering dental school expected the remainder of the technologies.

Examination of the difference between the reports of *actual use* presented in research question one, with the report of the expectation of the technology in dental school show that in all but three instances the entering dental students report the expectation of greater use of technology in dental school than they report using in their most recent pre-dental courses.

Entering dental students expect far greater levels of technology use during dental school than they previously experienced as undergraduates. This is of great importance to academic dentistry because it can assist dental educators and administrators as they seek to implement new technology-mediated curricula. The data from this study supports the further inclusion of technology in the dental curriculum.

Research Question Four

The fourth research question, "How do incoming dental students compare with undergraduates in their utilization of general and educational technology?" examines the similarities and differences between the participating entering dental students and the undergraduate students who participated in the 2007 ECAR technology survey (Salaway et al., 2007).

The survey items used for comparison comprise all items that were available in the data provided by ECAR that were also selected for inclusion in the abbreviated survey instrument created for this study. There are 28 of the 36 survey items used for comparison including questions: 1, 2, 4, 6, 8 - 18, 20 – 22, and 24 – 34. These items span all four evaluated TAM variables: *external variables*, *attitude*, *perceived usefulness*, and *actual use*.

Statistical analysis for research question four compares the percentages of the ECAR undergraduates to the entering dental students using *Cohen's h*. The comparison analysis for this question is presented in the following themes: *external variables*: equipment and devices students use and own; student *attitude* regarding IT in courses; *actual use* of technology by students; *perceived usefulness*: student reports on IT in courses; and areas of homogeneity between the entering dental students and the undergraduates.

External variables: equipment and devices students use and own.

External variables in this study include aspects of user-interfaces, and hardware and software. *External variables* have influence over a subject's *attitude* and perception of usefulness of technology. In this section, electronic devices ownership, which can

exert influence on their perception of future technologies are compared between entering dental students and undergraduate students.

Undergraduate students and entering dental students report owning electronic devices at different rates. Specific data on device ownership are presented in Table 17.

Table 17.

Electronic Device Ownership Reported: Effect Size Measurement Comparison of 2007 ECAR Undergraduate Study Participants and Entering Dental Students

Electronic device	Undergraduates	Dental Students	*Cohen's h*
Smart phone	12%	32%	.50**
Laptop	74%	91%	.46*
Gaming device	56%	38%	.36*
Simple cell phone	86%	77%	.23*
PDA	12%	18%	.17
MP3 player	76%	82%	.15

* Indicates a small effect size

** Indicates a medium effect size

More entering dental students than undergraduate students report smart phone ownership, yielding a small effect size measurement. Laptop ownership is another measure of difference found between undergraduate students and entering dental students. With a small effect size, more dental students than undergraduate students reported they own a laptop. In contrast, more undergraduate students than entering dental students report owning a gaming device, again with a small effect size. While primarily entering dental students own smart phones, simple cell phone ownership is reported by

more undergraduate students. Rates of ownership of PDA devices and MP3 players were not found to be appreciably different.

There were many differences found between undergraduate students, entering dental students, and their reported method of access to the Internet. Specific data on Internet connections reported by students are presented in Table 18.

Table 18.

Method of Internet Access Reported: Effect Size Measurement Comparing Between 2007 ECAR Undergraduate Study Participants and Entering Dental Students

Method of Access	Undergraduates	Dental Students	Cohen's h
Commercial broadband	37%	36%	.02
University broadband	32%	13%	.46*
Commercial wireless	10%	19%	.26*
University wireless	12%	29%	.43*
Commercial dial-up	3%	1%	.15
University dial-up	6%	2%	.21*
No access	10%	0	.64**

* Indicates a small effect size

**Indicates a medium effect size

A medium effect size (*Cohen's h .64*) was found between the number of undergraduate students and entering dental students reporting that they had no Internet access. All participating dental students indicated some method of access to the Internet. While undergraduate students reported higher use of university broadband connections

(*Cohen's h = .46*), entering dental students reported more use of university wireless connections (*Cohen's h = .43*) and commercial wireless connections (*Cohen's h = .26*). More undergraduate students report the use of a university dial-up connection (*Cohen's h = .21*) than dental students. Commercial dial-up and commercial broadband connections were not reported in appreciably different rates.

Actual use of technology by students.

When asked about specific technologies used during their most recent semester or quarter, there were differences found between the undergraduate students and the entering dental students. Specific data are presented in Table 19.

Table 19.

Technologies Used in the Most Recent Semester or Quarter: Effect Size Measurement Comparison of 2007 ECAR Undergraduate Study Participants and Entering Dental Students

Technology	Undergraduates	Dental Students	*Cohen's h*
Podcasting	5%	35%	.82***
Webcasting	4%	17%	.45*
Presentation	69%	87%	.44*
Spreadsheet	49%	70%	.43*
Course website	61%	78%	.37*
Audio/visual	6%	12%	.21*
Graphics	12%	19%	.19
Programming language	11%	6%	.18
Blogging	9%	14%	.16
Instant messaging	14%	19%	.14
Social networking	21%	27%	.14
Discipline-specific	19%	14%	.14
Email	96%	95%	.05
Course management system	77%	76%	.02
ePortfolio	7%	7%	.00

* Indicates a small effect size

*** Indicates a large effect size

A large effect size (*Cohen's h = .82*) was found between reports of the use of podcasting, with more entering dental students reporting its use in the most recent

semester or quarter. Medium effect size measurements were found for reports of the use of webcasting (*Cohen's h = .45*), presentation software (*Cohen's h = .44*), spreadsheet software (*Cohen's h = .43*), course web site use (*Cohen's h = .37*), as well as the use of audio/visual software (*Cohen's h = .21*) with each being reported more frequently by the entering dental students. On the remaining technologies there were no meaningful differences found.

The reported frequency of bringing a laptop to class was another area of technology use behavior that was found to contain differences between the two groups of students. As with previous items, subjects responded to a scale which included the following options: "never, " "one a year," "once a semester/quarter," "monthly," "weekly," "several times a week," "once a day," and "several times a day." For comparison purposes across different questions, response options have been collapsed into "weekly or more," "less than weekly, but more than once a year," and "never." Data on frequency of bringing a laptop to class are presented in Table 20.

Table 20.

Frequency of Bringing a Laptop to Class Reported: Effect Size Measurement

Comparison of 2007 ECAR Undergraduate Study

Participants and Entering Dental Students

Frequency	Undergraduates	Dental Students	*Cohen's h*
Weekly or more	19%	62%	.91***
Once/yr to once/month	17%	13%	.11
Never	64%	26%	.78**

*** Indicates a medium effect size

** Indicates a large effect size

More undergraduates than entering dental students reported that they never bring a laptop to class. This difference was found to be a medium effect size with a *Cohen's h* of .78. Taking a closer look at the data by looking at daily and weekly reports from subjects, the group of students reporting that they do bring a laptop to class on a daily basis was found to be the dental students with a Cohen's h of .69, also a medium effect size measurement. The dental students were also more likely to report bringing their laptops to class several times a week (*Cohen's h = .40*), a small effect size. Frequencies of weekly, monthly, once a year, and once a semester/quarter were reported at relatively the same rate by both groups of students.

Student attitude regarding IT in courses.

This section presents responses from survey items asking participants to share their *attitudes* regarding IT in their courses; their opinion of any learning benefits they associate with IT; as well as for opinions regarding the benefits, if any, of IT in courses.

A majority of responses to the inquiry of how much IT students prefer in their courses were found to represent insignificant differences between the undergraduate students and the entering dental students. Table 21 presents data on IT preferences.

Table 21.

Reported IT Preferences in Courses: Effect Size Measurement Comparison of 2007 ECAR Undergraduate Study Participants and Entering Dental Students

IT Preference	Undergraduates	Dental Students	*Cohen's h*
Exclusive IT	3%	2%	.06
Extensive IT	20%	38%	.40*
Moderate IT	59%	49%	.20*
Limited IT	15%	10%	.15
No IT	2%	1%	.08

* Indicates a small effect size

More entering dental students reported that they preferred extensive IT in their courses with a small effect size (*Cohen's h = .40*)

Table 22 presents the specific data reported when students were asked for their level of agreement with the statement " IT has improved my learning."

Table 22.

Levels of Agreement that IT has Improved Learning Reported: Effect Size Measurement Comparison of 2007 ECAR Undergraduate Study Participants and Entering Dental Students

Response	Undergraduates	Dental Students	*Cohen's h*
Strongly agree	10%	17%	.21*
Agree	50%	55%	.10
Neutral	30%	22%	.18
Disagree	6%	2%	.21*
Strongly disagree	4%	4%	.00

* Indicates a small effect size

More dental students than undergraduate students reported that they strongly agreed (*Cohen's h = .21*) that IT has improved their learning. Undergraduate students reported more frequency that they disagreed that IT had improved their learning (*Cohen's h = .21*). Response rates were found to be similar for other levels of agreement.

Students reported different benefits of IT use in courses as well. Table 23 presents data on IT use benefits.

Table 23.

Reported Benefits of IT Use in Courses: Effect Size Measurement Comparison of 2007 ECAR Undergraduate Study Participants and Entering Dental Students

Benefit of IT	Undergraduates	Dental Students	*Cohen's h*
Convenience	56%	34%	.45*
Communication	11%	21%	.28*
Improved learning	10%	19%	.26*
Manage activities	20%	24%	.10
No benefits	3%	1%	.15
Other benefits	1%	1%	.00

* Indicates a small effect size

While undergraduate students more frequently reported convenience as a benefit (*Cohen's h = .45*), entering dental students more frequently reported communication (*Cohen's h = .28*) and improved learning (*Cohen's h = .26*) as benefits. Effect size differences were not found in reports of other benefits of IT use.

Participants were given the option to add open commentary regarding other benefits they perceived associated with the use technology in courses with this survey item. Six of the entering dental students, representing 2% of total participants, offered additional comments. The comments were primarily reiterations of the provided categories and fell into four themes: time management (2), convenience (2), learning benefits (1), and other (1). An example of a student comment pertaining to convenience follows, "Helps to have all my notes on the computer in one place, and there are less

books to carry around-plus, you can type faster than you can write so I could take better notes."

Perceived usefulness: Student reports on IT in courses.

Students were asked to report their opinions regarding the *perceived usefulness* of several aspects of educational technology as well as common features of course management systems. The relevant survey items provide a Likert-like range of responses that included "extremely useful," "very useful," "useful," "somewhat useful," "not useful," and "did not use." "Extremely useful," "very useful" and "useful" have been combined in the following analysis and termed "useful +." The responses "somewhat useful," "not useful," and "did not use" are presented separately. The first item considered is how useful students find online quizzes and exams for grading purposes. Table 24 contains data regarding online graded quizzes and exams.

Table 24.

Reported Usefulness of Online Quizzes/Exams for Grading Purposes: Effect Size Measurement Comparison of 2007 ECAR Undergraduate Study Participants and Entering Dental Students

Response	Undergraduates	Dental Students	*Cohen's h*
Useful +	65%	58%	.14
Somewhat useful	8%	16%	.25*
Not useful	6%	26%	.58**
Did not use	21%	11%	.28*

* Indicates a small effect size

** Indicates a medium effect size

Entering dental students found online exams and quizzes used for grading purposes less useful (*Cohen's h = .58*) than did the undergraduate students, who were more likely to report not using such assessments (*Cohen's h = .28*). Entering dental students also responded that they found ungraded, online assessments to be "somewhat useful" (*Cohen's h = .25*) more frequently than did the undergraduates. There was no appreciable difference found for the other response option, "useful+", with both groups responding similarly.

However, students report ungraded online assessments that are intended for learning purposes to be more useful. Data are presented in Table 25.

Table 25.

Reported Usefulness of Online Sample Exams for Learning Purposes: Effect Size Measurement Comparison of 2007 ECAR Undergraduate Study Participants and Entering Dental Students

Response	Undergraduates	Dental Students	*Cohen's h*
Useful +	83%	94%	.36*
Somewhat useful	4%	0	.40*
Not useful	1%	6%	.29*
Did not use	12%	6%	.29*

* Indicates a small effect size

Entering dental students reported online sample exams and quizzes for learning purposes both as "useful +" (*Cohen's h = .36*) and "not useful" (*Cohen's h = .29*) more often than undergraduate students. Undergraduate students were found to report such

assessments as "somewhat useful" (*Cohen's h = 40*) and that they "did not use" them as much as the entering dental students (*Cohen's h = .29*).

Students were asked how useful they found sharing learning materials online. Data are presented in Table 26.

Table 26.

Usefulness of Sharing Learning Materials Online Reported: Effect Size Measurement Comparison of 2007 ECAR Undergraduate Study Participants and Entering Dental Students

Response	Undergraduates	Dental Students	*Cohen's h*
Useful +	54%	57%	.06
Somewhat useful	9%	4%	.21*
Not useful	5%	16%	.37*
Did not use	31%	13%	.44*

* Indicates a small effect size

Fewer undergraduate students reported the use of sharing online learning materials then did entering dental students (*Cohen's h = .44*). Dental students more frequently reported online sharing to be both "somewhat useful" (*Cohen's h = .21*) and "not useful" (*Cohen's h = .37*). Both groups reported online sharing as "useful +" at similar rates.

Participants were asked how useful they found online reading materials. Data are presented in Table 27.

Table 27.

Usefulness of Online Reading Materials Reported: Effect Size Measurement Comparison of 2007 ECAR Undergraduate Study Participants and Entering Dental Students

Response	Undergraduates	Dental Students	*Cohen's h*
Useful +	86%	81%	.14
Somewhat useful	9%	9%	0
Not useful	2%	10%	.36*
Did not use	4%	7%	.13

* Indicates a small effect size

Entering dental students were found to report online reading materials as "not useful" more than undergraduate students (*Cohen's h = .36*). Both groups responded similarly to "somewhat useful," "not useful," and "did not use."

Summary

In many areas of the study, the entering dental students and undergraduate students were found to respond essentially the same. Regarding *external variables*, the age of their laptop and desktop computers were found to be no different. They reported essentially the same number or hours online each week and the same frequency of online access to the library. *Attitudes* toward technology were also found to have many areas of homogeneity. The opinion that students experience higher levels of engagement in courses with IT was shared between both groups of students. Similarly, both groups saw benefits of IT as better communication, and better research. *Actual use* reports were the

same regarding the use of spreadsheets, audio/visual software, blogging, electronic device use and presentations.

The data for this study was collected at the beginning of dental school, so many of the subjects were only 3 months removed from being undergraduates. Thus the homogeneity between undergraduate and entering dental student responses on the majority of survey items makes sense given that entering dental students are not tremendously different from undergraduate students. This is important for educators because the data indicates that entering dental students are using at least as much, and often more technology than undergraduates.

Overall Summary

Entering dental student data on the use of educational technology and general technology, as well as expectations for technology in dental school are presented, as are comparisons between the dental students and the undergraduates participating in the 2007 ECAR Technology study.

Entering dental students were found to most often express preference for moderate IT in courses. Use of electronic device for coursework and university email access are reported weekly or more by a majority of respondents. Technology reported by a majority as used in courses during the most recent pre-dental semester or quarter include: email, presentations, course website, course management system, and spreadsheets.

Students overwhelmingly reported checking their personal email account at least once a week, with a response of 99%. Social networking was reported by 83%. MP3

players were reported as owned by 82% of participants, and more had simple cell phones than do gaming devices, smart phones or PDA devices.

Entering dental students reported most commonly expecting the following technologies in dental school: email, presentation software, course management systems, course websites, spreadsheet software, podcasting, and social networking. Fewer respondents entering dental school expected the remainder of the technologies.

In comparison to the ECAR undergraduate students, the entering dental students reported greater *actual use* of many educational technologies, including: podcasting, webcasting, presentation and spreadsheet software, course websites, and audio/visual software. Entering dental students reported more frequent laptop ownership and more wireless Internet connections, indicating a difference in *external variables* in comparison to the undergraduates. Dental students also reported more frequently that they believed the use of IT benefited their learning than did the undergraduate students. In many other areas, the two groups did not show appreciable differences.

Chapter Five

Summary and Conclusions

This study sought to gain a baseline understanding of dental student educational technology use behaviors, preferences, and expectations, as well as a view of entering dental students in comparison to undergraduate students. Results of the investigation can be used to guide curriculum development and delivery, and can begin to fill the current void in understanding of dental student educational technology use. In turn, this information can inform curriculum and educators toward the outcome of improved dental student learning and patient care.

Health-science students are enthusiastic about efforts made by educators to include technology in their education, according to the available evidence (Eynon et al., 2003; Hendricson et al., 2006; MacPherson & Brueckner, 2003; McLean & Murrell, 2002). The evidence also suggests educational technology as an efficacious means of supporting teaching that can have positive impacts on health-science student learning (Boberick, 2004; Eynon et al., 2003; Kerfoot, Armstrong, & Sullivan, 2008; Kerfoot et al., 2006; Kerfoot et al., 2007; Masiello, Ramberg & Lonka, 2005; McFarlin, 2008; Goldberg & McKhann, 2000). The dental curriculum is particularly well suited to the inclusion of technology for several reasons. Dental students, like most health-science students, need to learn large amounts of complex material, which in turn means that they are often facing a heavy cognitive load. Technology holds the potential for reducing cognitive load because it allows for anytime, anywhere access to learning materials, giving students the opportunity to revisit difficult curricular topics as often as necessary for comprehension rather then requiring them to incorporate new material in the

classroom alone. Another means of reducing cognitive load that can be afforded by the inclusion of technology is the opportunity for the student to spend less time essentially transcribing lectures or other classroom activities and instead take in the information and think about the topic, knowing they can revisit the material for greater detail at a later time if needed.

The collective community of dental academia appears to be following the trends seen in undergraduate institutions and working to integrate more technology into teaching (Hendricson et al., 2004; Kassebaum et al., 2004). Dental academics are increasing utilization of educational technology for many reasons including challenges presented by a lack of faculty (Haden et al., 2002). Both student expectation and shifting faculty populations create an environment filled with opportunities to implement technology that undergraduate students commonly use and have come to expect within the dental curriculum.

The remainder of the chapter will be presented in five sections, the first being conclusions highlighting the major findings of the study. Limitations to study procedures and study design are presented next. Research and educational implications follow with suggestions for how the current study can guide both further educational technology investigation and the dental curriculum. Lastly, there is a summary of the chapter.

Conclusions

Data show that entering dental students use technology in their studies (Gupta et al., 2004; Rajab & Baqain, 2005). The current study supports these findings. When asked about their preference for the amount of information technology (IT) in their courses, the majority response, 49%, expressed a preference for “moderate IT”, with the

next largest group, 38%, preferring "extensive IT", 2% indicated a preference for "exclusive IT" (Table 11). Only 11% of the respondents fell outside these preference categories. Again, it is important to acknowledge the subjective nature of the use of the terms the subjects had to choose from, and that there may be some variably in subject responses due to a lack of a common definition, but the essential message remains the same.

Illustrating the entering dental student desire for IT in courses further is the comparison of these entering students with the ECAR undergraduates. When this survey item was compared between the two groups of students, a shift toward "extensive IT" can be seen. A small effect size (*Cohen's h = .40*) is seen between the undergraduates and entering dental students reporting a preference for "extensive IT" rather than "moderate IT." This can be interpreted as an indication that there exists an even stronger preference for IT among the entering dental students than the undergraduates, which were found comparatively to report the desire for "moderate IT" more frequently with a small effect size (*Cohen's h = .20*). Salaway et al. (2006) reported the undergraduate preference for "moderate IT." The data from this study indicates that there are a greater percentage of entering dental students with preferences for higher amounts of IT.

Entering dental students were more enthusiastic about the learning benefits of IT, with more indicating with "strong agreement" that IT has improved their learning (Table 23) with a small effect size difference (*Cohen's h = .21*). This finding supports previous research that students hold the belief that IT will benefit their education (Frederico, 2001), yet it appears this is even more true for entering dental students. The undergraduates more frequently reported "strong disagreement" with the statement that

IT has improved their learning, again with a small effect size (*Cohen's h = .21*). It is interesting to see that while most respondents in both groups were in general agreement, the groups split on the extreme positions. The two groups of students saw benefits of IT use in courses differently as well (Table 23). While the undergraduates found convenience to be the most beneficial aspect of using IT in a course (*Cohen's h = .45)*, entering dental students more frequently reported that communication (*Cohen's h = .28*) and improved learning (*Cohen's h = .26*) were benefits. The entering dental student opinion that IT benefits learning supports previous research that indicates there are learning benefits to the inclusion of technology in health-science education (Goldberg & McKhann, 2000; Kerfoot et al., 2006; Kerfoot et al., 2007; McFarlin, 2008).

Entering dental students report greater *actual use* of educational technology than do the undergraduates (Table 19). In every area for which an effect size difference was found, the entering dental students were the group using the technology more. This further strengthens the position that entering dental students use more educational technology than the general undergraduate student population.

Specific technology use reported by entering dental students show them to be a mobile computing group. There is a medium effect size difference (*Cohen's h = .78*) between the two groups as undergraduates less frequently report taking their laptops to class. The entering dental students more frequently reported laptop ownership (Table 18) and wireless Internet connections (Table 19) supporting findings from Kennedy et al. (2006) that indicated that students desire mobile computing. Virtually all respondents, 99%, indicated owning a cell phone, and more entering dental students than undergraduates indicated that their cell phone was a smart phone (Table 17) with a

medium effect size difference (*Cohen's h = .50*). This data lends further support to a picture of the entering dental students using portable devices to do educational tasks.

Evaluation of the educational technology behaviors that entering dental students report once a week or more (Table 12) indicates that most are using technology for educational purposes on a regular basis. Student reports indicate that the majority of these students are using technology to complete coursework, accessing university email accounts and course management systems, as well as bringing their laptops to class at least once a week.

A comparison of entering dental student reports of technologies used in their most recent pre-dental semester or quarter to those reported used by the ECAR undergraduates by Salaway et al. (2007) (Table 19) is further evidence that the entering dental student population makes more use of technology in their education than the general undergraduate population. In every instance where there was an effect size difference it was the entering dental students reporting greater use. For example, a large effect size (*Cohen's h = .82*) between the undergraduate students and the entering dental students indicated far more dental students reporting they had used podcasting during their most recent courses. There were five medium effect sizes found for webcasting (*Cohen's h = .45*), presentations (*Cohen's h = .44*), spreadsheets (*Cohen's h = .43*), course websites (*Cohen's h = .37*), and audio/visual software (*Cohen's h = .21*), as well. It appears entering dental students have used more educational technology than the general undergraduate student population.

The relationship between the technology used during the most recent pre-dental semester or quarter and the expectation for technology in dental school reported by the

entering dental students is quite interesting. Overall, the expectation for technology use in dental school is higher than the *actual use* of technology as an undergraduate for everything except email, for which *actual use* and expectations are the same (Table 16).

Reviewing the data from this study it appears that students hold dental educators to a higher standard, and expect more technological support while attending professional school, than they had as undergraduates. Of the 15 technologies students were asked to consider, there were effect size differences found for all but three, with all 12 differences indicating the entering dental students expected more technology in dental school than they had previously used. Considering that professional school places higher demands on students than does undergraduate study, the expectation of more technology is not unreasonable. Consider the large effect size (*Cohen's h = .86*) found for the greater expectation of webcasting within the dental school curriculum. This expectation speaks to the efficiency of being able to learn independently, and to use classroom time in more stimulating ways, much in the same way that researchers have when touting the benefits of educational technology use (Boberick, 2004; Eynon et al., 2003; Masiello, Ramberg & Lonka, 2005; McFarlin, 2008; Goldberg & McKhann, 2000). Data analysis found eight technologies with medium effect size differences between previous use and expected use in dental school. Technologies for which medium effect size differences were noted include: graphics (*Cohen's h = .75*), social networks (*Cohen's h = .72*), eportfolios (*Cohen's h = .69*), podcasting (*Cohen's h = .63*), blogging (*Cohen's h = .62*), instant messaging (*Cohen's h = .61*), audio/visual (*Cohen's h = .60*), and discipline-specific software (*Cohen's h = .60*). Three other technologies were found to have small effect size differences: programming language (*Cohen's h = .41*), spreadsheets (*Cohen's h =*

.31), and course websites (*Cohen's h = .27*). The differences seen between previous use of technology and the expectation of use in dental school are significant considering where dental academia is in the implementation of technology within the dental curriculum. Currently this dental student expectation is largely unmet (Kassebaum et al., 2004).

Data pertaining to the TAM variables: *external variables*, perceived usefulness, *attitude*, and *actual use*, are also supportive of the position that the entering dental students are using technology at greater rates than the ECAR undergraduates. Entering dental students own sophisticated electronic devices, as well as report more overall ownership for all devices investigated except for one, gaming devices (Table 17). The Internet connections entering dental students use are also more sophisticated, as they report being connected wirelessly more, and less often report lack of Internet access than do the undergraduates (Table 18). All of these data are *external variables* in the TAM.

Perceived usefulness is a TAM variable for which the entering dental students showed themselves to be more discriminating than the undergraduates (Tables 24 and 25). While the dental students found online assessments useful, they did not find such assessments for grading purposes useful, whereas the undergraduates showed less difference in their responses to the usefulness of graded versus ungraded online assessments. Regarding sharing online learning materials, dental students indicated they used them more often, but reported them to be "not useful" more than did the undergraduate students. Entering dental students also reported online reading materials to less useful than did the undergraduates (Table 27).

Measuring the TAM variable *attitude*, entering dental students report a more positive attitude toward IT as well. They report preferring more IT in their courses (Table 21) and are found to agree with the statement "IT improves my learning" (Table 22), more strongly than do the undergraduates, but also finding improved learning to be one of the benefits of incorporating IT into courses (Table 23).

While there were a number of places where differences were seen, there were 38 individual variables for which no *Cohen's h* effect size differences of >.20 were found between the two student groups. However, this in itself is meaningful, for it is accepted that undergraduate students are technology users (Beard et al., 2004; Katz & Caruso, 2005; Rivera & Rice, 2002), so it then follows that dental students are as well. The data in this study suggest that the differences that do exist between the responding entering dental students and the ECAR undergraduates are primarily in the direction of more use of technology on the part of the entering dental students.

Limitations

There are limitations to the survey instrument itself. Some of the survey items leave room for subject interpretation, which may have resulted in the misinterpretation of the intent of a subject's responses by the researcher. For example, survey items asking about the use of instant messaging (IM) in pre-dental school courses could mean one thing to the participant, perhaps that they used IM to communicate with friends during class, and another to the researcher. The intent of that particular item was to ascertain whether IM was used within a course as part of the learning activities, not whether or not IM was being used coincidentally while attending a class. It is quite possible that individual interpretations of ambiguous items have resulted in data that is

less reflective of educational technology behaviors of the student participants than anticipated.

The online delivery of the survey and the format of some of the questions also caused user interface limitations. Some survey items were formatted as drop-down menus. It was noticed that during the first data collection, when only one school was participating, that a few subjects incorrectly identified themselves as students of another program, the program listed immediately above the correct school. Possibly this was the result of letting go of the mouse too late when making the selection, and thereby inadvertently choosing the incorrect school. This may have occurred occasionally with survey items that were presented in that manner, again potentially misrepresenting a few responses.

Another limitation identified concerns the time lapse that occurred between the collection of the data used for comparison of the undergraduate students in 2007 to the entering dental students who completed the survey in 2008. While a year is not a terribly long interval, during that year some technology became more accessible and that change may account for some of the differences found between the two student groups relating to cell phone and smart phone ownership in particular. For example, since the time of the undergraduate administration in 2007, the iPhone dropped in price and was eligible for promotional discounts for customers of the wireless carrier affiliated with the iPhone. Ownership of smart phones was financially more feasible in 2008 than in 2007, which may account for some of the higher rates of adoption seen in the entering dental students.

Finally, this study used a descriptive research design, which was useful in gaining student viewpoints, and allowed an instrument feasible to implement at several sites, but

this design does have limitations. Because the study is descriptive, it is not possible to make statistical inferences about the differences between the two groups of students. While it is possible to report that there are effect size differences, the data is limited in that it does not allow for causal speculation.

Research Implications

This is a partial replication of a large national study applied to graduate students for the first time. The data has shown important differences in the specific graduate student group to which it was applied, dental students. It is likely that discovering more specifics about other professional and graduate student groups would be useful in maximizing the use of educational technology for their learning benefits. Additional study with other professional school students is suggested.

This study used an adapted version of the TAM model, which the author refers to as the eTAM model (Figure 4). The difference between the two models is that the eTAM is extended to include improved learning as an outcome of educational technology adoption. The data does suggest that this studied group of students has adopted technology, and the combination of the descriptive results on student reports of the benefits of IT (Tables 22 and 23) indicate that this student group shares the belief that IT has improved their learning. This seems to suggest that it is possible to extend the model to indicate that the adoption of technology may lead to improved learning outcomes based on the student perceptions gained from this study. This area warrants additional study.

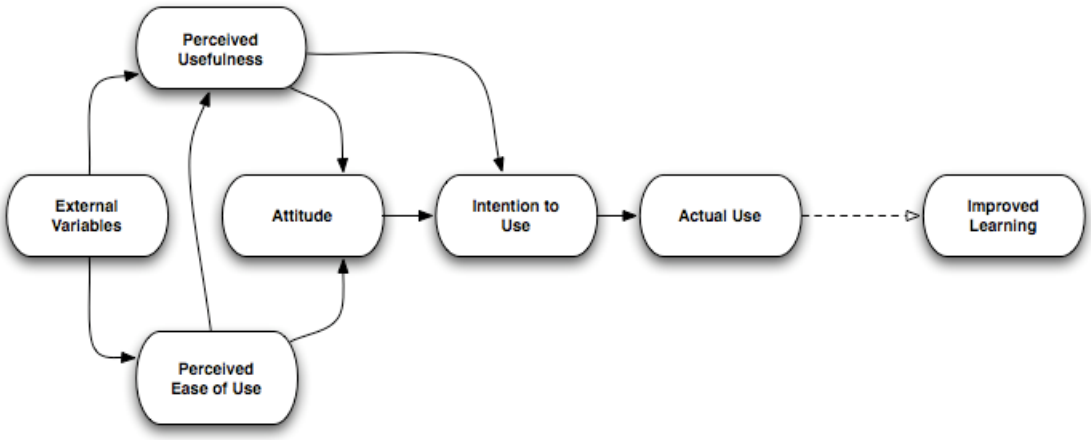

Figure 5. Educational Technology Acceptance Model (eTAM), proposed by Essex, adapted from Davis et al (1989).

A further suggestion for future research would be to extend the information obtained with the current study by conducting a more targeted investigation. Entering dental students use more IT; they report using IT for learning benefits; and there are specific technologies that this group of students uses more. A focused study on student reasons behind these differences would further benefit dental academia.

A survey instrument that is shorter, and targeted to the areas of difference found in the current study would aid in gaining more understanding as to why entering dental students use technology differently than the general undergraduate population. A better understanding of student motivation would be useful in designing and implementing a technology-enhanced curriculum. Specifically, if survey items were limited to 10 -15, were targeted to the areas of difference that have been identified, and included more options for open-ended responses there could be two enhancements to the current study. First, a shorter instrument is likely to influence a higher response rate, and with a shorter assessment tool, more programs would be likely to participate, increasing the sample size. Second, more student input in the form of open-ended survey items would provide

a more detailed basis for follow-up interviews. Such interviews would be helpful in understanding why particular technologies are reported as more useful than others, and would benefit dental educators as they work to implement new delivery options within the dental curriculum.

Educational Implications

Academic dentistry is serving a student population that is likely to be more technologically sophisticated than the general undergraduate population. Entering dental students have high technology expectations according to the study. These students have already made use of many different educational technology tools and expect to continue to do so in dental school, in most cases, at a higher level. The data from this study supports the continued inclusion of educational technology that facilitates student learning and creates more effective classroom time. For students to face the demanding full-time schedule of professional school and not receive the technology support they expect must be quite an additional, and unnecessary, frustration for students.

The participants of this study may communicate this frustration. Table 22 indicates that 72% of respondents reported that they either "strongly agreed" or "agreed" that IT improved their learning. Yet, Table 23 illustrates that when asked the benefits of IT as used in courses, only 19% indicate improved learning as a benefit. One interpretation of that difference is that while students believe IT provides learning benefits, they also think educators are not taking full advantage of these benefits both in and outside the classroom. The data from this study indicates that students use technology, expect to use technology, and believe they benefit when they use technology.

The challenge is to overcome the barriers to innovation and develop a means of delivering the dental curriculum that recognizes student ability to learn with technology independently, as well as transform the use of traditional class time. As many studies have indicated (Boberick, 2004; Eynon et al., 2003; Masiello, Ramberg & Lonka, 2005; McFarlin, 2008; Goldberg & McKhann, 2000), educational technology can transform class time from what has traditionally been a passive learning experience focused on information transfer in the form of a lecture, to a more active and engaging learning opportunity. When technology provides basic preparation in advance, in the form of a narrated content module, or a movie clip to demonstrate clinical techniques, the result is that class time can then be used to engage in the more complex aspects of health science and patient care. This benefits students by recognizing their ability as adult learners to learn independently with appropriate learning experiences developed by faculty. This benefits faculty by giving them the opportunity to engage with students that have prepared and are ready to actively engage in more advanced curricular content. Ultimately, these lead to benefits to the end-users of health-science curriculum, patients

Specific areas of technology implementation that should be considered would be those for which there is a high expectation on the part of the entering dental students (Table 16), that also support independent and active learning which include: webcasting, eportfolios, podcasting, blogging, and discipline-specific software.

Webcasting, the audio and visual capture of activities in a classroom, for example, allows students to independently review classroom activities in their own time. A webcast captures the classroom content thus removing the requirement for students to take copious notes. This has a great deal of value in many situations. In addition,

webcasting may help students become more active and engaged if the focus is on participating in the classroom discussion rather than documenting the classroom activity. A student can more actively participate, and use class time to consider the information they are receiving more carefully, if the onus of taking notes is less and they know they can revisit the course activities via the web again if necessary. When considering the shear volume of complex material dental students must learn, the benefits of webcasting become very important. By allowing a student to actively participate during class, rather than focusing on simply capturing content, there is more cognitive space available to make connections between the material presented and other related topics. It seems reasonable that a student would have an increased ability to integrate theoretical concepts with clinical procedures if given the opportunity to revisit information outside of class as necessary, concentrate on class activities, as well as do any necessary review or additional preparation before treating a clinical patient, which are all possible with webcasting. While previous research has shown that students indicate the availability of webcasting will not negatively affect class attendance (Rajab & Baqain, 2005; Walmsley et al., 2003), there are times that students are not able to attend class. Another benefit of implementing this technology is that it allows students who are ill, or otherwise legitimately unable to attend class, to gain more than a classmate's notes on the missed material.

The use of eportfolios can be a method of guiding a student's reflections on their skill acquisition and professional development. By documenting clinical skills and reflecting on their work, a student can gain a better understanding of their individual learning needs and accomplishments. Particularly in the health sciences, where

professionals are required to constantly evaluate their own abilities and maintain their knowledge base independently, engaging students in self-evaluation and reflection, as is possible with eportfolios, is a good strategy for guiding them in developing those skills that will ultimately lead to better patient care decisions. The ultimate goal of the dental curriculum is to produce a self-regulating professional who engages in life-long learning and knows to refer a patient if the patient's needs are not within the scope of their abilities. By utilizing a technology-based portfolio to engage in self-evaluation during professional development, it is reasonable to believe that the process of self-evaluation will become a working habit with these professionals. One practical implication of being more self-reflective is that professionals are more likely to consistently improve and refine their skills thus leading to the better care of patients.

Podcasting is an example of technology use that can be very valuable in preparing students on basic, lower-level, information, which allows more time for complex classroom activities that require more discussion. Rather than only using live classroom presentations instructors can deliver their presentations by podcast and use classroom time for enriched discussions and activities. For example, if a lecturer usually takes an hour to present a topic, they can gain an hour in the classroom with prepared students and engage at a higher level by giving the foundational material before class in a podcast format. This allows faculty to become more of a learning coach in the classroom rather than be primarily focused on content delivery. By providing students with basic content via narrated presentations it is possible for educators to plan more advanced classroom discussions that can build on the framework provided by the content the class has already reviewed. This has particular benefits for health-science students. Much of the health-

science curriculum is complex and the ability for individual students to access basic information as much as is personally necessary to gain comprehension is an asset. Allowing individuals to prepare in advance may bring a group into the actual classroom that is better able to engage in case presentations, or other more complex activities, at a higher level overall (Boberick, 2004; Eynon et al., 2003; Masiello, Ramberg & Lonka, 2005; McFarlin, 2008; Goldberg & McKhann, 2000). Podcasting would allow students more time in class to think about connections between different areas of the curriculum and build on theoretical concepts through in-class activities. Podcasting can also be used to prepare for a clinical patient by reviewing a relevant podcast which may lead to increases in quality patient care.

A blog is another potential tool for guiding self-directed learning behaviors in developing professionals. Much like an eportfolio, a blog can capture students' own views on their individual learning processes and guide the development of the ability to self-assess. Students can use blogging to reflect on clinical performances to ensure that they take the time to learn from the experience and bridge the gap between theory and practice. Blogging assignments can also guide the creation of learning goals and plans for clinical experiences, assisting in developing the necessary ability to anticipate and plan clinical situations. As stated previously, the ability to self-assess one's own abilities is critical in the health-sciences because a clinician's poor decisions can have a negative impact on the patient. The ability of a clinician to know their strengths and weaknesses affects patient care. The ability to self-asses must be developed, and blogging can be an effective means of fostering this essential skill if the instructor has incorporated course activities that encourage reflective writing on the part of the student.

The use of technology unique to the area of study, discipline-specific software, allows students to learn independently. Discipline-specific software includes a variety of tools, including things such as digital anatomy atlases. However, potentially the most important discipline-specific tool is the use of simulations. A simulation program that allows a student to practice a clinical sequence, for example, gives the student the opportunity to practice as much as is necessary whenever convenient. The ability to practice outside of scheduled clinics and classes offers great advantages for students. In addition, discipline-specific software that allows for simulation gives educators the ability to simulate a complex and/or dangerous patient situation allowing students to confront difficult cases without patient risk. The potential for these technologies to improve patient care is immense. Rather than confronting a critical situation for the first time on a real patient, if a student can reason their way through a clinical emergency without the high stakes that come with a human being, it is quite reasonable to believe that they will be better prepared when faced with a real clinical situation.

Summary

Dental education is facing an exciting opportunity to redesign health-science content and develop new curricular strategies that recognize the technological abilities of contemporary students. The advantages of utilizing a hybrid course method, one which employs both technology-delivered material and coursework with traditional classroom meetings, is shown to be a well-received teaching method by students (Beard et al., 2004; Rivera & Rice, 2002) and also has been shown to have improved learning outcomes in health-science programs (Boberick, 2004; Eynon et al., 2003; Masiello, Ramberg &

Lonka, 2005; McFarlin, 2008; Goldberg & McKhann, 2000). Data from this study supports the position that entering dental students are using technology, and are receptive to the inclusion of technology to a greater level in the dental curriculum than is currently implemented.

These facts combined with the potential for a greater opportunity to develop competency with patients make a strong case for dental academics to thoughtfully include technology in the curriculum wherever it would address the current learning needs of our students. Technology can ease the cognitive load of the dental curriculum. Technology can improve the ability to synthesize material by allowing anytime access and pre-class preparation. Technology can allow a student to more easily review concepts and skills before engaging in patient care. All of these benefits may lead to a higher quality of patient care, which is the desired outcome of dental education.

Appendix A

Informed Consent

INFORMED CONSENT FORM

UNIVERSITY OF SAN FRANCISCO

CONSENT TO BE A RESEARCH SUBJECT

Purpose and Background

Ms. Gwen Essex, a graduate student in the School of Education at the University of San Francisco is doing a study on incoming dental student perception and behavior relating to educational technology. Dental schools employ varied technologies in support of dental education. This study seeks student input regarding the use of technology in education.

I am being asked to participate because I am an incoming dental student.

Procedures

If I agree to be a participant in this study, the following will happen:

1. I will complete a short electronic survey giving basic information about me, including age, gender and the type of computer/s and operating system/s I own.

2. I will complete a survey about technology tools I have used in my education.

Risks and/or Discomforts

There are no identified risks or discomforts associated with participating in this research study.

Benefits

There will be no direct benefit to me from participating in this study. The anticipated benefit of this study is a better understanding of the use of technology by incoming dental students.

Costs/Financial Considerations

There will be no financial costs or benefits to me as a result of taking part in this study.

Questions

If I have further questions about the study, I may contact Ms. Essex at (415) 514-0476 or essexg@dentistry.ucsf.edu.

If I have any questions or comments about participation in this study, I should first talk with the researcher. If for some reason I do not wish to do this, I may contact the IRBPHS, which is concerned with protection of volunteers in research projects. I may reach the IRBPHS office by calling (415) 422-6091 and leaving a voicemail message, by e-mailing IRBPHS@usfca.edu, or by writing to the IRBPHS, Department of Psychology, University of San Francisco, 2130 Fulton Street, San Francisco, CA 94117-1080.

Consent

PARTICIPATION IN RESEARCH IS VOLUNTARY. I am free to decline to be □in this study, or to withdraw from it at any point. My decision as to whether or not □to participate in this study will have no influence on my present or future status as a dental student.

My completion of the survey indicates that I agree to participate in this study.

Appendix B

Original ECAR Survey Instrument

EDUCAUSE Center for Applied Research 97
Students and Information Technology, 2007 ECAR Research Study 6, 2007
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Appendix B
Students and Information Technology in Higher Education:
2007 Survey Questionnaire

Thank you for your willingness to answer this survey, which focuses on your experiences with and opinions about information technology. The information you and other undergraduate students provide will be reported in a national study that will be available to higher education institutions. We will also make available to your school's leaders data that you and your classmates give us about your school. The primary goal of the study is to better understand student experiences with information technology, which, in turn, can help your school's leadership to respond to your IT needs.

Your answers are confidential, and neither your school nor the EDUCAUSE Center for Applied Research will be able to identify you.

For the purposes of this survey, information technology refers to "personal electronic devices such as laptops and handheld computers, smart phones, and your institution's computers and associated devices."

Please submit your survey responses as soon as possible within the next two weeks. It should take you approximately 15 minutes to complete the survey. As thanks for your time and valuable input, each participant who provides an e-mail address will be entered in a drawing for one of 60 $50 and $100 gift certificates for Amazon.com.

You may print a blank copy of the survey, if you'd like, before completing it by clicking "Printable version of the survey" in the header. To print your responses after completing the survey, select the "Review" button at the end of the survey.

We appreciate your time and participation. If you have any questions or concerns, please contact the campus representative specified in the e-mail you were sent.

Click the "Next" button to begin the survey. Once again, thank you for your assistance!

Section 1.

We may only survey students age 18 or older.

1.1 **I am 18 years old or older. <Required>**

No <Proceed to Section 5>

Yes <Proceed to 1.2>

I give my consent to the following:

For this survey you were selected at random from a list of students at your institution. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

Sponsored by the EDUCAUSE Center for Applied Research, this study is being conducted by Judy Caruso of the University of Wisconsin–Madison and Dr. Gail Salaway, EDUCAUSE Center for Applied Research. EDUCAUSE is a nonprofit association whose members include information technology leaders in higher education. Its mission is to advance higher education

by promoting the intelligent use of information technology.

Background Information

If you agree to be in this study, please complete and submit the following survey. The survey asks for basic background information and questions you about:
What kinds of information technologies you use and how often.
What your level of skill is at using different information technologies.
How these technologies contribute to your undergraduate experience.
What value information technologies provide in teaching and learning in higher education.
It will take about 15 minutes to complete the survey. Please answer the questions to the best of your ability. There is no right or wrong answer. You only need to fill out the survey once.

Risks and Benefits of Being in the Study

There are no known physical, psychological, social, or medical risks associated with your participation in this study. The benefit of your participation is to inform school officials of the benefits of their technology investments for students.

Compensation

We will hold a raffle for gift certificates of $50 and $100 from Amazon.com for participating in this survey. If you choose to participate in the raffle, you must include an e-mail address in the space provided at the beginning of the survey. Once the survey has closed, we will conduct a random drawing from the e-mail addresses of those who participated within four weeks of the closing of the survey.
Your e-mail address will be kept separate from the data collected in the survey. It will not be used to connect your survey responses with your name, nor will it be used for any purpose other than to contact you should you win a prize.

EDUCAUSE Center for Applied Research 99
Students and Information Technology, 2007 ECAR Research Study 6, 2007

Confidentiality

The records of this study will be kept private. In any report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely.

Voluntary Nature of the Study

Participation in this study is voluntary. Your decision about whether to participate will not affect your current or future relations with your institution, with any of the institutions participating in this survey, or with EDUCAUSE. If you decide to participate, you are free not to answer any non-required question or withdraw at any time without affecting those relationships.

Contacts and Questions

You may direct any questions to Judy Caruso, 608-263-7318, judy.caruso@doit.wisc.edu, or to a representative of your institution's Institutional Review Board.
If you wish to print a copy of the survey before completing it online, a PDF version is available from the link in the online survey header. Once you complete and submit the survey by clicking the Finish button, a summary of your responses will be displayed with the option to print and/or save them.

Statement of Consent

1.2 **I have read the above information and have had the opportunity to ask questions and receive answers. I consent to participate in the study. <Required>**
No <Proceed to Section 5>
Yes <Proceed to next question>
1.3 **If you are interested in entering the drawing for gift**

certificates, please enter your e-mail address. <Optional>.

_____

Section 2. Your Use of Electronic Devices

2.1 **How old is your personal desktop computer?** <Drop-down list including less than 1 year, 1 to 10 years (increments of 1), More than 10 years, and Don't own>

2.2 **How old is your personal laptop computer?** <Drop-down list including less than 1 year, 1 to 10 years (increments of 1), More than 10 years, and Don't own>

2.3_2.7 **Which of the following electronic devices do you own?**

No Yes

2.3 **Simple cell phone (without Web access)**

2.4 **Personal digital assistant (PDA) (Palm, Blackberry, etc.)**

2.5 **Smart phone (combination cell phone and PDA device) (Blackberry, etc.)**

2.6 **Electronic music/video device (iPod, etc.)**

2.7 **Electronic game device (Game Boy, Xbox, PlayStation, etc.)**

2.8 **How often do you access your university e-mail account?**

Do not have a university e-mail account
Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily

2.9 **If your institution could communicate with you in any form, what would your first choice be?**

Instant messaging
E-mail
Text messaging
Personally authenticated Web site (portal)
Paper mail
No preference

2.10 **How many hours each week do you normally spend doing online activities for school, work, and recreation?**

<Drop-down list including Less than one, 1-168 (increments of 1)>

2.11 **How often do you use an electronic device to access a library resource on an official college or university library Web site?**

Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily

2.12 **How often do you use an electronic device for writing documents for your coursework?**

Never
Once per year
Once per semester/quarter

Monthly
Weekly
Several times per week
Daily
2.13 **How often do you create, read, and send e-mail?**
Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily
2.14 **How often do you create, read, and send instant messages?**
Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily
2.15 **How often do you play computer games?**
Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily
2.16 **How often do you download Web-based music or videos?**
Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily
102
Students and Information Technology, 2007 ECAR Research Study 6, 2007
2.17 **How often are you doing online shopping?**
Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily
2.18 **How often are you doing online gaming (partypoker.com, etc.)?**
Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily
2.19 **How often are you blogging?**

Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily

2.20 **How often do you participate in online social networks (thefacebook.com, friendster.com, etc.)?**

Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily

2.21 **How often do you use an electronic device for creating spreadsheets or charts (Excel, etc.)?**

Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily

2.22 **How often do you use an electronic device for creating presentations (PowerPoint, Keynote, etc.)?**

Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily

2.23 **How often do you use an electronic device for creating graphics (Photoshop, Flash, etc.)?**

Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily

2.24 **How often do you create audio/video (Director, iMovie, etc.)?**

Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily

2.25 **How often do you create Web pages (Dreamweaver, FrontPage, HTML, XML, Java, etc.)?**

Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily
104
Students and Information Technology, 2007 ECAR Research Study 6, 2007
2.26 **How often do you access a course management system (ANGEL, WebCT, Blackboard, Desire2Learn, FirstClass, Moodle, Sakai, OnCourse, etc.)?**
Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily
2.27_2.33 **What is your skill level using the following computer technologies and applications?**
Poor
Fair
Good
Very good
Excellent
Do not use
2.27 **Spreadsheets (Excel, etc.)**
2.28 **Presentation software (PowerPoint, etc.)**
2.29 **Graphics software (Photoshop, Flash, etc.)**
2.30 **Video/audio software (Director, iMovie, etc.)**
2.31 **Online library resources**
2.32 **Computer maintenance (downloading software updates, installing additional memory, organizing files, etc.)**
2.33 **Course management system (ANGEL, WebCT, Blackboard, Desire2Learn, FirstClass, Moodle, Sakai, OnCourse, etc.)**
2.34 **Why did you learn spreadsheet software (Excel, etc.)?**
College or university course requirement
High school or previous course requirement
Personal interest
Job requirement or to enhance job opportunities
Other
Do not use
2.35 **Why did you learn presentation software (PowerPoint, Keynote, etc.)?**
College or university course requirement
High school or previous course requirement
Personal interest
Job requirement or to enhance job opportunities
Other
Do not use

Students and Information Technology, 2007 ECAR Research Study 6, 2007
2.36 **Why did you learn graphics software (Photoshop, Flash, etc.)?**
College or university course requirement
High school or previous course requirement

Personal interest
Job requirement or to enhance job opportunities
Other
Do not use

2.37 **Why did you learn video/audio software (Director, iMovie, etc.)?**
College or university course requirement
High school or previous course requirement
Personal interest
Job requirement or to enhance job opportunities
Other
Do not use

2.38 **During the academic year, what is your most frequently used method for access to the Internet?**
Commercial dial-up modem service (AOL, EarthLink, etc.)
College- or university-operated dial-up modem service
Commercial broadband service (DSL modem, cable modem, etc.)
College- or university-operated wired broadband service
Commercial wireless network
College- or university-operated wireless network
I do not access the Internet

Section 3. Your Use of Technology in Courses

3.1 **Which of the following best describes your preference with regard to the use of information technology in your courses?**
I prefer taking courses that use no information technology.
I prefer taking courses that use limited information technology.
I prefer taking courses that use a moderate level of information technology.
I prefer taking courses that use information technology extensively.
I prefer taking courses that use information technology exclusively

3.2_3.16 **Are any of the following technologies used in your courses during the current semester or quarter?**

	Not using this semester/ quarter	**Using this semester/ quarter**
3.2 **E-mail**		
3.3 **Instant messaging**		
3.4 **Presentation software (PowerPoint, Keynote, etc.)**		
3.5 **Course management system (ANGEL, WebCT, Blackboard, Desire2Learn, Moodle, Sakai, OnCourse, FirstClass, etc.)**		
3.6 **Course Web site**		
3.7 **Programming languages (C++, Java, etc.)**		
3.8 **Graphics software (e.g. Photoshop, Flash, etc.)**		
3.9 **Video/audio software (Director, iMovie, etc.)**		
3.10 **Podcast**		
3.11 **Webcast**		
3.12 **Blogs**		
3.13 **Online social networks (thefacebook.com, etc.)**		
3.14 **E-portfolios**		
3.15 **Spreadsheets (Excel, etc.)**		
3.16 **Discipline-specific technologies (Mathematica, Matlab, AutoCAD, Stella, etc.)**		

3.17_3.19 **Please give us your opinion about the following statements regarding your experiences with in your courses.**

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
3.17 **I am more engaged in courses that require me to use technology than in courses that do not use technology.**					
3.18 **Overall, my instructors use information technology well in my courses.**					
3.19 **My school needs to give me more training on the information technology that I am required to use in my courses.**					

3.20_3.23 **The use of information technology in my courses:**

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
3.20 **Helps me better communicate and collaborate with my classmates than in courses that do not use technology.**					
3.21 **Results in more prompt feedback from my instructor than in courses that do not use technology.**					
3.22 **Allows me to take greater control of my course activities than in courses that do not use technology.**					
3.23 **Helps me do better research for my courses than in courses that do not use technology.**					

3.24 **Have you ever taken a course that used a course management system (e.g., ANGEL, WebCT, Blackboard, Desire2Learn, Moodle, Sakai, OnCourse, FirstClass)?** <Required>
No <Proceed to 3.35>
Yes <Proceed to 3.25>
Don't know <Proceed to 3.35>

3.25 **How would you describe your own overall experience using a course management system?**
Very negative
Negative
Neutral
Positive
Very positive

3.26_3.34 **How useful did you find the following course management system features?**

	Not useful	**Somewhat useful**	**Useful**	**Very**

useful
Extremely useful
Did not use
3.26 Online syllabus
3.27 Online readings and links to other text-based course materials
3.28 Online discussion board (posting comments, questions, and responses)
3.29 Online access to sample exams and quizzes for learning purposes
3.30 Taking exams and quizzes online for grading purposes
3.31 Turning in assignments online
3.32 Getting assignments back online from instructors with comments and grades
3.33 Online sharing of materials among students
3.34 Keeping track of grades on assignments and tests online

3.35 **Which of the following benefits from using information technology in your courses was the most valuable to you?**
Improved my learning
Convenience
Helped me manage my course activities (planning, apportioning time, noting success and failure, etc.)
Helped me communicate with my classmates and instructors
No benefits
Other

3.36 **The use of information technology in my courses has improved my learning.**
Strongly disagree
Disagree
Neutral
Agree
Strongly agree

3.37 **How often do you bring your laptop to class?**
Never
Once per year
Once per semester/quarter
Monthly
Weekly
Several times per week
Daily

3.38 **Which of the following best describes you?**
I love new technologies and am among the first to experiment with and use them.

I like new technologies and use them before most people I know.
I usually use new technologies when most people I know do.
I am usually one of the last people I know to use new technologies.
I am skeptical of new technologies and use them only when I have to.
3.39 **How do you learn best?**
I learn best working alone
I learn best working with others
I learn equally well working alone or working with others
Don't know
3.40_3.43 **How do you like to learn?**
No
Yes
Don't Know
3.40 **I like to learn through text-based conversations over e-mail, IM and text messaging**
3.41 **I like to learn through programs I can control such as video games, simulations, etc.**
3.42 **I like to learn through contributing to websites, blogs, wikis, etc.**

Section 4. Information About You

4.1 **What is your gender?**
Male
Female
4.2 **What is your age?**
<Drop down menu with ages from 18 to 99 >
110

4.3 **What is your cumulative grade point average (GPA)?**
Under 2.00
2.00–2.24
2.25–2.49
2.50–2.74
2.75-2.99
3.00–3.24
3.25–3.49
3.50–3.74
3.75–4.00
Don't know
4.4 **What is your class standing?**
Senior at a four-year institution
Freshman at a four-year institution
Student at a two-year institution
Other
4.5 **Are you currently a full-time or part-time student?** <Part time is fewer than 12 credit hours per semester/quarter>
Full-time
Part-time
4.6 **Do you reside on campus or off campus?**
On campus
Off campus
4.7_4.16 **What disciplines are you majoring in? Check all that apply.**
4.7 **Social sciences**
4.8 **Humanities**
4.9 **Fine arts**
4.10 **Life sciences, including agriculture and health sciences**
4.11 **Physical sciences**

4.12 **Education, including physical education**
4.13 **Engineering**
4.14 **Business**
4.15 **Other**
4.16 **Undecided**
4.17 **In 2006, what was your total family income from all sources, before taxes?**
Less than $30,000
$30,000 to $74,999
$75,000 to $149,999
$150,000 or more
Decline to answer
Don't know

4.18 **Which institution are you attending?** <Required> <Drop-down list of institutions>
Before proceeding, please confirm that the name of your institution appears in box 4.18.
4.19 **If you have any other comments or insights about your information technology use and skills or about how IT has helped or not helped your undergraduate experience, please feel free to share them with us.**

Section 5. Thank You.

You have reached the end of the survey. Thank you! Please submit the survey by clicking the Finish button now, or if you wish to review, print, or save your responses, click "Review."

Appendix C

Survey Instrument

Thank you in advance for assisting with my dissertation research. My name is Gwen Essex and I am a doctoral
student in the Learning and Instruction program in the School of Education at the University of San Francisco. I am
conducting research about instructional technology utilization behaviors of selected groups of graduate and
professional students.
This study has been reviewed by the Institutional Review Board at both University of the Pacific and the University
of California at San Francisco. There are no identified risks or discomforts associated with participating in this
research study. There will be no direct benefit to you from participating in this study. The anticipated benefit of this
study is a better understanding of the use of technology by students. PARTICIPATION IN RESEARCH IS VOLUNTARY
and you are free to decline to be in this study, or to withdraw from it at any point. Your return of the completed survey indicates your informed consent to participate in this study.
Please take a few moments to answer these questions about technology. The entire survey should take less than 15 minutes. Be assured that your responses are both confidential and anonymous. As the project and survey author, I am collecting no identifying information with the survey. Your responses will be collated with those of the other participants and reported as aggregate data.
Thanks in advance for your participation in this study. If you experience technical problems, please contact Dr. Susan Prion, a member of my dissertation committee and Assistant Professor, School of Nursing, USF at
prions@usfca.edu.
If you have additional questions or concerns about the survey, please contact me directly at essexg@dentistry.ucsf.edu.
Thank you again for assisting me with my dissertation research and helping to inform dental educators about your instructional technology needs and expectations.

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1. How old is your personal DESKTOP computer?
2. How old is your personal LAPTOP computer?
3. Which operating system do you use the majority of time?

j m Mac
j m PC/Windows
j m Other

4. Which of the following electronic devices do you own?

	Yes	No	don't know
Simple cell phone (without Web access)	m	j	m
Personal digital assistant (PDA) (Palm, BlackBerry, etc.)	m	j	m
Smart phone (combination cell phone and PDA device) (BlackBerry, etc.)	m	j	m
Electronic music/video device (iPod, etc)	m	j	m
Electronic game device (Game Boy, Xbox, PlayStation, etc.)	m	j	m

5. How often do you access your university e-mail account?
6. If your institution could communicate with you in any form, what would your first choice be?

j m Instant messaging
j m E-mail
j m Text messaging
j m Personally authenticated Web site (portal)
j m Paper mail
j m No preference

7. How many hours each week do you normally spend doing online activities for school, work and recreation?
8. How often do you use an electronic device to access a library resource on an official college or university library Web site?
9. How often do you use an electronic device for writing documents for your coursework?

10. How often do you create, read, and send e-mail?
11. How often are you blogging?
12. How often do you participate in online social networks

**(thefacebook.com,
friendster.com, etc.)?**

**13. How often do you use an electronic device for creating spreadsheets or charts
(Excel, etc.)?**
**14. How often do you use an electronic device for creating presentations
(Powerpoint, Keynote, etc.)?**
**15. How often do you use an electronic device for creating graphics (Photoshop,
Flash, etc.)?**

16. How often do you create audio/video (Director, iMovie, etc.)?
**17. How often do you create Web pages (Dreamweaver, FrontPage, HTML, XML,
Java, etc.)?**
**18. How often do you access a course management system (ANGEL, WebCT,
Blackboard, Desire2Learn, FirstClass, Moodle, Sakai, OnCourse, etc.)?**

**19. What is your skill level using the following computer technologies and
applications?**

	poor	fair	good	very good	excellent	do not use
Spreadsheets (Excel, etc.)	m	m	m	m	m	m
Presentation software (PowerPoint, etc.)	m	m	m	m	m	m
Graphics software (Photoshop, Flash, etc.)	m	m	m	m	m	m
Video/audio softward (Director, iMovie, etc.)	m	m	m	m	m	m
Online library resources	m	m	m	m	m	m
Computer maintenance (downloading software updates, installing additional memory, organizing files, etc.)	m	m	m	m	m	m
Course management system (ANGEL, WebCT, Blackboard, Desire2Learn, FirstClass, Moodle, Sakai, OnCourse, etc.)	m	m	m	m	m	m

**20. During the academic year, what is your most frequently used method for access
to the Internet?**
21. Which of the following best describes your preference with

regard to the use of information technology in your courses?

j m I prefer taking courses that use NO information technology
j m I prefer taking courses that use limited information technology
j m I prefer taking courses that use a moderate level information technology
j m I prefer taking courses that use information technology extensively
j m I prefer taking courses that use information technology exclusively

22. Were any of the following technologies used in your courses during your last semester or quarter?

	Not used	Used during last semester/quarter
E-mail	m j	m j
Instant messaging	m j	m j
Presentation software (Powerpoint, Keynote, etc.)	m j	m j
Course management system (ANGEL, WebCT, Blackboard, Desire2Learn, Moodle, Sakai, OnCourse, FirstClass, etc.)	m j	m j
Course website	m j	m j
Programming languages (C++, Java, etc.)	m j	m j
Graphics software (Photoshop, Flash, etc.)	m j	m j
Viewo/audio software (Director, iMovie, etc.)	m j	m j
Podcast	m j	m j
Webcast	m j	m j
Blogs	m j	m j
Online social networks (thefacebook.com, etc.)	m j	m j
E-portfolios	m j	m j
Spreadsheets (Excel, etc.)	m j	m j
Discipline-specific technologies (Mathematica, Matlab, AutoCAD, Stells, etc.)	m j	m j

23. Which of the following technologies do you EXPECT to use during your graduate professional education?

	Expect to use	Don't expect to use
E-mail	m j	m j
Instant messaging	m j	m j
Presentation software (Powerpoint, Keynote, etc.)	m j	m j
Course management system (ANGEL, WebCT,		

Blackboard, Desire2Learn, Moodle, Sakai, OnCourse, FirstClass, etc.)
m j m j
Course website m j m j
Programming languages (C++, Java, etc.)
m j m j
Graphics software (Photoshop, Flash, etc.)
m j m j
Viewo/audio software (Director, iMovie, etc.)
m j m j
Podcast m j m j
Webcast m j m j
Blogs m j m j
Online social networks (thefacebook.com, etc.)
m j m j
E-portfolios m j m j
Spreadsheets (Excel, etc.) m j m j
Discipline-specific technologies (Mathematica, Matlab, AutoCAD, Stells, etc.)
m j m j

24. Please rate your level of agreement with the following statements regarding your experiences with technology use in your courses.

Strongly disagree Disagree Neutral Agree Strongly agree
I am more engaged in courses that require me to use technology than in courses that do not use technology.
m j m j m j m j m j
Overall, my instructors use information technology well in my courses.
m j m j m j m j m j
My school needs to give me more training on the information technology that I am required to use in my courses.
m j m j m j m j m j

25. The use of information technology in my courses:

Strongly disagree Disagree Neutral Agree Strongly agree
Helps me better communicate and collaborate with my classmates than in courses that do not use technology.
m j m j m j m j m j
Results in more prompt feedback from my instructor than in courses that do not use technology.
m j m j m j m j m j
Allows me to take greater control of my course

activities than in courses than do not use technology.

Helps me do better research for my courses than in courses that do not use technology.

26. Have you even taken a course that used a course management system such as ANGEL, WebCT, Blackboard, Desire2Learn, Moodle, Sakai, OnCourse, FirstClass?

27. How would you describe your overall experience using a course management system?

- Yes
- No
- Don't know
- Very negative
- Negative
- Neutral
- Positive
- Very Positive
- I have not taken a course that used a course management system.

28. How useful did you find the following course management system features?

	Not useful	Somewhat useful	Useful	Very useful	Extremely useful	Did not use
Online syllabus						
Online readings and links to other text-based course materials						
Online discussion board (posting comments, questions, and responses)						
Online access to sample exams and quizzes for learning purposes						
Taking exams and quizzes online for grading purposes						
Turning in assignments online						
Getting assignments back online from instructors with comments and grades						
Online sharing of materials among students						
Keeping track of grades on assignments and tests online						

m j m j m j m j m j m j

29. Which of the following benefits from using information technology in your courses was the most valuable to you (mark all that apply)?

30. The use of information technology in my courses has improved my learning.

31. How often do you bring your laptop to class?

c e Improved my learning
c e Convenience
c e Helped me manage my course activities (planning, apportioning time, noting success and failure, etc.)
c e Helped my communicate with my classmates and instructors
c e No benefits
Other (please specify)

32. Which of the following best describes you?

33. How do you learn best?

34. How do you like to learn?

	No	Yes	Don't know
I like to learn through text-based conversations over e-mail, IM and text messaging	m	m	m
I like to learn through programs I can control such as video games, simulations, etc.	m	m	m
I like to learn through contributing to websites, blogs, wikis, etc.	m	m	m

j m I love new technologies and am among the first to experiment with and use them.
j m I like new technologies and use them before most people I know.
j m I usually use new technologies when most people I know do.
j m I am skeptical of new technologies and use them only when I have to.
j m I learn best working alone
j m I learn best working with others
j m I learn equally well working alone or working with others
j m I don't know how I learn best

35. What is your gender?

36. What is your age?

37. What institution are you attending?

38. If you have any other comments or insights about your information technology use and skills or about how IT has helped or not helped your undergraduate experiences, please feel free to share them with us.

Thank you very much for assisting with my dissertation research.
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