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MOBILE TECHNOLOGY IN DENTAL HYGIENE PRACTICE AND EDUCATION

BY

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Dedication

This thesis is dedicated to my loving family. Their encouragement and endless support gave me the strength to overcome obstacles and fulfill my goals.

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Abstract

The adoption of mobile technology in the education of health care practitioners has become more widespread. As more dental hygienists work in independent settings, the use of mobile technology at the point of care is essential to provide optimal oral health care. Very little work has been done to study the adoption of mobile technology in dental hygiene practice and education. The purpose of this study is to identify the current use of mobile technology in dental hygiene education, and dental hygiene clinicians', educators' and students' perceptions about this use. Results reveal that mobile technology use in dental hygiene education is still in its infancy. Educators and students value their use and feel that mobile technology can enhance dental hygiene practice. Collaboration with governing bodies to create best practice guidelines for the clinical use and increased dialogue amongst educators must be encouraged to discover and promote champions for change.

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List of Symbols, Abbreviations, and Nomenclature

CDHA – Canadian Dental Hygienists Association

CDHO- College of Dental Hygienists of Ontario

CNA- Canadian Nursing Association

PDA – Personal Digital Assistant

RNAO - The Registered Nursing Association of Ontario

Mobile Technology in Dental Hygiene Education and Practice

Chapter 1 - Introduction

Mobile technology such as personal digital assistants (PDAs), is an umbrella term for mobile hand held computers increasingly used in health care environments. Health care practitioners use hand held computers primarily for administrative tasks and to direct clinical work. For example, physicians use PDAs in their medical practice for decision support, as well as collecting and accessing data. PDAs are also favored for reasons of convenience, portability, connectivity, inexpensive cost, and ease of access to software (Free et al. 2010). A popular adoption of mobile technology has been in the education of medical residents and other health professionals (Luanrattana, Than Win, Fulcher, & Iverson, 2012; Siddiqui, & Jonas-Dwyer 2013). This includes the use of PDAs to help access pertinent information at the point of care in the training of pharmacy, radiology, and more recently nursing students (Applegate, 2010; Chatterley& Chojecki, 2008; Moloney & Becarria, 2009; Siracuse & Sowell, 2008). In particular, there is a growing body of literature exploring the use of mobile technology in nursing education. This has been stimulated by mandates from organizations such as the Canadian Nurses Association (2006) and the Canadian Association of Schools of Nursing (2011) that have recognized the need for the incorporation of new technology into nursing education. Similarly, the College of Dental Hygienists of Ontario (2009) practice guidelines for educators encourages the use of appropriate technology to promote student learning. Very little research has been done to study the use of mobile technology in dental hygiene practice and education. In the literature that was reviewed, benefits and barriers of PDA use in nursing education were described. In addition, strategies for the successful

integration of mobile technology into current curricula were outlined. Based on the benefits, health professions such as dental hygiene may want to use mobile technology in practice and education. It is important to identify the current use of mobile technology in clinical practice and education, and dental hygiene clinicians', educators' and students' perceptions about this use. This would provide information about the current use and understanding of mobile technology in practice as they relate to dental hygiene and as they compare to practices in other health professions. Such information would be useful in planning purposeful integration of mobile devices into education.

Background

Personal digital assistant (PDA) is a generic term for various mobile hand held computers increasingly used in health care environments (Covington & Claudepierre, 2006; Free et al., 2010). First generation PDAs included basic applications for calendars, contacts, and notes. More recently, PDAs include advanced functions such as mobile phone and computing capability. The Registered Nursing Association of Ontario (RNAO) promotes the use of PDAs in practice through a PDA initiative. The initiative includes a list of resources for nurses in the education and adoption of PDAs into practice. PDAs outlined in the initiative include Blackberry, iPhone, Pocket PC, and tablet devices (RNAO, 2012). For the purpose of this study, PDAs outlined by the RNAO initiative were included i.e. smartphones, tablet, and Pocket PC devices. These are highly portable mobile devices that allow for communication through network activity. The increased utilization of these devices has pushed society into a mobile era.

Mobile technology has changed how individuals work, learn, and communicate with each other. PDA technology includes wireless connectivity providing immediate

access to information, learning materials, and other people. Increased access to learning material anywhere at anytime has contributed to the growth of mobile learning (Ally, 2009). PDAs are used across multiple disciplines and industries for education and training. A popular adoption of PDAs has been in the education of medical residents and other health professionals (Luanrattana et al., 2012). This includes the use of PDAs in the training of pharmacy, radiology, and more recently nursing students (Applegate, 2010; Chatterley& Chojecki, 2008; Moloney & Becarria, 2009; Siracuse & Sowell, 2008).

Dental hygiene education includes theory and clinical components that revolve around the dental hygiene process of care. This process of care includes the assessment, planning, implementation, and the evaluation phase of care (Darby & Walsh, 2009). Each phase of care requires immediate access of information that PDAs can provide through wireless connectivity. PDAs can also support effective communication between students and faculty.

The assessment phase of care involves recording the client's medical and dental history, charting periodontal and dental conditions, and taking radiographs. In this phase of care, the use of a smartphone with Internet access might help students and faculty identify potential oral implications of certain medications. This phase may include consultation with a medical doctor before treatment can commence. Utilization of PDAs can help both student and faculty immediately obtain information such as the address and phone number of the associated medical doctor.

The planning phase involves developing a dental hygiene care plan that includes client/patient -centered goals in oral health. This involves identifying the patient's wants

and needs in improving and or maintaining their oral health. The planning phase may also include referring the client to other health professionals such as a dietician in order to improve overall health. The appropriate PDA can help students access information that may help them communicate the link between oral and systemic health. This may include a short video or power point presentation that the student develops to educate the client.

Oral health education and the debridement of clients' teeth is the implementation phase of care. Oral health education includes the use of photos and intra oral demonstration of proper brushing and flossing. Visual aids may be downloaded on a tablet and presented during oral health education to help educate and motivate the client.

The evaluation of care involves reassessing the client's oral health condition and current home care. PDAs with a photo application can allow the patient to see before and after treatment photos providing motivation for continued care.

Dental hygiene clinical faculty monitor students through each phases of care and communicate directly with both the client and the student. The utilization of a smartphone can help faculty provide immediate feedback on student performance through text or e-mail. Tracking student competencies on the PDA can help faculty identify students requiring more attention. PDAs can also support interprofessional education allowing students from different programs with different timetables communicate and learn outside of scheduled classes and clinics. This may be facilitated through case study presentations supported by webinars or podcasts. These platforms for disseminating information support the growth of mobile learning (Plicher & Belford, 2010).

Mobile learning

Mobile learning is defined as skill development and knowledge attainment that occurs in various locations, times, and settings through the use of mobile devices (Ally, & Palalas 2012). According to Palalas (2012), mobile learning occurs through the use of highly portable devices that are always on, and allow for communication and network connectivity. With the growth of mobile technology worldwide, Ally (2009) advises that society will demand access to learning materials on their existing mobile devices. This will force educators to adopt mobile learning into current curricula.

A recent survey of various Canadian organizations identifies several benefits of mobile learning. These include: (a) learning on the go and at the time of learner's preference (b) on demand access to materials, and resources (c) immediate communication with experts and other learners (d) easy exchange of knowledge and information (e) instant delivery of notifications and reminders (f) "just in time" learning (g) learning with feedback in a relevant and real world setting and (h) convenience of mobile and web applications (Ally, & Palalas 2012). Many benefits of mobile learning are highly applicable to the teaching and training of health professionals (Free et al., 2010).

Purpose of Study

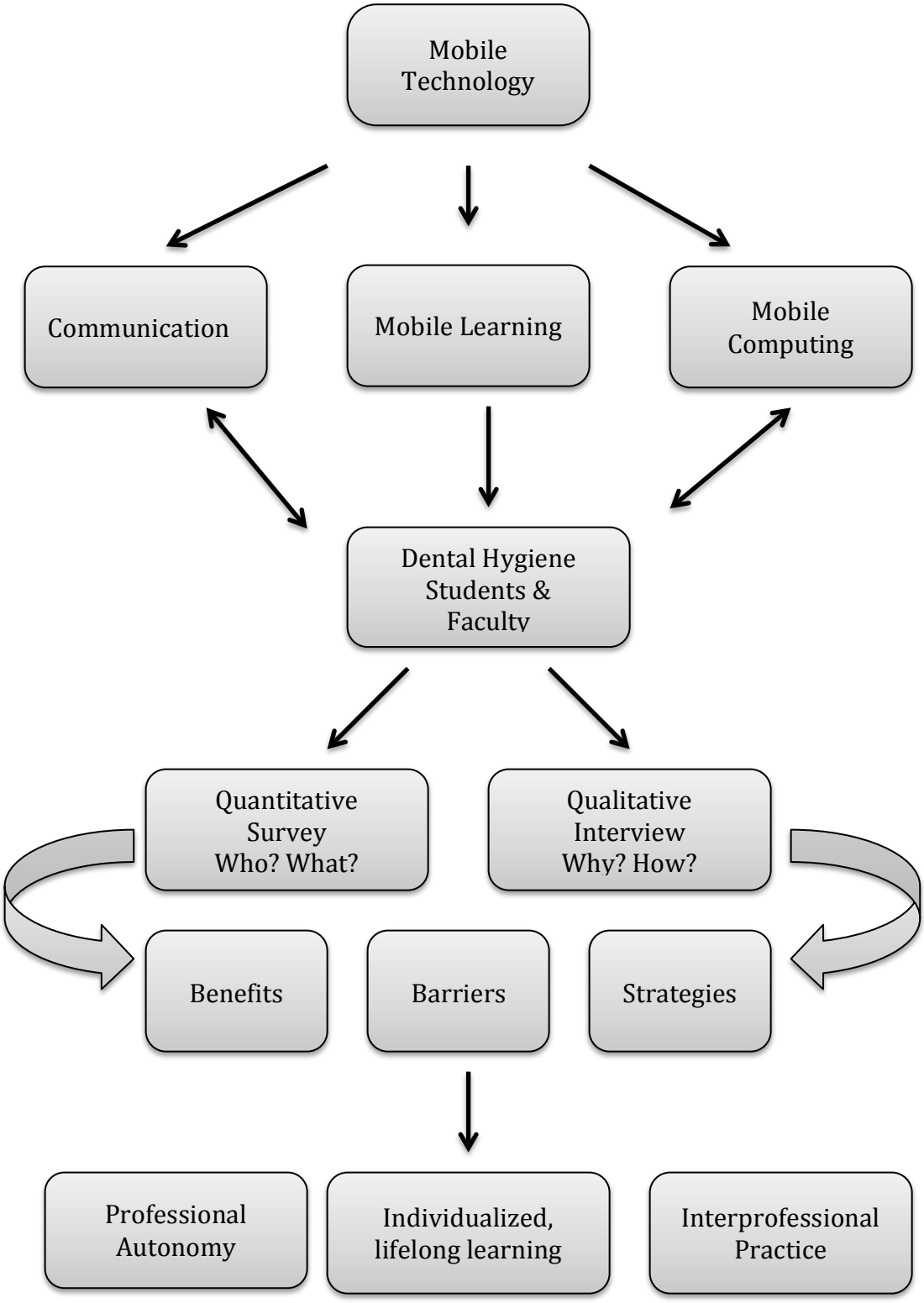
The purpose of this study is to identify current use and perceptions of use of mobile technology in dental hygiene practice and education and the identification of benefits and barriers for the adoption of mobile technology specific to the dental hygiene profession. Two research questions will be addressed. (1) What is the current use of

PDAs in dental hygiene education in Ontario? (2) What are these faculty and students' perceptions about using PDAs in dental hygiene education?

Fundamental Principles and Conceptual Framework

Several assumptions provide fundamental principles for this study. 1) Adult learning is self-directed, continuous, and demands innovative methods to meet the needs of the learner. 2) Mobile technology is ubiquitous penetrating all aspects of our lives (Ally, 2009). 3) If adopted properly, mobile technology can enhance the autonomy of dental hygiene practice. (4) The use of mobile technology can promote interprofessional education aligning the profession within the context of other health care providers (CDHA, 2010). (5) Mobile technology is a tool that can be used to individualize and localize learning at all stages of dental hygiene education and practice. These assumptions inform the decision to understand the role of mobile technology in dental hygiene practice and education. A conceptual framework illustrates the ubiquitous nature of mobile technology and the outcomes proposed from this study (see Figure 1).

Figure 1. Fundamental Principles and Conceptual Framework



Chapter 2 - Review of Literature

To identify current literature on the use of mobile technology in nursing and dental hygiene education, a literature search limited from 2005 to 2013 was conducted through the PUBMED and PROQUEST databases using the following key words and their combinations: Personal digital assistant (PDA), smartphones, tablets, pocket pc, mobile technology, dental, dental hygiene, nursing and education. The search resulted in two articles that involved the use of PDAs in dental education and only one article that related to dental hygiene education. Several articles related to nursing education were found. The search was limited to original work. Literature reviews and position papers were not included in the review. Upon analysis of the nursing literature, two themes were predominant; identifying benefits and barriers to the application of mobile technology in nursing education and strategies for successful implementation.

PDA Use in Nursing Education

As PDA use in the health care setting has increased, nursing faculty have identified the importance of incorporating this technology into nursing education. In 2008, the Canadian Nursing Association (CNA) developed an e-nursing strategy for Canada. The strategy addresses the need for reform of nursing education to prepare students for a health care environment that requires the use of sophisticated technology (CNA, 2006). In addition, the Canadian Association of Schools of Nursing includes the incorporation of technology into core competencies for entry-to-practice nurses. These mandates have prompted research exploring the opinions of both nursing faculty and students on the use of PDAs in clinical practice. Other articles focus on strategies from successful implementation of PDAs into curricula.

Benefits. Several authors identified many benefits of PDA use by both nursing faculty and students. Nursing students introduced to PDAs by faculty reported using them regularly during their clinical learning experience (Cibulka & Crane- Wilder, 2010; George, Davidson, Serapiglia, Baria, & Thotakura, 2010; Kenny, Park, Van-Neste Kenny, Burton & Myers, 2009; Miller et al., 2005; Park, Van-Neste Kenny, Burton, & Kenny, 2010; Whitman-Price, Kennedy, Godwin, C, 2012). They identified portability and the ability to retrieve and store data as a benefit for clinical use (Cibulka & Crane-Wilder, 2010; Kenny et al., 2009). Students also found that most applications and software on the mobile device were easy to use and the option to access nursing reference software bedside was ideal (Kenny et al., 2009; Anonson, Bassendowski, Pertucka, Ralston, & Schweitzer, 2008). Drug reference software along with diagnostic and laboratory test references were valued most by students especially during clinical care (Anonson et al., 2008; Brubaker, Ruthman, & Walloch, 2009; George et al., 2010; Goldsworthy, Lawrence, & Goodman, 2006; Miller et al., 2005; Park et al., 2010).

Students felt that the PDA helped improve their standard of care. A pilot study involving nine second-year nursing students found that the utilization at the point of care allowed students to spend more time with patients (Anonson et al., 2008). Quick access to information on the palm pilot prevented students from having to go back and forth to the nurses' station to check data and reference books (Anonson et al., 2008). In addition, the authors found that a major benefit of using PDAs in the clinical setting was the accessibility of the pharmacological information that provided potential for greater accuracy in drug administration (Anonson et al., 2008). Students were also more likely to double check drug information due to quick access of information versus referring to a

traditional text (Park, et al., 2010). Nurse practitioner students also found that palm pilot use at the point of care improved their time management allowing them to spend more time with patients (Koeniger-Donahue, 2008). Increased time with patients improved personalization of care by utilizing information on the palm pilot to tailor and record the history and physical exam of patients (Koeniger-Donahue, 2008). Staff nurses who observed students' use of smartphones during clinical rotations noticed that the students were more prepared and confident in their care of the patients (Whitman Kennedy & Godwin, 2012).

In addition to improved clinical outcomes, PDAs have made a positive contribution to the learning experience of nursing students. Nursing students felt that PDA use contributed to learning both in the classroom and clinical area and was an effective educational tool (Cibulka & Crane- Wilder, 2010; George et al., 2010). They also found that PDA use helped bridge the gap between theory and practice (Brubaker, Ruthman, & Walloch, 2009). Many students were able to independently download texts and information that supported them during lectures (Goldsworthy et al., 2006). The use of applications such as class notes organizer, calendar, and phonebook helped them feel more organized (Cibulka & Crane Wilder, 2010; Goldsworthy et al., 2006; Kuiper, 2008). Increased organization enabled the students to download information prior to clinical rotations that aided in overall clinical preparation (Park et al., 2010).

Students acknowledged the convenience of accessing information not only in clinic but anywhere and at anytime (Brubaker et al., 2009; Hudson & Buell, 2011). Wireless access was perceived to be beneficial during classroom work. According to Park et al., (2010), students utilized the Internet to access information during class. The

access to immediate information during group work provided pertinent real time information for discussion that enhanced group learning. In addition, learning was more efficient since students were able to access missing information immediately instead of waiting to review the information during the next class a week later (Park et al., 2010).

Nurse practitioner students identified the ability to access volumes of information on the PDA as a positive impact on their overall learning experience (Koeniger-Donahue, 2008). Senior nursing students recognized that information found on the PDA was timelier than traditional textbook references available to them allowing them to remain current in practice (Brubaker et al., 2009; Kenny, Park, Van-Neste Kenny, Burton & Myers, 2009). In a study that looked at nursing students' information seeking behavior with PDAs, the majority of students felt that the PDA allowed them to answer current clinical issues and questions (Miller et al., 2005). Although students favored the PDA for accessing information they also felt that the PDA was an adjunct to traditional texts and faculty and would continue to utilize other resources (Kuiper, 2008).

PDA use in nursing education has shown promise in improving nursing students' pharmacological knowledge clinical reasoning, and self-efficacy. A study by Wyatt et al., (2010), reported on the relationship between mobile learning and nurse practitioner students' learning styles. The PDAs were utilized in various learning activities and results reveal that all students benefited from PDA use regardless of learning style (Wyatt et al., 2010). Farrell and Rose (2008) describe improved pharmacological knowledge of nursing students with PDA use during clinical practice in a medical surgical area. A pre and post-test on pharmacological knowledge was done by both study and control groups. Students using PDAs demonstrated an increase in their mean score, which was double the

increase of the control group (Farrell & Rose, 2008). Improved pharmacological knowledge at the point of care had a positive effect on students' self-efficacy (Goldsworthy et al., 2006). Kuiper (2008) identified that PDA use by students improved their overall clinical reasoning. Forty- six students completed an online questionnaire, clinical reasoning sheets, and a clinical log at the end of the project. The results of the cohort group were compared with a group of students who did not use the PDA during clinical experiences. Based on the results, the author suggests that the PDAs can be used as a clinical reasoning resource and the use of the device does not have a negative effect on clinical decision- making (Kuiper, 2008). The students showed high levels of self-confidence when using PDAs (Kuiper, 2008).

Students who utilized PDAs in clinic were often consulted by nursing staff for information (Goldsworthy et al., 2006; Park et al., 2010). Anonson et al., (2008) found that students involved in the study freely offered information on PDAs and encouraged other faculty and students to use them. Students felt more like team players and became role models for staff in the use of technology for the access of information (Anonson et al., Park et al., 2010). Nursing students felt that using PDAs as a student would contribute to their future use of hand held technology (George et al., 2010).

The literature review reveals benefits of faculty use of PDAs. White et al., (2005) report on the implementation of PDAs into an accelerated baccalaureate-nursing program. The authors note that the PDA was useful for gathering information for instructor evaluation of student performance. In addition, the PDA improved instructor time management. The mobility allowed the instructor to keep notes and review student entries promptly (White et al., 2005).

The literature indicates several benefits for the adoption of mobile PDAs into nursing education. This includes ease of use with improved access to current information at the point of care, increased time with patients, enhanced learning experience, and learning outcomes such as pharmacological knowledge and self-efficacy improved. Faculty also benefited from the use of mobile technology.

Barriers. Numerous barriers were also identified in nursing literature. Cost is a barrier for the adoption of PDAs into an educational program (Anonson et al., 2008; Cibulka & Crane-Wilder, 2010; Garret & Klein, 2008; Whitman-Price, Kennedy Godwin, 2012). Anonson et al., (2008), recognized that the cost of both PDAs and the software must be offset by a reduction in the number of textbooks purchased by students. In a survey identifying barriers to PDA use, students identified the high cost of both the PDA and software as a deterrent for future use (Cibulka & Crane-Wilder, 2010).

Students felt technological difficulties with PDAs as a barrier for regular use. Nursing students found both keeping the battery charged and low memory as a challenge to the ease of use (Brubaker et al., 2009; Cibulka & Crane-Wilder, 2010; Garret & Klein, 2008; George & Davidson, 2005; George et al., 2010). Some students experienced a loss of software that proved to be difficult to reload (George & Davidson, 2005). In hospital settings, students found it difficult to use wireless and GPRS connectivity (Kenny et al., 2009).

The small screen size of the PDA made it difficult for some learning assignments making it frustrating for students to complete assignments. The screen size was fine for mobile formatted programs and but it was not ideal for browsing non formatted websites or reading and creating word documents (Kenny et al., 2009; Miller et al., 2005).

Although the PDA was found to be small and portable, many students found it heavy and difficult to carry while on clinical rotations (Farrell & Rose, 2008; Kenny et al., 2009; Park et al., 2010).

The comfort levels of both students and faculty had an affect on how well PDAs were integrated into current curricula. Some students felt they needed more time to feel comfortable with the use of PDAs (Brubaker et al., 2009; Park et al., 2010; Swan, Smith, Frisby, Schafer, & Hanson-Zalot, 2012). Farrell and Rose (2009) found that students' comfort levels with the PDA varied based on their previous experience with technology. Those that had more experience with technology in general found the PDA easy to use (George et al., 2010). Recent high-school graduates found them easy to use through trial and error while older and international students found them difficult to use and preferred smaller training groups (Farrell & Rose, 2009). Graduate nursing students were hesitant to use the PDA due to their lack of preparation in the use of technology (George & Davidson, 2005). In addition, many students found it difficult to devote time to learning how to use the PDA due to the intensity of the program (Kenny et al., 2009). Third year nursing students felt learning to use the PDA was much too time consuming to incorporate it efficiently into practice (Park et al., 2010). Some students did not feel they received the support they required because faculty did not have adequate experience and knowledge on PDA use (Farrell & Rose, 2009).

In a study that looked at the integration of tablets into nursing curricula, researchers gave faculty and students an iPad four weeks prior to implementation. Faculty felt this was not enough time to prepare for class. They needed more instruction on how to incorporate technology into their lesson plans, classroom activities,

simulations, and clinical rotations. Students also felt unprepared and often noticed a discrepancy between the information presented by their professor and information available on the iPad. It was interesting to note that an instruction manual with one-on-one student and faculty sessions with technical and instructional design staff were offered however few students and faculty attended (Swan, Smith, Frisby, Schafer, & Hanson-Zalot, 2012).

In summary, several studies identified barriers to the adoption of PDAs in nursing clinical and classroom education. These barriers included cost, technological difficulties, size of screen, and comfort levels of students and staff.

Strategies for successful implementation. Several articles focused on strategies for the successful implementation of mobile technology into current curricula. Cornelius and Gordon, (2006) describes the process used to implement the use of PDAs in an undergraduate-nursing program over a three-year period. Thirty-seven undergraduate nursing students were given PDAs with drug and laboratory assessments along with a geriatric assessment tool. The authors identified several strategies to improve the adoption of the PDA into the nursing program. This included an early introduction of PDA use by students prior to clinical work with comprehensive training for both students and faculty. Administrative and institutional support with a core informatics team was also important. In addition, the authors learned that having one standard device was essential to avoid compounded technical issues. Although the authors did not formally evaluate or test students' opinions and productivity, by the end of the three-year study, the response by students and staff were favorable (Cornelius & Gordon, 2006).

Scollin, Healy-Walsh, Kafel, Mehta, and Callahan (2007) found that the attitudes of students towards PDA use were most influenced by the faculty champion. Therefore, identifying a faculty champion for change is key in the successful adoption of PDAs into nursing curricula. A champion leader is also required to sustain ongoing work and support of the students (George et al., 2010).

Technology support should be an essential part of the budgeting process and a champion leader is needed to sustain ongoing work and support of the students. Faculty should be supported in their use of technology so that they may be role models for the students (George et al., 2010). In addition, the most important element for successful adoption was to provide training for both students and faculty (Cibulka & Crane-Wider, 2010).

The literature review on the use of mobile technology in nursing education is vast. Although the information presented is valuable, there are limitations to these studies. The sample sizes were small and students volunteered to participate. A more random selection from a larger population may produce a broader scope of what the participants experienced. In addition, the voluntary nature of the participants may have skewed the results towards more favorable findings. With respect to study design, the majority of the articles were descriptive in nature. Only three articles described a control group experimental design (Farrell & Rose, 2008; Kenny et al., 2009; Kuiper, 2008). More studies of experimental design may provide more information on a cause-effect relationship between mobile technology use and the benefits described.

PDA use in Dental Hygiene and Dental Education

Upon literature review of mobile technology in dental and dental hygiene education, only three studies were identified (Covington & Claudepierre, 2006;. Dyer, Presler, Raybould, Burklow, & Smith, 2006; Reynolds, Harper, Dunne, Cox, & Myint, 2007).

Covington and Claudepierre (2006) recognized the absence of research exploring the use of PDAs in dental hygiene education. The authors evaluated the use of PDAs by five dental hygiene students over the course of one academic year. The opinions of the participants were gathered through informal reports via email and a structured questionnaire. The participants' opinions on the usefulness of PDAs were generally positive (Covington & Claudepierre, 2006). Minimal guidance by faculty and the lack of software applicable to dental hygiene education were considered barriers to PDA use (Covington & Claudepierre, 2006).

Dyer et al. (2006), studied the effectiveness of hand held computer technology in tracking dental residents' clinical experiences. Faculty was able to tabulate types and frequencies of various clinical experiences, financial production summaries and percentage distribution of procedures by discipline. The authors also examined the opinions of the residents through a questionnaire regarding the use of handheld technology. In general, dental students favored the use of handheld technology in a clinical setting (Dyer et al., 2006). In addition, the students felt that the drug and medical software in the clinical setting were invaluable (Dyer et al., 2006).

Barriers to the implementation of handheld technology were identified. This included the cost of the units with maintenance and support (Dyer et al., 2006).

Technical issues such as battery charge and synchronization problems from off-site locations were also identified as barriers (Dyer et al., 2006). The authors suggest that proper training of students in techniques to maintain optimal battery use would eliminate battery charge issues (Dyer et al., 2006).

A pilot study by Reynolds et al. (2007), investigated the use of PDAs by undergraduate dental students in accessing a virtual learning environment in a dental clinic. A cross over trial of six students with PDAs and six students without was competed over twelve weeks. An evaluation of general and educational use and students' attitudes towards use was completed via online questionnaires and focus group discussions. Ninety percent of participants wanted PDAs as part of their dental kit. Specific benefits outlined by students included being able to keep notes of their lectures and individual study, the ability to keep a diary of their commitments including their undergraduate timetable, and having online access to support materials, particularly video materials (Reynolds et al., 2007). Poor battery life and memory problems were main barriers to use (Reynolds et al., 2007). These were overcome with hardware upgrades. Based on the pilot study, the dental institution recommended the use of PDAs throughout the five-year dental curriculum (Reynolds et al., 2007).

In summary, both dental and dental hygiene students favored the use of PDAs in clinical learning. Benefits and barriers on PDA use were similar to those found in nursing literature. There is no literature that identifies strategies to the successful implementation of PDAs into dental and dental hygiene education. The review of literature on the use of mobile technology in dental and dental hygiene education demonstrates a dearth of studies. A common limitation to all studies reviewed reveals the

use of small sample sizes. The results of these articles may not represent the general population of student dentists and dental hygienists. In addition, the participation of students in these studies was voluntary; perhaps only students with the most experience in the use of mobile technology were represented in these studies. Although the results of these studies are favorable in the application of mobile technology into dental and dental hygiene education, more work in this area is needed.

Implications for Dental Hygiene Practice

The dental hygiene profession in Canada has made great strides in establishing self-regulation and self-initiation of practice. Dental hygienists were previously required to work under the guidance of a dentist. With ability to self-initiate practice, many are setting up mobile practices to visit clients that are in rural settings, home bound, community health centers, cultural communities, and stand-alone dental hygiene clinics. In these settings, dental hygienists become part of an interdisciplinary health care team providing optimal oral heath care to a growing diverse population. Independent practice for dental hygienists requires increased access to health information at the point of care. It also requires communication with various health care providers to ensure proper safe care. Mobile technology resources provide the support needed to achieve competencies required in information-intensive healthcare delivery systems (George et al., 2010). Mobile technology, such as the PDA, allows for immediate access to important knowledge for practice as well as solidifying professional confidence by allowing the student to provide immediate patient feedback (White et al., 2005). While several articles have been published on the use of PDAs in nursing education, little work has been done in the application of PDAs in both dental hygiene practice and education (Covington &

Claudepierre, 2006). The lack of knowledge in this area creates a disadvantage for dental hygienists who must be able to participate in an interdisciplinary health care team.

Summary

There is a growing body of literature exploring the use of PDAs in nursing education. Unfortunately, very little work has been done to study PDA use in dental hygiene practice and education. A literature review in nursing education describes benefits and barriers of PDA use. In addition, strategies for the successful integration of PDAs into current curricula have been outlined. Based on these findings, health professions such as dental hygiene may benefit from the use of PDAs in practice and education. As more dental hygienists work in independent settings, the use of PDAs at the point of care may be essential to provide optimal oral health care to a growing diverse population.

Chapter 3 - Methods

This study involves a qualitative mixed methods design of descriptive statistics with descriptive interpretation of interviews. Quantitative data provided detail on the current use of mobile technology in dental hygiene education and practice. Qualitative data identified unknown processes of mobile device use and further developed fundamental principles that guided this study.

LimeSurvey was used to identify demographic information, mobile device use and patterns, and details of the potential use of mobile technology in dental hygiene education. This included descriptive statistics.

Qualitative descriptive methodology provided the methodological framework for describing and analyzing follow up telephone interviews. Qualitative description is inquiry that seeks to describe a specific phenomenon or experience from the participant's perspective. It is considered the most transparent of methodologies as it commits to describing data in the direct language and perspective of the participant. It is derived from naturalistic inquiry and is the least affected by theoretical and philosophical foundations.

In terms of analysis, the researcher is required to stay close to the data without getting deep and interpreting data based on theory. As a result, the descriptions are considered low inference. The benefit of low inference data is that researchers of the same study agree on each other's descriptions. These descriptions however, must display validity in that they must accurately convey events in proper sequence with true account of participants' story. As a result, it may be applied to obtain answers to questions of importance to practitioners and policy makers (Sandelowski, 2000).

Qualitative descriptive design involves combinations of sampling, data collection, analysis, and representational techniques. This methodology helps describe the current use of mobile technology in dental hygiene education and highlight perceptions of use by both faculty and students.

Sampling and Recruitment

Participants included faculty and students from the sixteen accredited dental hygiene schools located in Ontario, Canada. Contact information for these schools was obtained from the Commission on Dental Accreditation (CODA) website. The potential population sample for faculty and students was one thousand.

Upon ethical approval from the Athabasca University Research ethics Board, an introductory recruitment letter was sent to the program director of each school (see Appendix A). A final contact to non-respondent program directors was made using an alternate mode two weeks after the recruitment letter was sent. For example, if initial contact was made via email, a final contact was attempted via mail or telephone. Upon agreement of the program director, the program director emailed an information letter with informed consent and the online survey to faculty and students (see Appendix B). Survey participants were asked to provide contact information upon completion of the survey if they would like to participate in a follow-up telephone interview.

Purposive sampling was used to gather participants for telephone interviews. Inclusion criteria were respondents who agreed to participate in a telephone interview and responded to initial contact. The estimated sample size for the survey was thirty to forty with fifteen to twenty for telephone interviews.

Data Collection

The online survey questionnaire with information letter and informed consent was sent via email to faculty and students by the program director of each school (see Appendix C). Informed consent was included on the first page of the online survey form. The online survey included both close and open-ended questions. Upon completion of the survey, respondents were invited to participate in a follow-up telephone interview conducted by the primary researcher. Telephone interviews were semi-structured in design with open-ended questions (see Appendix D). The interviews were recorded. Follow-up interviews were not required.

Data Analysis

Descriptive statistics were obtained through univariate analysis. Frequency distribution and central tendencies described specific variables.

Telephone interviews were subject to *inductive content analysis*. Content analysis is used in qualitative description and involves six analytic strategies that are of common practice to other qualitative methods (Elo & Kyngas, 2007; Miles & Huberman, 1994). Content analysis in this study involved: (a) coding of data from notes, and interviews (b) recording insights and reflections on the data; (c) sorting through the data to identify similar phrases and themes; (d) looking for commonalities and differentiations among the data and isolating them for further analysis; (e) progressively deciding on overviews that hold true for the data; and (f) studying these generalizations with respect to knowledge that is known (Miles & Huberman, 1994).

Ensuring Rigor

Milne and Oberle (2005) describe strategies to enhance rigor in qualitative descriptive research. This includes attention to authenticity, credibility, criticality, and integrity (Milne & Oberle, 2005). These strategies were enhanced through the use of a methodological journal that provided an audit trail accounting for decisions made throughout the research process (Richards & Morse, 2007).

Credibility and Authenticity

The credibility of a qualitative descriptive study should be directly related to the purpose of the study. This involves accurately portraying the insider perspective maintaining authenticity. In order to establish authenticity, the participants must be able to speak freely, their voices are heard, and their perceptions are accurately represented. These requirements should be maintained throughout each stage of research.

Purposive sampling includes finding participants who have experienced the phenomena in question allowing for data that may truly reflect and represent the purpose of the study. It is also important to recognize that because data collection and analysis occur simultaneously, sampling may need to change and therefore be flexible. The use of content analysis ensures data-driven coding and categorizing (Milne & Oberle, 2005). Critical review of coding will be ongoing as new codes continue to emerge requiring re-examination of existing ones. Authenticity is also established by allowing codes to emerge from the data versus imposing them (Sandelowski, 2000).

Criticality and Integrity

A methodological journal was maintained by the researcher to increase the criticality and integrity of qualitative descriptive research. Reflection on the critical

appraisal applied to every research decision ensured criticality. Constant reflection on the researchers' bias promoted integrity. The dual role of clinician and researcher during the interview and analysis was reflected on by the researcher and documented through journaling.

The importance of ensuring authenticity, credibility, criticality, and integrity throughout the research process when studying PDA use in dental hygiene education is apparent. The researcher is a clinical dental hygiene instructor with minimal PDA use in education. Therefore, it was vital that the researcher maintain a methodological journal reflecting on his/her role as a dental hygienist/ clinician/ educator when obtaining data from the participant. The researcher separated and reflected on how he/she influenced the data to accurately record and represent the data in the language presented by the participants. This enhanced methodological congruence in qualitative descriptive methodology.

Ethical Considerations

Ethical approval was obtained from the Athabasca Research Ethics Review board. School contact information was taken from the Commission on Dental Accreditation of Canada website. Program directors for each school were notified of study details through the recruitment introductory letter. Participants were notified of the purpose and timeframe of study. In addition, all participants completed an informed consent. The researcher informed participants of the voluntary nature of the study and the confidentiality of their identity. Surveys, tapes and notes from telephone interviews were kept locked in a filing cabinet at the primary researcher's residence. Data will be kept secure for five years.

Significance Statement

Despite the many reported benefits of mobile technology in the education of health care providers, very little investigation of their use in dental hygiene education has been conducted. As employment of dental hygienists in independent settings is the norm, the use of mobile devices in their education may equip them with skills and tools needed to provide up-to-date oral health care to their clients. It is anticipated that exploring the current use of, and perceptions about mobile technology, from the perspective of dental hygiene educators and students will provide key information to inform dental hygiene curricula and practice.

Chapter 4 – Results

In this chapter, data from the online survey and telephone interviews are described. Ten of the sixteen accredited dental hygiene schools in Ontario participated in the study. From the ten schools, five agreed to participate upon receiving the initial recruitment letter while three schools required their own institution's ethical approval prior to participation. Four schools agreed to participate after several emails and telephone contact. Four schools refused to participate while two schools did not respond to several emails, and phone messages. Initial contact was made with recruitment letters that were sent out via e-mail early November 2012. The information letter, and survey were sent to those who agreed to participate in January 2013. Ethics approval was achieved for the last participating school in May 2013.

From the ten participating schools, there was an estimate of ninety dental hygiene educators and six hundred dental hygiene students. Thirty-three dental hygiene educators participated in the online survey and five participated in a telephone interview. Fifty-seven dental hygiene students participated in the online survey and of these, seven participated in a telephone interview. A 37% response rate was achieved for dental hygiene educators with a 10% response rate from students in the participating schools.

Demographics

The initial part of the survey gathered demographic information on both educator and student participants.

Educator demographics. Information on participants' age, years of teaching experience, area of teaching, and employment status provided a description of the participants' overall teaching experience. Participants were also asked to provide

information on their current experience in private practice. The purpose was to describe educators' experience outside of teaching, within a clinical environment. Figure 2-6 reveal educator characteristics.

Figure 2. Years Worked as Educator

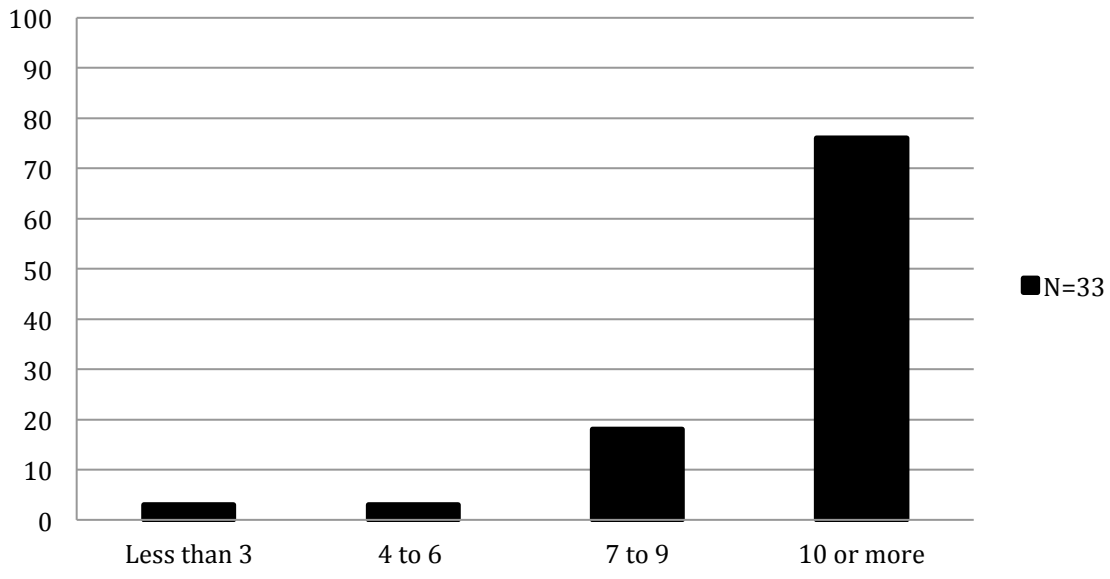


Figure 3. Educator's Age

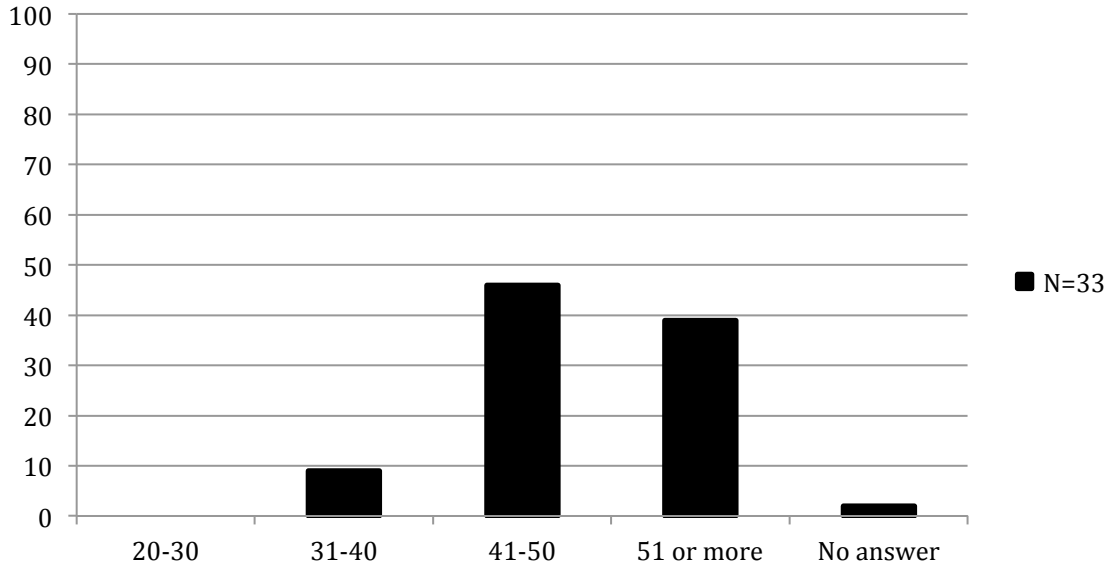


Figure 4. Teaching Role

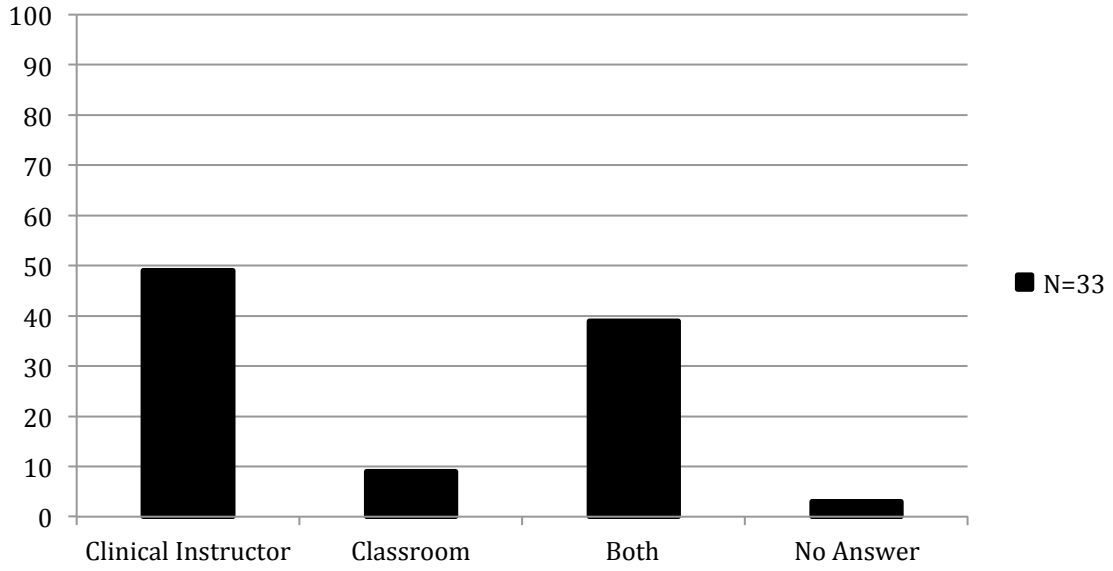


Figure 5. Dental Hygiene Educator Employment Status

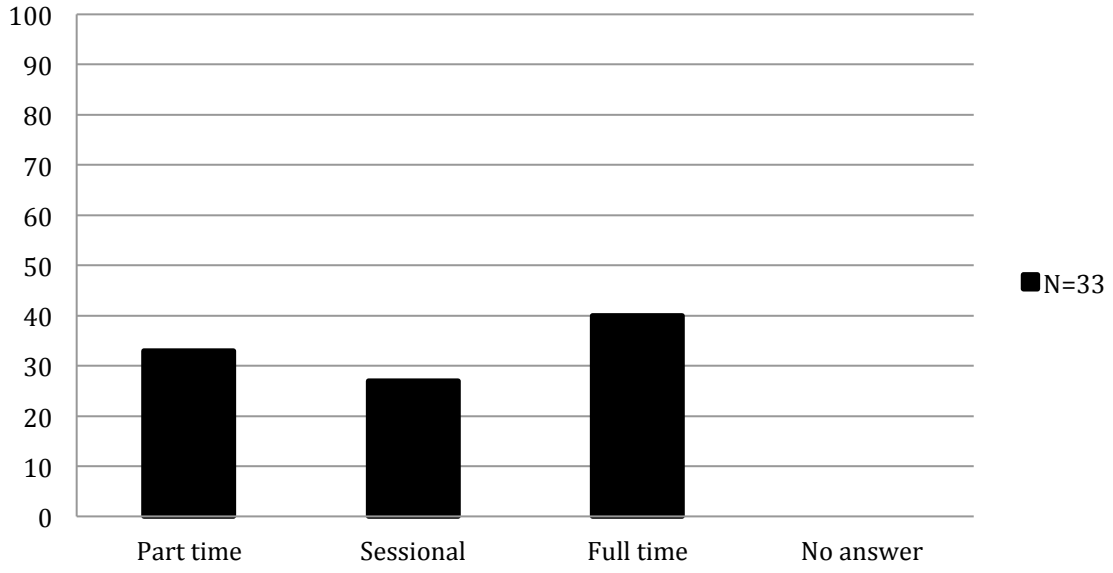
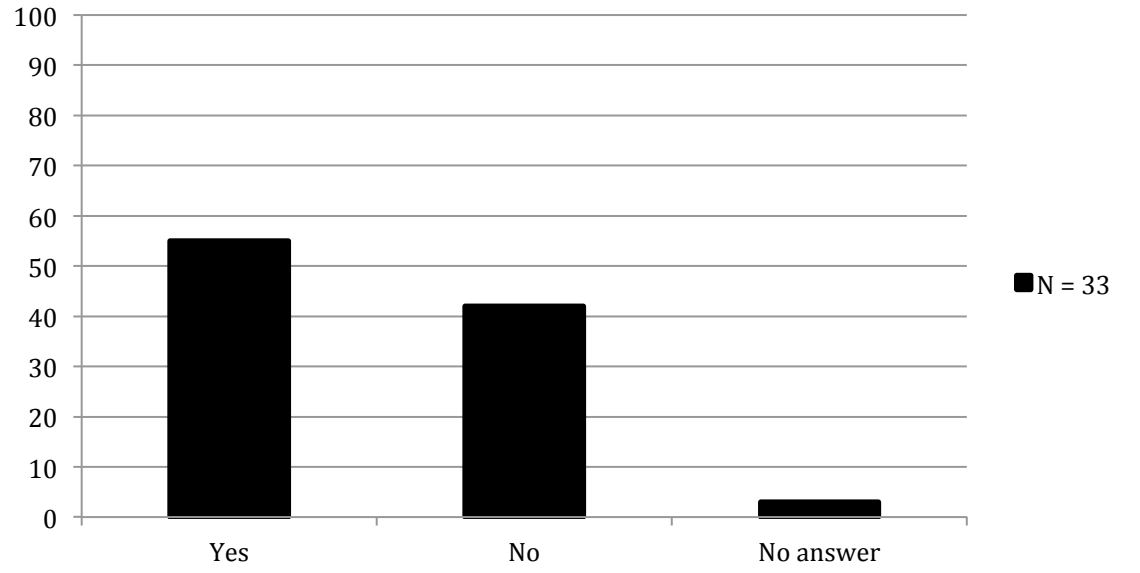


Figure 6. Private Dental Practice Experience



Dental hygiene educator participants were mostly between the ages of forty one to fifty years old (46%) having ten or more years of experience in education (76%). Almost half worked full time (40%) while most (60%) worked part time or sessional hours as clinical instructors. Just over half of the participants also worked in a private dental practice (55%).

Student demographics. Information on student participants' sex, age, and year of study provided background on student characteristics. Figures 7-9 reveal the results of student participants.

Figure 7. Student Sex

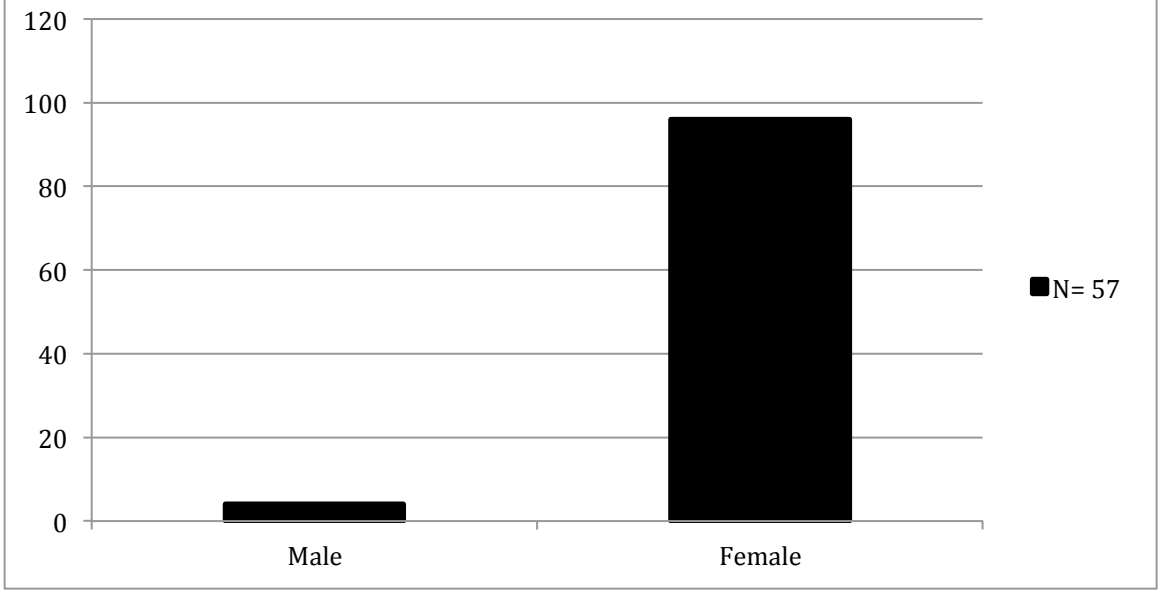


Figure 8. Student Age

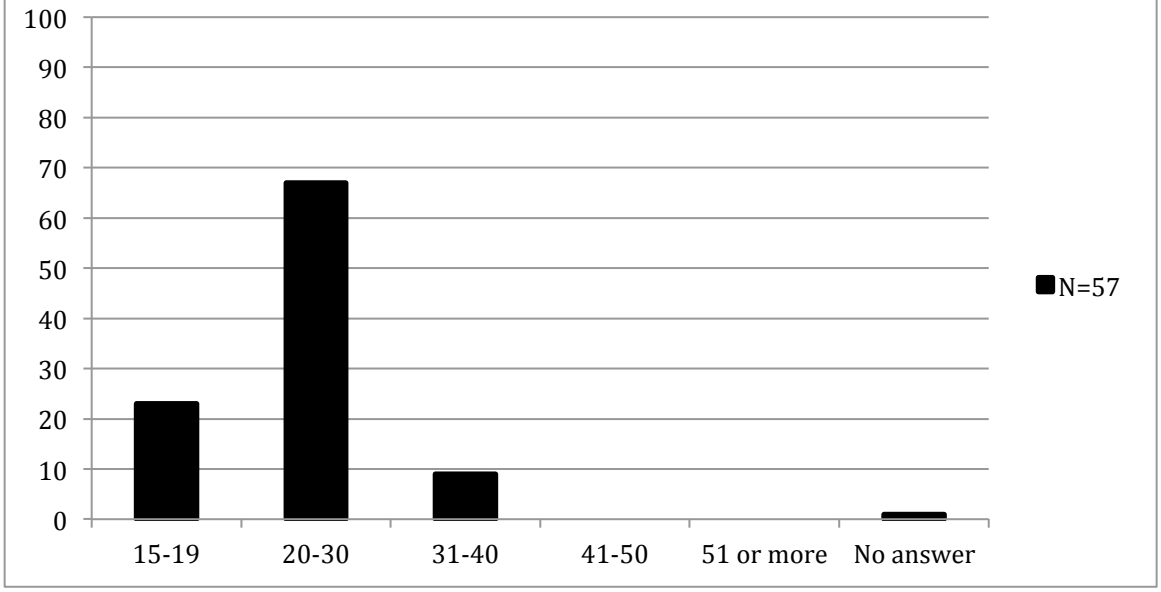
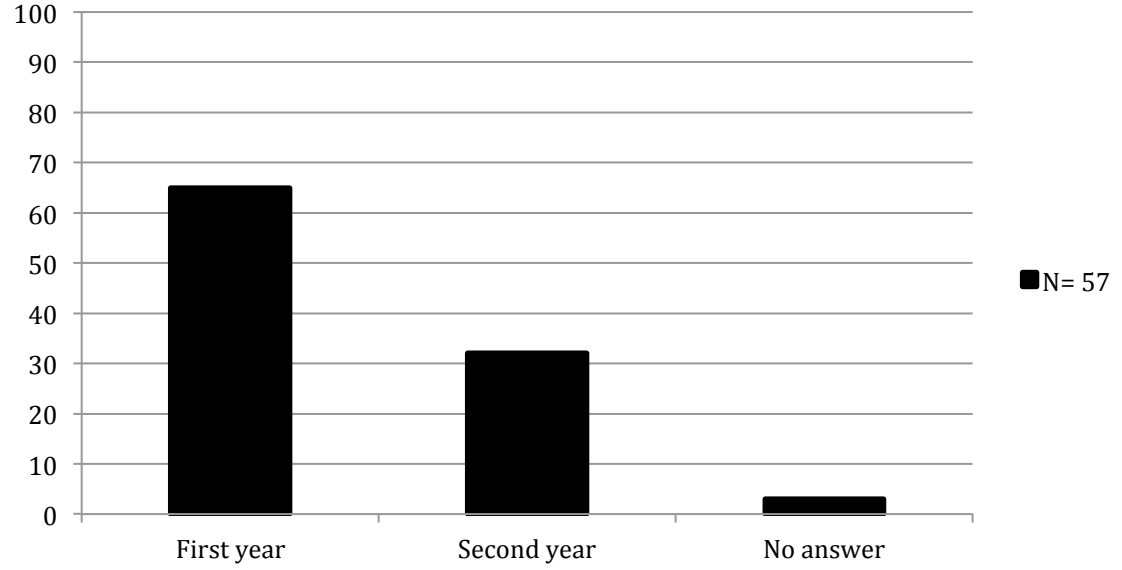


Figure 9. Year of Study



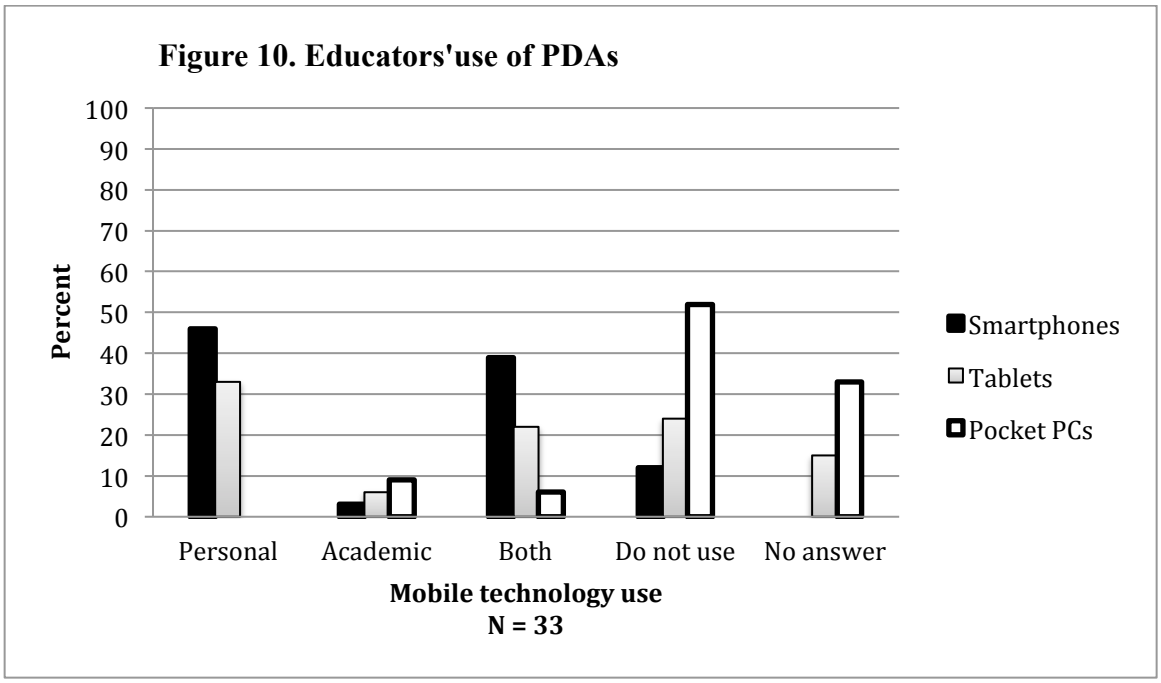
Dental hygiene student participants were mostly female (96%), between the age of twenty to thirty years old (67%), and in their first year of study (65%).

Overall, educator participants included an older age group with ten or more years of teaching experience. The group consisted of a mix of both clinical and classroom experience and over half also worked in a private dental practice. Student participants were predominantly female and consisted of a younger age group, within their first year of study.

Mobile Technology Use

In order to understand the current use of PDAs by dental hygiene educators in practice and education, a series of questions regarding PDA use were given. Participants were asked about online resources they used with students and whether or not they promoted the use of PDAs for their students' learning.

Educator data. Figure 10 reveals educators' use of smartphones, tablets and pocket PCs.



Dental hygiene educator participants used smartphones (46%) and tablets (33%) for personal use. Most did not use Pocket PCs. Many more used their smartphones than those using tablets for both personal and academic use (39%). Also, the majority of the respondents had data plans associated with their mobile device (76%).

Resources. Dental hygiene educators were asked about online resources they utilized with students. Table 1 reveals forms of communication educators used with students. Table 2 reveals resources or tools they used with their students.

Table 1

Educator Communication with Students

Form of Communication N=33	Currently use (%)	Plan to use (%)	Don't use/no plans to use (%)	No Answer (%)
Email	91	0	9	0
Text messaging	3	3	55	39
Instant messaging/online chatting	9	6	49	36
Twitter	3	0	55	42
Facebook	6	6	48	39
LinkedIn	3	0	55	42
Other social network sites	3	0	52	45
Social studying sites (Cramster, CourseHero)	0	0	58	42
Phone like communication over the internet (Skype, G-chat)	6	0	52	42
Course learning management system (WebCT/Blackboard)	89	3	3	7

Table 2

Resources used with Students

Resource N=33	Currently use (%)	Plan to use (%)	Don't use/no plans to use (%)	No Answer (%)
Course learning management system (WebCT, Blackboard)	94	0	0	6
E-portfolios	21	0	33	46
Web based word processor, spreadsheets, presentation software (Google documents, Prezi)	46	0	24	30
Wikis (Wikipedia, course wiki etc.)	18	6	33	43
Blogs	6	3	45	46
Recommend an article or information online by tagging/bookmarking/"liking"	30	9	24	36
Online forums or bulleting boards	27	6	30	37
Podcasts and webcasts	18	9	27	46
Web based videos	39	3	24	34
Video sharing websites (YouTube, etc.)	52	9	15	24
Photo sharing websites (Flickr, Snapfish etc.)	12	3	30	55
Simulation or educational games	21	15	24	40

Dental hygiene educator participants used email (91%) and course management systems (WebCT/Blackboard) (89%) as a main form of communication with students. Most educators did not use and had no plans to use Twitter (55%), LinkedIn (55%), social study sites (58%), and phone like communication over the Internet (52%). Although most participants did not use text messaging (55%), instant messaging/online chatting (49%), and Facebook (48%), some indicated that they planned to use in their teaching for the next semester.

A course management system (WebCT/Blackboard) was also used as a resource/tool with students (94%). Web sharing videos such as YouTube (52%) and web based docs (46%) were also popular resources. In addition, educators recommended an article or information online by bookmarking, tagging and or "liking" (30%). Some educators reported using simulation or educational games as a teaching tool (21%) while others planned to incorporate in their next semester (15%). The use of blogs (6%), and photo sharing sites (12%) was least popular amongst participants.

Mobile technology use in classroom and clinic.

Educator participants were asked if they recommended that students use their mobile devices to facilitate their classroom and or clinical learning. They were also asked what ways they encouraged students to use their mobile devices to facilitate classroom and or clinical learning. Figure 11- 12 reveal survey results.

Figure 11. In the past academic year, have you asked students to use their mobile devices for learning?

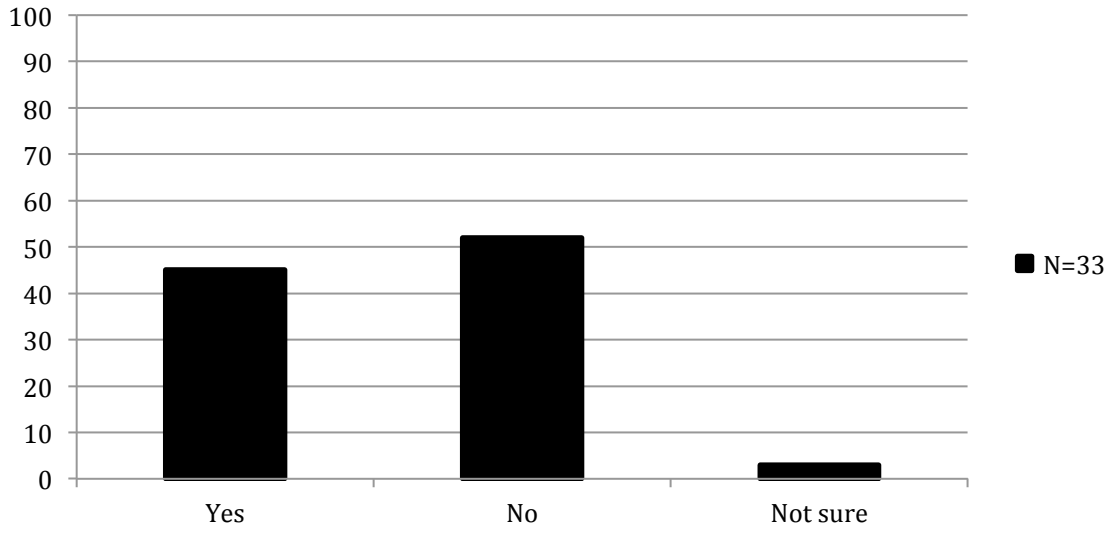


Figure 12. How often have you asked your students to use their mobile device for learning?

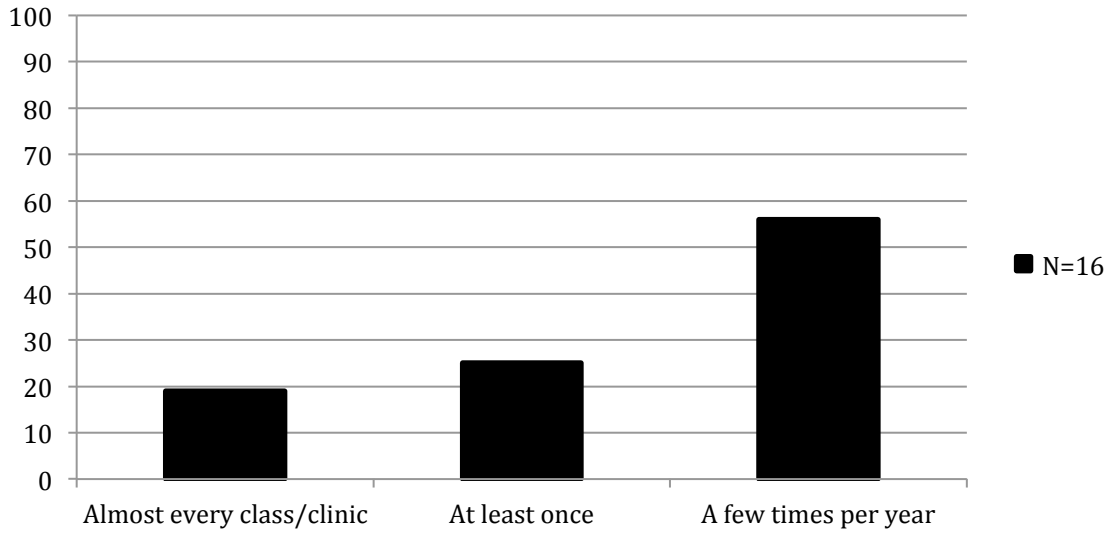


Table 3

Applications/ Tools Educators Encouraged Students Use to Facilitate Classroom and or Clinical Learning

Applications/ Tools N= 33	Educator positive response (%)
Encourage students to use the datebook to manage their schedule.	18
Encourage students to use the address book to save contact information	15
Encourage students to use medical and dental references for clinical use	24
Encourage students to use clinical tools	15
Encourage students to use apps for tracking	6
Encourage students to communicate and interact with each other – via email, chats, forums, discussion boards, etc.	39
Encourage students to access information on the Internet	48
Use custom apps for teaching	12
Encourage students to access electronic resources/libraries	42
Use Blackboard/WebCT	52
Email or text me	45
Play audio and video podcasts	18
Use e-books	24
Play educational games	12
Use mobile assessments (quizzes)	12
Poll/survey using mobile devices	6
Encourage students to create and share audio, photos, video	15
Incorporate social/professional networking activities in teaching	12
To access STU-View	12
Send reminders and notifications of homework, tests, quizzes, exams, class cancellations	30
Encourage lecture capturing	12

Despite the evidence of mobile technology usage by dental hygiene educators, less than half asked students to use mobile devices to facilitate classroom and clinical learning (45%). In addition, they asked students to use mobile devices only a few times

per year (56%). They predominantly recommended that students use mobile technology to access Blackboard/ WebCT (52%), information on Internet (48%), email/text (45%), use electronic libraries (42%), and send reminders and notifications of homework, tests, quizzes, exams, class cancellations (30%). Some encouraged students to communicate and interact with each other via email, chats forums, discussion boards (39 %). Encouraging students to use apps for tracking work was least popular (6%).

Evaluation of student mobile device use. Educator participants were asked how they evaluated mobile learning and how effective mobile devices were in facilitating student learning. Figure 13- 14 reveal participant results.

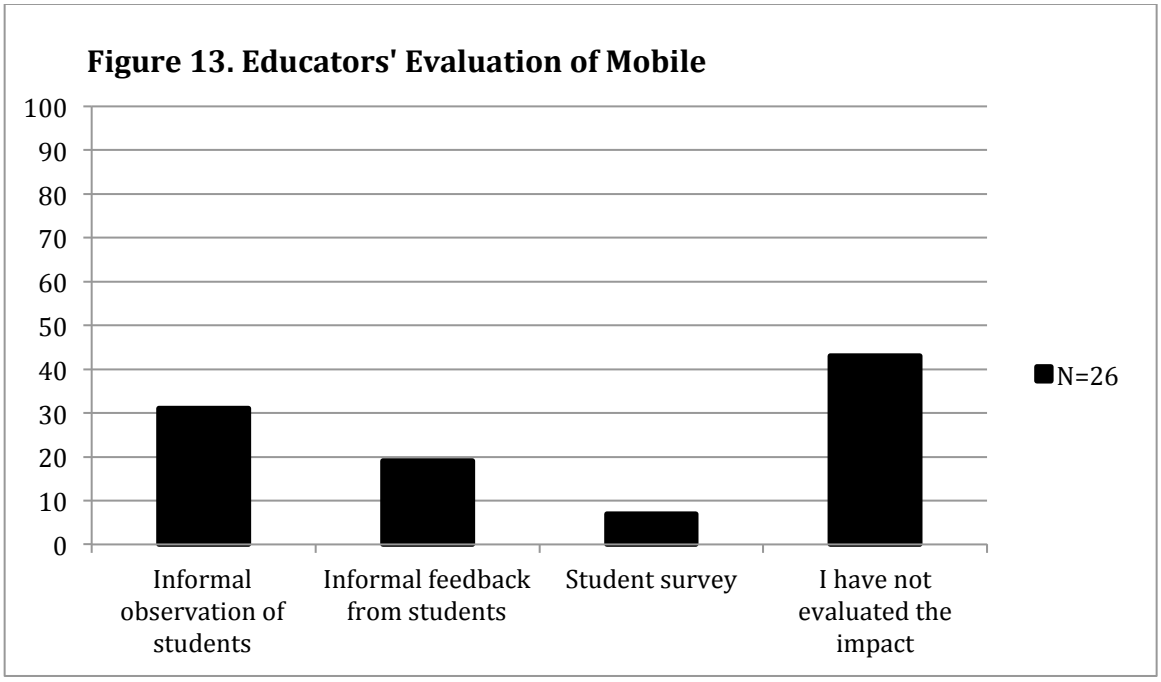
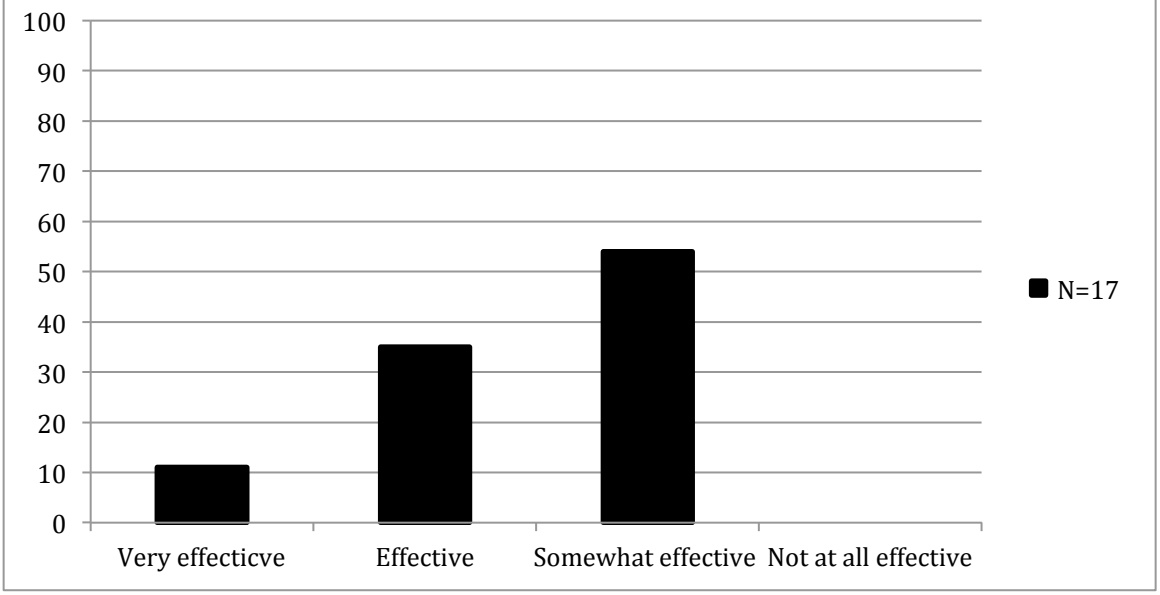


Figure 14. Effectiveness of Moblie Device



Although only sixteen participants out of thirty-three participants recommended students use a mobile device for learning, twenty-six participants reported that they evaluated the impact of mobile learning. Most educator participants evaluated the impact of mobile learning (57%) but found that mobile learning was only somewhat effective (54%).

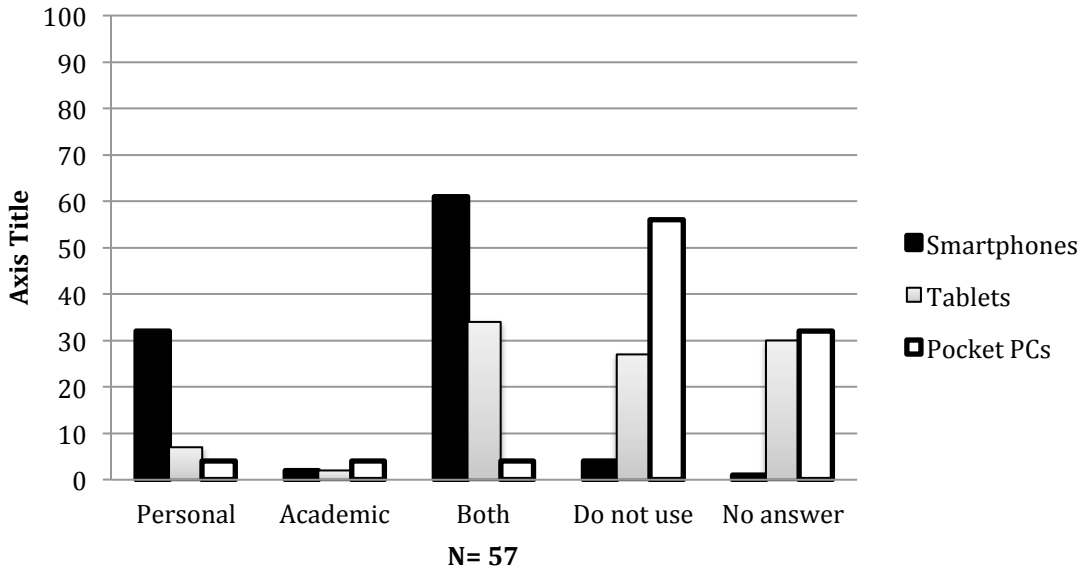
In summary, most educator participants used either a smartphone or tablet for both personal and academic purposes. In addition, most had a data plan associated with their mobile device. Course management systems such as WebCT/Blackboard and email were main forms of communication with students. WebCT/Blackboard was also used as a resource/tool with students, along with web sharing videos such as YouTube and web based documents.

Despite participants' use of mobile devices for both personal and academic purposes, most did not ask their students to use a mobile device in their learning. In

addition, most only asked their students to use a mobile device a few times per year. They recommended that students use mobile technology to access Blackboard/ WebCT, information on Internet, email/text , use electronic libraries, and send reminders and notifications of homework, tests, quizzes, exams, class cancellations. Many encouraged students to communicate and interact with each other via email, chats forums, and discussion boards. In addition, most educator participants did not evaluate the impact of mobile learning and of those that did, they found them to be only somewhat effective.

Student data. In order to understand the current use of PDAs by dental hygiene students, a series of questions regarding PDA use were given. Participants were also asked about online resources they used and if educators recommended using their mobile devices for learning. Table 4 reveals students' use of smartphones, tablets and pocket PCs

Figure 15. Student Use of Mobile Technology



Results reveal that most student participants used smartphones (61%) and tablets (34%) for both personal and academic purposes. Most student participants did not use

Pocket PCs. Also, most had a mobile Internet data plan for their mobile device (82.46%)

Resources. Dental hygiene students were asked what online resources they utilized. Table 5 and 6 reveals results; it is important to note that the option to pick "no answer" was given.

Table 4

Student Communication with Professors/Instructors and Other Students

Form of Communication N= 57	Currently use (%)	Plan to use (%)	Don't use/no plans to use (%)	No Answer (%)
Email	93	2	2	3
Text messaging	68	0	21	11
Instant messaging/online chatting	38	2	38	22
Twitter	20	2	59	19
Facebook	64	0	21	15
LinkedIn	2	11	58	29
Other social network sites	18	7	48	27
Social studying sites (Cramster, CourseHero)	5	9	55	31
Phone like communication over the internet (Skype, G-chat)	38	7	39	16
Course learning management system (WebCT/Blackboard)	79	0	5	16

Student participants indicated that they communicated most through email with their professor/instructor and peers (93%). Many utilized WebCT/Blackboard as a form of communication (79%). In addition, many also used texting (68%) and Facebook (64%) to communicate with both educators and peers.

Table 5 – *Students' Use of Online Resources/ Tools*

	Currently use (%)	Plan to use (%)	Don't use/no plans to use (%)	No Answer (%)
Course learning management system (WebCT, Blackboard)	95	0	3	2
E-portfolios	2	12	51	35
Web based word processor, spreadsheets, presentation software (Google documents, Prezi)	63	7	19	11
Wikis (Wikipedia, course wiki etc.)	55	5	25	15
Blogs	16	5	54	25
Recommend an article or information online by tagging/bookmarking/"liking"	32	11	37	20
Online forums or bulleting boards	25	9	42	24
Podcasts and webcasts	18	5	54	23
Web based videos	47	4	29	20
Video sharing websites (YouTube, etc.)	62	4	18	16
Photo sharing websites (Flickr, Snapfish etc.)	27	5	45	23
Simulation or educational games	19	11	44	26

The majority of student participants used a course management system such as WebCT/ Blackboard as a learning resource (95%). They also used web based processor, spreadsheets, and presentation software such as Google Docs, and Prezi (63%). Wikis (55%), and video sharing websites such as YouTube as a learning resource (62%) were also popular amongst student participants. Interestingly, many did not use or plan to use podcasts or webcasts (54%), e-portfolios (51%), Blogs (54%), photo sharing sites (45%), and simulation or educational games (44%). However, some plan to use e-portfolios (12%), and simulation games (11%).

Mobile technology use in classroom and clinic. Dental hygiene student participants were asked if their professor/instructor recommended they use their mobile

device to facilitate their classroom and or clinical learning. They were also asked how often they used mobile devices in the classroom or clinic, and how effective they felt mobile devices were in facilitating their learning. Figures 15 to 17 reveal student participant results.

Figure 16. Within the past academic year, have you been asked by your professor to use a mobile device for learning?

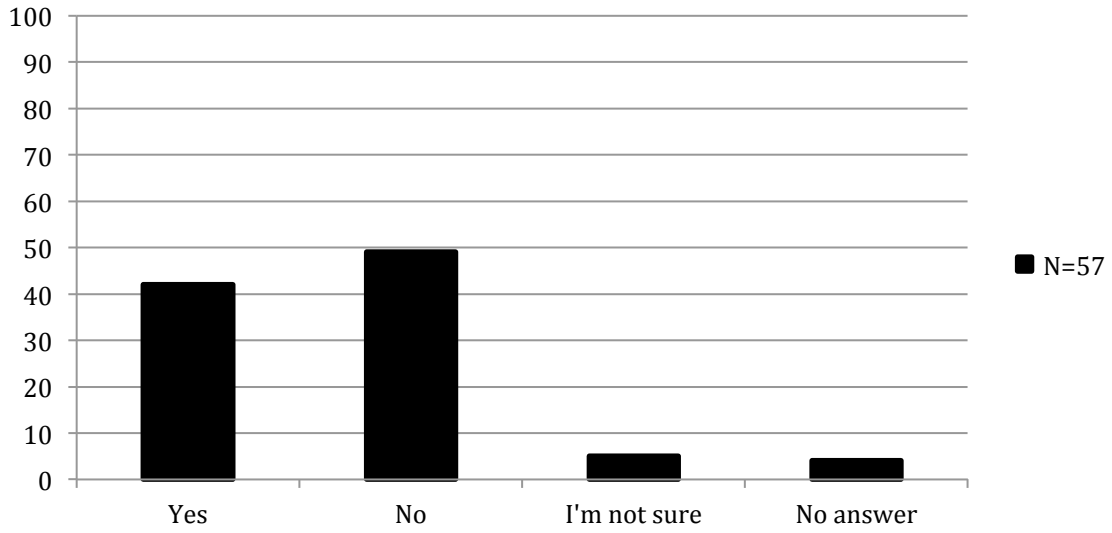


Figure 17. Within the past academic year, how often do you use a mobile device to facilitate your learning?

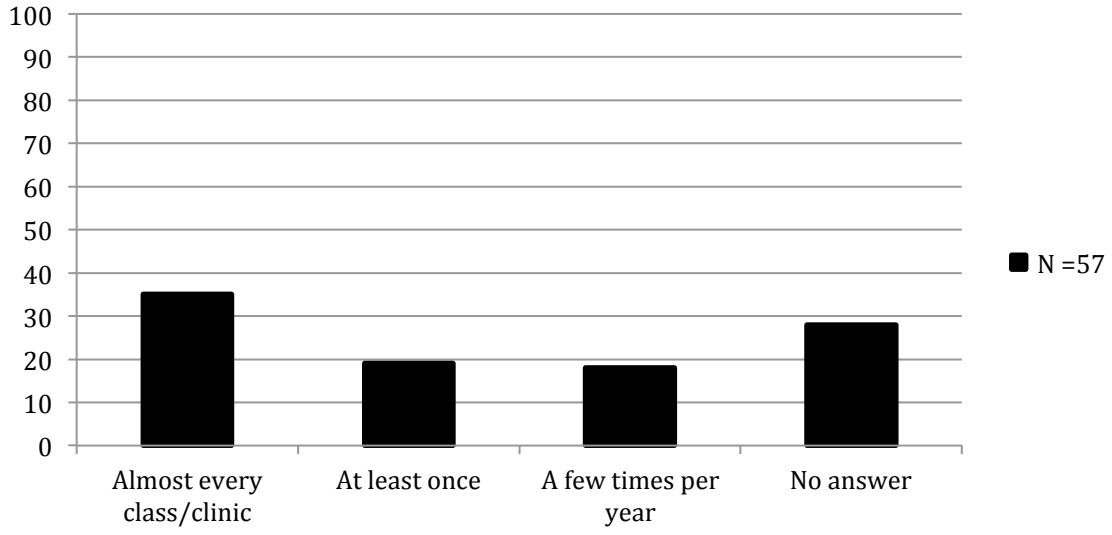
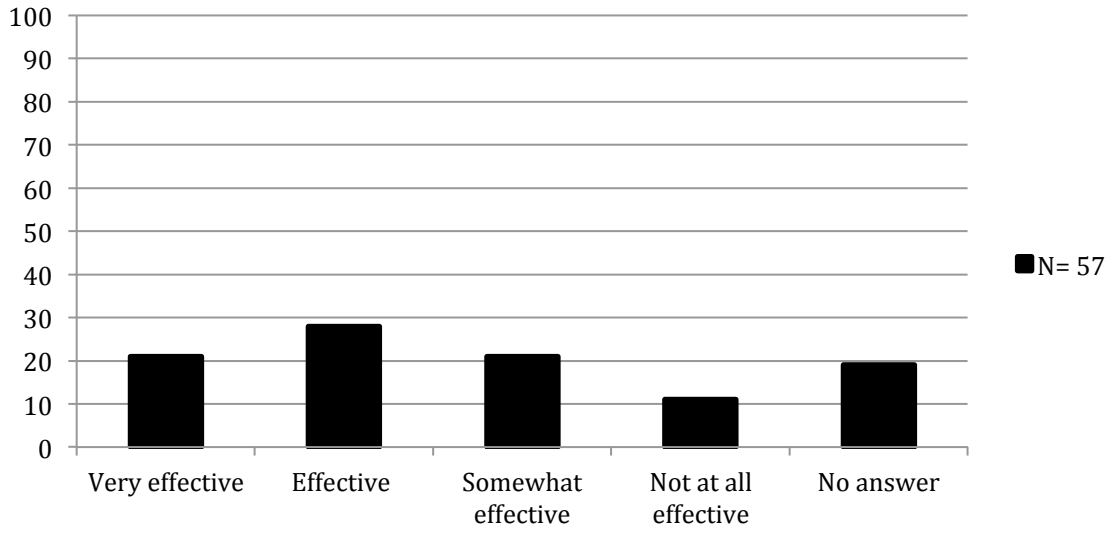


Figure 18. Effectiveness of Mobile Technology Use by Students



Many students who participated in the survey were not asked by educators to utilize their mobile device for educational purposes (49 %) however more than a third of them used a mobile device in almost every class/clinic (35%). In addition, many found their mobile device to be effective in facilitating their learning (28%) and some found them to be very effective (21%).

As with the educator participants, most student participants had a data plan and used smartphones and tablets for both personal and academic purposes. Students also used email and WebCT/ Blackboard to communicate with both educators and peers. Both texting, and Facebook were used in communication however; educators did not utilize these resources. Similar to educator participants, student used WebCT/Blackboard and web based documents as a learning resource.

Perceptions of use

A Likert five-point scale was used to determine educator and student perceptions of PDA use in education. Participants were asked how they felt about each statement.

It should be noted that participants had the option of picking "no answer".

Educator data.

Table 6

Educators' Perceptions of Mobile Technology Use

Perception (N=57)	Strongly Agree (%)	Agree (%)	Neither (%)	Disagree (%)	Strongly Disagree (%)	No Answer (%)
1. Professors/instructors should incorporate the use of mobile devices in the classroom to impact students' academic success.	18	46	21	15	0	0
2. Mobile devices belong in a classroom.	18	36	30	6	18	7
3. Mobile devices belong in clinic.	9	33	18	21	6	13
4. It is the professor/instructor's responsibility to provide students with adequate training for the mobile technology used in courses.	9	27	31	15	9	9
5. Mobile technology has a role outside the classroom, to assist with or supplement classroom learning.	27	58	6	3	0	6
6. Professors/instructors should use new andcutting-edge technologies in their teaching.	27	33	27	9	0	4
7. Students get more actively involved in courses that use mobile	15	27	34	9	6	9
8. Students are more likely to skip classes when materials from course lectures are available online.	12	33	30	18	3	4
9. The use of mobile technology encourages collaborative learning.	9	42	36	3	3	7
10. Professors/instructors who incorporate mobile devices in their teaching are better able to	9	45	27	9	6	4
11. It is the responsibility of the college to ensure that professors/instructors are trained in the use of mobile	33	36	21	6	0	2

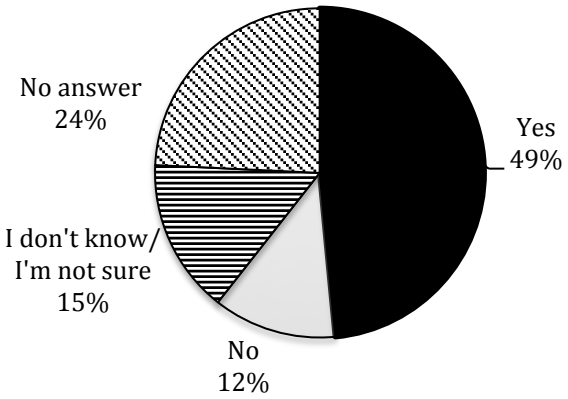
Overall, dental hygiene educators who participated in the study felt that professors/instructors should incorporate the use of mobile devices to improve students'

success (64%). Many also felt that educators should use cutting edge technology in their teaching (60%), of these twenty-seven percent strongly agreed and thirty-three percent agreed. Around half of the participants agreed that mobile devices belong in the classroom (54%) and clinic (42%). More agreed that mobile technology had a role outside of the classroom to assist with or supplement classroom learning (85%).

Many dental hygiene educators who participated in the survey felt that students were more actively involved in courses that use mobile technology (42%), only a few disagreed (15%). They also felt that students were more likely to skip class if materials from courses or lectures are online (45%), some felt indifferent (30%), and only a few disagreed/strongly disagreed (21%). However, they also thought that instructors/professors who incorporate mobile devices into their teaching were better able to understand and connect with their students (54%).

Many of the participants felt that it was the professor/instructor's responsibility to provide students with adequate training for the mobile technology used in courses (36%), while some neither agreed nor disagreed (30%), and a small group disagreed (24%). Most agree that it is the responsibility of the college to ensure that professors/instructors are trained in the use of mobile devices/technology (69%) while within this group some strongly agreed (33%).

Figure 19. Have you experienced barriers in incorporating mobile technology into your teaching? N =33



When participants were asked if they experienced barriers to incorporating mobile technology into their teaching, forty-nine percent answered yes and twelve percent answered no.

In summary, many dental hygiene educators who participated in the study felt that professors/instructors should incorporate the use of mobile devices to influence students' success. They felt that mobile technology belongs in the classroom and in the clinic. Participants also felt that mobile technology has a role outside the classroom to assist with or supplement classroom learning.

Many participants felt that students were more actively involved in courses that use mobile technology. Yet quite a few felt that students were more likely to skip class if materials from courses or lectures are online however, they also held the belief that instructors/professors who incorporate mobile devices into their teaching were better able to understand and connect with their students. Many of the participants felt that it was the professor/instructor's responsibility to provide students with adequate training for the mobile technology used in courses. Also, most agree that it is the responsibility of the

college to ensure that professors/instructors are trained in the use of mobile devices/technology.

Student data.

Table 7. *Students' Perceptions of Mobile Technology Use* N = 57

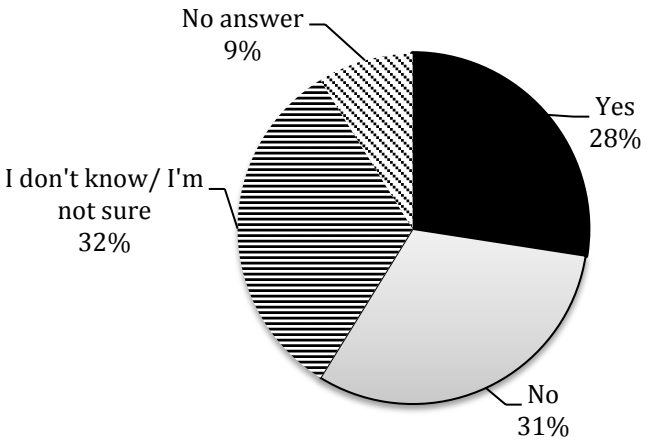
	Strongly Agree (%)	Agree (%)	Neither (%)	Disagree (%)	Strongly Disagree (%)	No Answer (%)
1. Professors/instructors should incorporate the use of mobile devices in the classroom to impact students' academic success.	18	34	23	18	4	3
2. Mobile devices belong in a classroom.	23	36	23	11	4	3
3. Mobile devices belong in clinic.	7	14	23	30	21	5
4. It is the professor/instructor's responsibility to provide students with adequate training for the mobile technology used in courses.	18	25	26	26	2	3
5. Mobile technology has a role outside the classroom, to assist with or supplement classroom learning.	36	45	13	2	0	4
6. Professors/instructors should use new and cutting-edge technologies in their teaching.	32	32	27	2	0	7
7. Students get more actively involved in courses	16	36	32	9	2	4
8. Students are more likely to skip classes when materials from course lectures are available online.	18	18	29	19	13	3
9. The use of mobile technology encourages collaborative learning.	21	23	32	13	4	7
10. Professors/instructors who incorporate mobile devices in their teaching are better able to understand and connect with their students.	14	38	25	13	7	3
11. It is the responsibility of the college to ensure that professors/instructors are trained in the use of mobile	21	25	27	14	7	6

Just over half of the student participants felt that professors and or instructors should incorporate the use of mobile devices in the classroom to influence their success (52%). They also agreed that educators should use new and cutting-edge technologies in their teaching (64%). Of those who responded, over half felt that mobile devices belong in the classroom (59%) but only twenty one percent felt that they belong in the clinic. Eighty-one percent of student participants agreed that mobile technology has a role outside of the classroom to assist with or supplement classroom learning.

Just over half of the student participants felt that they get more actively involved in courses that use mobile technology (52%). They also felt that students are more likely to skip classes when materials from course lectures are found online (36%). Just over half of student participants agreed that professors who incorporate mobile devices in their teaching are better able to understand and connect with their students (52%). Almost half (44%) felt that mobile technology encourages collaborative learning.

However, many did not feel that it was the educators' responsibility to provide students with adequate training for mobile technology use in their classrooms (43%). Forty- six percent of student participants felt that it was the responsibility of the college to ensure that educators are trained in the use of mobile technology/ devices.

Figure 20. Have you experienced barriers in incorporating mobile technology into your learning?
N= 57



When asked if student participants experienced barriers in incorporating mobile technology into their learning, many did not know or were unsure (32%). However, students were roughly evenly split between yes (28%) and no (31%).

In summary, student participants felt that professors and or instructors should incorporate the use of mobile devices in the classroom. They also agreed that educators should use new and cutting-edge technologies in their teaching. Many student participants agreed that mobile devices belong in the classroom but they did not belong in clinic. The majority believed that mobile technology has a role outside of the classroom to assist with or supplement classroom learning.

Similarly to educator participants, student participants felt that they were more actively involved in courses that use mobile technology. In addition, they also felt that students were more likely to skip classes when materials from course lectures are found online however they agreed that professors who incorporate mobile devices in their teaching are better able to understand and connect with their students. Interestingly,

contrary to educator participants' response to experiencing barriers, students did not feel that they experienced barriers in incorporating mobile technology into their learning.

Short Answer Survey Questions. Both dental hygiene educators and students were asked to complete short answer questions that required them to list barriers and the benefits of incorporating mobile technology into their current teaching or study. They were also asked to list software, apps, or sites that they used in their teaching and learning.

Educator data. Over half of the educator participants provided short answers to each of the questions listed.

Item 1. List the barriers you have experienced incorporating mobile technology/ devices into your teaching.

Twenty- two out of the thirty- three participants answered the question. Participants felt that at times, mobile technology in the classroom was distracting. In addition, they said that mobile devices were not permitted in the clinical setting.

With regards to mobile devices being a disruption in class, an educator wrote,

> I find that PDA's (particularly in a Wi fi environment) add a level of disruption to class.

Disruption was described as the use of mobile devices to access personal information, an educator wrote,

> Students are more involved in personal applications (i.e. Facebook using mobile devices) can be disruptive in class.

Another educator wrote,

> There is the concern that student will partake in personal communication if their phones are out and available.

Participants also felt that the lack of training and or time to learn how to properly use mobile technology made it difficult to guide students in proper use. Also, lack of administration support to provide flexibility in implementing mobile devices into current curricula was also noted as a barrier.

One educator wrote,

> Administration's lack of appreciation of the time required to properly design and integrate mobile learning activities into existing curricula.

Another educator wrote,

> Lack of knowledge with mobile devices and technology. Lack of flexibility in the program to implement such devices. Lack of authority to incorporate such devices.

In addition to lack of administration support, lack of IT to support technical difficulties was also seen as a barrier to mobile technology use in education. An educator commented,

> If the Wi fi is down and the class depends on the use of PDA's to access web information, then the class is impacted greatly. Lack of IT support.....it's left to professor to deal with student's technology related issues.

The cost of both technology and access to the Internet for students was noted as another barrier. One educator commented,

> Some students choose not have access to a mobile device. Students may not have a data plan to support learning. Students may not have the financial resources to either access a mobile phone or be able to pay for a data plan on their mobile phone. Mobile technology is ever changing, and students may not have the most current mobile device and can't afford to change as the technology change.

Item 2. List the benefits you have experienced in incorporating mobile technology in your teaching.

Twenty-two out of the thirty-three participants answered the question. Educators described students' instant access to information as a benefit of incorporating mobile technology into their teaching. One educator wrote,

> Students can quickly access information on their mobile device versus looking it up in a textbook, particularly related to pharmacology and pathophysiology concerns for the client. Students can efficiently schedule clients. Students can look up quick facts and access notes. Students can edit notes and power points.

Also, they felt that activity in class that involved mobile technology helped engage students and promote collaborative learning. One educator commented,

> Engagement with students within the classroom (is a benefit). Has them using a technology many are familiar with already. Makes them more apt to participate and respond whereas going to a learning management system may be something new for the student.

Another educator commented,

> Communication with students is enhanced with the use of mobile devices. Although I don't teach theory courses, I think using mobile devices are paramount if we are going to connect with our students and engage interest in the learners.

Item 3. List software and or apps that you currently use.

Several educators listed using blackboard, discussion boards, and online quizzes to facilitate learning activities. In addition, windows, Flicker, Facebook, Linked in, Pinterest, Stumble upon, QR codes, Tumblr, lockerz, and YouTube were also listed as tools used to facilitate student learning.

Item 4. List software and or apps that you have recommended to students use to facilitate classroom learning and clinical competencies.

Most participants indicated that they did not recommend anything different from what they were currently using themselves. One educator commented on how she recommended use of mobile devices within the clinical environment,

> Camera phones for intra-oral pictures. I have recommended websites and Internet searches when a student is trying to find information related to clients medical history or to provide further knowledge and understanding about diagnostic findings. I encourage them to return with the information for further clarification and discussion.

Overall, participants listed several barriers that impeded their use of mobile technology both in the classroom and clinical setting. They felt that mobile technology use in the classroom provided a level of disruption to the class. In addition, program policy did not allow for mobile technology use in the clinical setting. Lack of

administration support for training and the time required to integrate mobile technology into their teaching was also described as a barrier. Technological difficulties along with lack of IT support made it difficult for educators to successfully integrate mobile technology into the classroom. In addition, cost for both the technology and access to the Internet through data plans was seen as a barrier for students.

Participants described several benefits to incorporating mobile technology into their teaching. They felt that student access to information was key for student learning and that mobile technology helped engage students and promote collaborative learning. Educators also listed several apps and different software they used but didn't recommend anything different to students than what they currently used themselves.

Student data.

Item 1. List the barriers you have experienced incorporating mobile technology/ devices into your teaching.

Less than half of student participants listed barriers (42%). Those that experienced barriers felt that the main barrier was educators' lack of familiarity with technology. This caused educators to prohibit the use of mobile devices in the classroom and clinic. One student commented,

> Teachers often assume students are on social media websites such as Facebook. This is a barrier because with that thought the teachers do not allow the devices in the classroom and with the minimal information they provide in their power points combined with only hand written notes from lectures makes it difficult to get a 70% passing grade. When I am able to add notes into power points with quick typing it is easier to be successful. I do not have Facebook and in my

> opinion if students wish to go on Facebook or other social media sites during class it is there disadvantage not having the notes.

Another student commented on educators' lack of knowledge,

> Some teachers don't know how to work the programs they've chosen for the students to use. Some love mobile devices but most are against it.

Student participants also felt technological difficulties impeding access to free Wi fi was a barrier, as data plans were considered costly. Some students also found mobile technology use in the classroom distracting.

Item 2. List the benefits you have experienced in incorporating mobile technology in your teaching/learning.

Over half of the student participants (58%) listed benefits to incorporating mobile technology into their learning. They felt that the main benefit of mobile technology use in the classroom was immediate access to information. They felt this ultimately helped improve their study. A student wrote,

> My mobile device is very helpful to have at my fingertips, if my professor is lecturing, or when I'm studying and I don't understand something I can just look it up on the Internet.

One student wrote about how information accessed on her mobile device supplemented information provided by the professor,

> I expand on resources by looking to the Internet for additional content, other perspectives, and different memory cues, through blogs with discussions on related topics.

Another student wrote about his appreciation of the mobility of information,

> It is a great benefit to be able to have all information at hand, and to be able to study at any time or place or research information at very rapid paces.

Students also felt that their mobile device improved communication with both professors and peers. This allowed them to text classmates and or email faculty when they had questions or concerns. A student commented,

> Communication between students and teachers is more effective since everyone always have their phones on them it's easy to send a message that can be delivered directly to the recipient in a timely manner.

Student participants felt that mobile technology use improved their study for reasons of convenience and time management.

> I am able to take notes on my iPad, sync them to my home computer, and access them anywhere. Also, I'm able to get instant updates when a new file is uploaded to Blackboard.

Another student commented on how her mobile device helped her organize her schedule.

> I like scheduling things into my phone or iPad calendar as we have a lot of different events in dental hygiene. Another great benefit is apps for iPad or tablets that allow students to keep course schedules, add assignments with reminders, making it simple to keep track of our homework, as well as flash card apps.

One student commented on how he utilized his mobile device within the clinical environment to improve patient care,

> In clinic it's quicker to find a doctors or dentist fax number for the purpose of collaborating treatment for the patient. Sometimes the client asks certain questions which are not related to dentistry you can look up and answers them.

Like for example places to find low cost dental services. Also I have used my iPhone to download many apps that help us find the side effects and pharmacology of drugs.

Item 3. List software and or apps that you use to facilitate your learning experience.

Students listed Blackboard, Facebook, and email as their main resources for education and communication.

Overall, student participants listed faculty lack of experience and knowledge with technology as a major barrier for incorporating mobile devices into their learning experience. They also felt that technological difficulties that impeded access to free Wi-Fi as a barrier as data plans were costly. In addition, student participants felt that the use of mobile devices within the classroom can be distracting.

Student participants described various benefits to the use of mobile technology in their learning. Immediate access to information was a major benefit that improved their study by supplementing information provided by their professors. In addition, the use of mobile devices improved communication with both faculty and fellow students. Instant access to information along with improved communication added to improved time management and organization of their work and schedule. Mobile technology within the clinical environment helped students access information that improved client education.

Telephone interviews. Follow-up telephone interviews provided information on the current use of PDAs by dental hygiene educators and students. Participants also provided more detail on educator and student perceptions of PDA use. In particular, insights on the benefits, and barriers for PDA use were given. Participants also gave

examples of how they used mobile devices in education and also discussed strategies they employed to help overcome some of the barriers they have experienced.

Educator interviews. Fourteen out of the thirty-three educator participants provided contact information at the end of the survey. Of these, five dental hygiene educators participated in a follow-up telephone interviews. The five participants were educators from different schools. The interviews were semi-structured and were recorded on a digital recorder.

Benefits. All five participants had some experience in incorporating mobile technology into their teaching and felt that the use of mobile technology enhanced dental hygiene education. A major benefit described was the ability for students to access information anywhere and at anytime. They also felt that mobile technology incorporated into the curricula allowed for learner based education. It also helped foster curiosity, and supports interactive, and collaborative learning. Participants also felt that mobile technology use had the potential to improve how dental hygienists currently practice.

An educator commented on the ease of information access with a mobile device,

> I think that it just introduces students to kind of a new world of how things can be done and gives them an opportunity to just look up information easily and quickly that they might not have accessed before.

Another participant described student reactions to the ease of information access,

> In my night classes, the students come and they don't realize that they have lifelong online access to the library for example as a resource center. And to get them on an iPad or on their computer in the classroom depending on what

> classroom we are in and to get them using their phones to access information from the College resource center is so big! They are like, oh my goodness! It is like Christmas for them. They would look at all this information that they didn't realize they could access.

The benefit of mobile technology in the classroom setting was also emphasized an educator commented,

> It is wonderful when working on projects in class and when the technology works. It provides easy access to online databases for research and to blackboard for notes.

In addition, another educator stated,

> A benefit is the ability to have the material right in front of them (students) and they don't have to print it. Plus it allows them access to the world of information that is out there based on what they are learning in the class...

Educator participants also recognized the importance of information access anywhere, anytime. One participant discussed how she directs students on the appropriate use of their mobile device,

> I tell them you don't have to be on your Facebook, you don't have to be on twitter, you can be reading the articles I've uploaded for you. You can be looking at the apps, they can be doing all of this while they are commuting, while they are on the go train, while they are on the bus, while they are sitting and having lunch, so it becomes...it's their library, it's a traveling library for them, it's a traveling resource center.

Participants also noted that mobile technology use in dental hygiene education is learner based, fosters curiosity, and supports interactive, and collaborative learning. One educator commented on how mobile technology fosters curiosity,

> So if indeed the students can adapt to using these mobile devices for learning, then we expand their study time and we also foster their curiosity, which I think is the most important thing we can do in education. And I'll say to the students that if there's something you want to learn about log it in, like if you are curious about something read about it.

An educator commented on the benefit of mobile technology use in classroom group work supporting collaborative learning,

> Mobile device use in the classroom promotes collaboration amongst students while working in small groups. This makes it more interesting for students, improves participation. Online in-class puzzles etc. are fun and reinforce learning.

An educator commented on how the combination of current technology and the use of mobile devices by her students improved her presentations,

> The SMART Board technology has made some of my presentations more learner based and allow for feedback from the students, which can be incorporated into the presentation.

In addition to discussing the benefits of using mobile technology in education, educator participants also felt that it would benefit dental hygienists in their practice. One educator stated,

> You have the ability to access information. So for example the patient comes in and they are taking a drug you have never heard of or if the patient needs to access some specialist of some type or if you they trying to tell them where they can buy a certain type of electric toothbrush for home use. You can go online and figure out where is the closest shop that they might sell it.

Barriers. In addition to outlining the benefits of mobile technology use in the education of dental hygienists, several barriers were also described. Participants felt that mobile devices could often be a distraction for students. They also felt that faculty mindset and technological difficulties were the main barriers of incorporating mobile devices into their teaching. Many schools that participated in the study prohibited the use of mobile devices within the clinical environment. Main reasons for this included, infection control, and privacy issues.

In regards to distraction, one educator commented,

> Very often students who should be listening to a presenter or working on a specific in-class project are on line working or accessing material completely unrelated to the task at hand. I have noticed a great decrease in attention to and retention of class material in our new Wi fi environment …regardless of whether I provide a power point lecture style class or I provide an activity-based approach to the material.

Many educators felt that colleague mind set was often a major barrier when trying to incorporate mobile technology into their teaching. One educator commented on her personal experience at the institution she works for,

> It hasn't really been openly discussed, but I think there are many people that feel the students should not be on these devices in their classrooms and they take offense.

She also provided her opinion on perhaps why this may be the case for some colleagues,

> I do think there are some faculties that are not versatile with mobile devices and I see in meetings they feel a bit challenged; I don't want to use the word threatened because I don't think it's a threat but there's a gap and there's I think some people put up a wall where really it's not that big a deal but their comfort level is not there.
>
> And I think some of that relates to past bad experiences with viruses on computers, things like that that really aren't at all an issue on these devices but people are still injured from previous computer traumas and they haven't moved on to the new world yet. So I think that that's a big stepping-stone for a lot of people.

Another educator provided this personal experience,

> Many faculty are pretty concerned when having to incorporate mobile technology into their teaching due to their maybe lack of familiarity and feeling they would have to totally redevelop course so the way its being ruled out….

Technological difficulties that impede access to institutional free Wi fi have become a main barrier for mobile device usage within the classroom. An educator commented on the role of IT personnel, who deal with network projections for the institution,

> IT department does the best projections of what they anticipate the network load to be at the beginning of the school year the things that almost every time they underestimate that. Now it seems that the vast majority of students here have two or three mobile devices that are always on …..so that is a huge hurdle, just ensuring that you have the proper infrastructure to be able to handle it.

In general, students were not permitted to utilize mobile devices within the clinical environment. Privacy, and infection control were main issues emphasized by the participants. One educator stated,

> The whole infection control piece of the puzzle, how do we use this in an environment where infection control is important, how do we protect them how do we sanitize them what sort of protocols are we going to set in place to allow these devices entry in to the clinical environment and that is something we are still sort of trying to puzzle around with and see if we can locate best practices from a medical arena.

Another participant gave an example of how privacy became an issue within the clinical environment forcing a ban on mobile technology with students while in clinic.

> We had a case one time when one of our students was so proud of what she had done with her client that she posted a before and after picture of his mouth on Facebook. We learned a lesson; we never even thought that she would do this. But she was just excited about his improvement. The patient's sister recognized his smile and was very upset that her brother's photo was all over Facebook.

Methods and tools/apps used. Educators who participated in the telephone interview also shared how they have incorporated mobile devices into their teaching. For

the most part, educators incorporated activities that involved research and gathering data on the Internet in pairs or in groups. An educator stated,

> So if they have data plans they can be looking something up for me, I usually have them in pairs or three students looking up things on the Internet for example.

Another educator commented on how her method can be adapted to other health science students not only dental hygiene,

> I do the same thing with my teach oral pathology to dental technicians, when I lecture on those classes, for example I ask them go online, find notes about some type of treatment modality, evaluate it based on what you've learned and give me an opinion. Would you advise this, wouldn't you advise it is it academically sound, is it based on knowledge?

According to one educator, wikis helped her students collaborate,

> Wikis are really good for that, for them to be able to discuss with each other and change it on the go.... I just think that is a really neat way of being able to collaborate outside of the classrooms because if they have got so many other things going on, which they do, they can be doing that work... Anytime anywhere sort of thing.

In addition, Blackboard was popular amongst educators. An educator commented on her use of Blackboard to facilitate student learning,

> I upload my lectures to blackboard, so my lectures blackboard and there is a mobile app for blackboard and so the students can access my lectures on these devices.

She goes on further and describes apps that she encourages students to use,

> There are a few anatomy apps that I use, many of them you have to pay for but I don't use those. So if we do tutorial groups, they are my apps I pay for them I use them and I use them in that type of interaction with students but I don't require that they purchase them.

A participant described how she has students log into the college library to research specific topics,

> I have had them be able to connect with our college library. And that is significant because our students don't always use the library as well as they can because they kind of forget about it. They go to the Internet or whatever and they kind of forget about the search engines and the things that are specific to help scientists for example in our library. So in class we connect to the library and do searches and stuff through their hand held.

Although mobile devices were not permitted within the clinic she talks about how she utilizes her iPad with students and patients in clinic.

> In clinic, I share a site that I have my own iPad. Students have desktops at in their operatory, but often they have got their charts up there and they are looking at something. We would often be on my iPad looking at something else, that we just look up quickly. So I think I'm just using it more as an adjunct when teaching in clinic.

Strategies to overcome barriers. Educators also gave insight on strategies they used to overcome barriers experienced in incorporating mobile technology into their teaching.

One educator stressed the importance of collaborating with others,

> I think the main strategy is just getting out of our own silos and talking to other people and finding out what do you do, how are you doing it, have you thought about this issue, how do you cope with it? Trying to identify best practices. Sometimes we get too much in to the habit of trying to reinvent the wheel. We should first looking around us and see what possible solutions already exist. Sometimes we feel we have to do everything from scratch. We start to get a little overwhelmed as well and end up doing nothing, so it is again kind of a viscous cycle. But I think first and foremost we have to be looking at what others are doing.

The participant also shared a strategy to help overcome faculty inexperience, or resistance to the use of mobile technology in teaching,

> A goal for educators at the college is trying to add one or two mobile activities per course per year trying to make it a little easier for faculty to accept, get used to it more than anything else.

With regards to mobile devices causing a distraction in class, one educator described how she has dealt with this barrier,

> Students would be sitting in front of class and they would be watching You Tube for example, or they would be doing things that were distracting to the students behind them. I did have some students complain about that and I would make an announcement to the students to say if you are using a tablet or a laptop and you are not on the lecture material that they sit on the back row so that it's is not distracting to the people in front of them; that would be the only type of thing that I would suggest.

She also described how banning the use of mobile devices in the classroom unproductive,

> I think without doubt every student is using mobile devices and in the academic classroom their mobile devices are always in front of them, they are accessing information on them, they are interacting with them, they are using them not necessarily doing school work but... they are there... I don't think any effort that would go in to trying to put up a barrier would be worth it. Honestly, if a student really want to look up something or whatever why am I blocking them? Why I'm I going through all that effort? Why would I want to control the environment so much? I don't believe in that. They are mature learners and honestly, I don't want to put myself in that situation. If I was going to a lecture and somebody had blocked my access to Internet, I would not be happy about it and I don't know that I would see it as an open learning environment. It would get my guard for up for sure.

Another participant commented on how the college she worked for forced students to place their mobile devices in a basket before class started,

> I would have to admit that they really did try and institute this basket at the front door thing this year and I think they have just seen that it didn't work. People are still at that corner using with them on. So really what's the purpose, it doesn't make any sense. And so in my mind that is sort of, I mean, they are on them continuously so lets use them as part of the class, let them even if it is not everybody who has one, enough people in the class have one that even if they have to share they can. So if it going to be so invasive in their lives then lets stop fighting it and just make it part of the class.

Participants also emphasized the need to teach students how to use technology appropriately. One participant stated,

> We assume that the majority of the students coming in to college now are very tech savvy and we are finding more and more they are actually not. Students today are very tech social, but not really tech savvy. There is a lot of having to instruct the students and teach the students how to properly use these devices.

He then brings up the importance of defining who is responsible for teaching students how to utilize their mobile device,

> Should this be the professors' responsibility or should this be the college as a whole and how to best address this? If I am to teach all the pharmacology they have to know, how am I going to be able to take away an hour or two as a bare minimum to devote to teaching them, how to utilize their mobile device and teach them the things that they will be asked to do.

Overall, educator participants were quite experienced in incorporating mobile technology into their teaching and felt that their use had a positive effect on students' learning. They appreciated the ability for students to access information anywhere and at any time supporting a learner based education. Most participants asked students to use a mobile device to research information pertinent to both class and clinic. Participants felt that lack of experience with the use of mobile devices from both students and faculty were main barriers to the successful adoption. Proper guidance for student use rather than banning mobile devices was an important message brought through by participants. In addition, the need for collaboration and increased communication with faculty to find best practice solutions was also described.

Student interviews. Twenty- four out of the fifty-seven student participants provided contact information for a follow-up interview. All twenty- four were contacted and seven students participated in a telephone interview. The students came from different schools. Student participants provided insight on some of the benefits, barriers and strategies employed to alleviate barriers they experienced. Although most schools banned the use of mobile devices in the clinical environment, one student discussed how his class convinced faculty to change their policy and allow students to use their mobile device in clinic.

Benefits. All seven students utilized mobile devices for study and felt that mobile devices enhanced their learning. One of the main benefits was immediate access to information. They also felt it improved time management, communication with faculty, and overall learning experience. Student participants also felt that mobile technology could enhance how dental hygienists practice.

One student described her experience with her mobile device and accessing information,

> It is just it is easy to access all the information, the syllabus is online, and you can just get it. If you do not understand a concept you can quickly go on to YouTube or go and look at other resources online and you know that information. There is a wide knowledge of information and that is just available online that you can just get your hands on. So if the teacher is explaining a concept, you can quickly look it up when they give you a moment to read up on it. You can just go and look it up and if it is the way they are explaining it to you if they are helping, if they have a limited focus, you can just look it up online. It is just information at your finger

> tips, your PowerPoint presentations are online, you can look at those usually as opposed to looking at them on a piece of paper.

Another student commented on how it helps him during treatment with a client within clinic,

> For example, if I am taking a medical history some of the drugs that I am not sure of so I just take out my device and I check the drugs and it comes up with all the drugs reactions, control indications order of systemic effect and everything. And when we are updating the medical history sometimes the client doesn't know the dentist phone number or a fax, or a physicians fax, so and we have to put it there so we cant leave it empty so I Google it and they come up with the address and everything and then it has changed to fill the medical sheet.

Student participants also felt that using a mobile device improved their time management,

> A benefit…would be time management. This is crucial at this point of time because being in schools we have to record everything and it takes so much of time and referencing with the book so that even the drug group that we have it consumes a lot of time and then I don't know we have to tell the client to come up next appointment you have to bring the physicians phone number, fax, we need it, so it becomes easier for us to concentrate on things.

One student stated,

> It is really helpful and having access to black board is so helpful with knowing like when the assignments are due and if a teacher is posting announcements, and funding at your grades really quickly and having blackboards really helpful and just them posting activities and posting the notes and makes it a lot quicker and

> more convenient because I have an iPhone as well, so I can have the blackboard app on my phone, they can also find stuff out really quickly because I always have my phone with me.

Student participants felt that using mobile devices improved their learning. One student commented on how using a mobile device is learner centred.

> It gives you another perspective. It shows the different ways of learning, like reading from a book, if that is not working you can find different ways of understanding the concept. Especially for example when learning about Neurons, the way they have it in the book and the way teacher was explaining that wasn't working for me and for much of the class as well, so we just Googled it and the one that everybody adopted and now we will never forget it.

Student participants also thought that mobile devices improved communication with other classmates and educators. One student participant commented on the ease of communication with other students when working group projects. She also emphasized the importance of contact through a mobile device when class size is particularly large.

> Yeah, it worked out very well although would never really put files into blogs we kind of just texted each other because that was quicker, yeah but it if you are working with people you don't usually hang out with, the classes are fairly small so it is not that big of a deal but if with a huge class it is definitely beneficial.

Another student commented on how her smartphone improved communication with faculty,

> My smartphone allows for easy communication when people are missing, or sick. It's good for communicating with professors on days that you don't have class with them and easy to work on projects from home with your group.

Student participants also felt that mobile technology could enhance how dental hygienists practice. Although students had no experience working with clients outside of the learning environment, they provided their thoughts on how dental hygienist's could benefit from a mobile device. One student emphasized how a mobile device helps with patient education,

> We have something called chair side motivator for the patient oral health education so we used to have like a paper like hard copy, but no we all carry our devices with us into clinic. We have YouTube link in them so if we are doing nutrition counseling we just make some videos right there and we give the link to the client. So when they go home, they can actually look at it as we demonstrate it.

He also gave an example of patient feedback and interest,

> They actually like it the other day I had... a client who actually at his first appointment with me. He saw what I was doing on my mobile device and he was like so what is that? I explained it to him; he is 67 years old. At the next appointment he brought his personal questions to me, he was like so can you can find out this on your phone? I need to know this information…. I said for sure. And like he wanted to know different places where he can find low cost Dental services even though I provided a brochure he wanted to know more in details so I Google it and I showed him.

Barriers. Student participants also described barriers to incorporating mobile technology into their study. They felt that mobile devices could become a distraction for the professor during class. Educator's lack of familiarity with technology was also a barrier along with technological difficulties that affected Wi-Fi Internet access.

A student discussed how students get distracted from the lesson/ teacher,

> I can see in class people are not using them for like class purposes like searching Facebook and stuff. Smart phones and devices that have access to the Internet and the entire social media network so say, either in class or in clinic, you have a distraction.

Another student commented on how access to information may become more of a distraction during class activity,

> It's (mobile technology) considered a great distraction since its so easy to do many things at one time, we wont be entirely focused on what is being taught our attention might be diverted to other things.

Unlike educator participants, student participants also discussed how the mobile device could be a distraction for the educator. One student commented,

> I can see how some of the professors maybe feeling like they are not being like paid attention to because a lot of people are looking at their screens and they are not really looking at them.

Another student commented on why some educators dislike mobile devices in their classrooms,

> Some hate it. Some are like they see you using your phone they give you the evil eye and tell you to put it away or whatever but that is because it becomes very distracting for them.

Educator's lack of familiarity with technology was also described as a barrier for students to incorporate a mobile device into their learning. One student commented on her how her teacher asks students to post things for her,

> A lot of our teachers don't really understand how to use a program, so trying to use and they post things wrong or things they post are not up so we have to search for things. One of our teachers has someone else (student) post everything for her because she doesn't know how to do it.

Another student discussed how some educators are 'old school',

> They old school and are not that tech-savvy. For example, they might have a YouTube video they want to show but often something goes wrong because it is not set up right. Whatever it is, exactly, they don't know what to do so that is a problem. When they are making their power point presentations they are so large that they don't know how to condense them so they end up printing it all off for us. You can't see it online because the website wont let them put it online for them. So that will be a problem; I mean what are you going to do with a hand out it is more paper to carry.

Another barrier that student participants described was technological difficulties that impeded with Internet and Wi-Fi connection. One student commented,

> Well the Internet is a big one, so if the Internet is down you can't really do anything with the computer is because everything that we do is on blackboard.

A student described an experience she had while doing a presentation and the Internet went down,

> Yeah Wi-Fi is not working, and the Internet was down so that is the one instance that I found that was a draw back. We had presentations in communications techniques class and people had emailed themselves handouts and whatever where the information was. They were planning on showing a YouTube video what ever it was, some information on the Internet as part of their presentation. The Internet was down so I was one of the few students who had a data plan and I had an iPhone so I was able to piggy back my laptop Internet off my phone. That is why I was why my project was not affected like everyone else.

Methods and apps/software used. Student participants also described examples of how they incorporated mobile technology into their learning. They also gave insight on the particular resources and apps they found most useful. One student discussed how he uses his mobile device to access patient information when completing their medical history,

> If I am taking a medical history and there are some drugs that I am not sure of, I just take out my device and I check the drugs and it comes up with all the drugs reactions, control indications order of systemic effect and everything. And when we are updating the medical history sometimes the client doesn't know the dentist phone number or a fax, or a physicians fax, so and we have to put it there so we cant leave it empty so I Google it and they come up with the address and everything and then it has changed to fill the medical sheet.

Student participants were asked to describe the current apps and or resources they used. One student described how she uses YouTube to help her study dental anatomy,

> I just Google it and I am surprised with the information even YouTube, because it is not similar to what we are taught in school. Like for example, with dental anatomy everything is online and even our professor from dental anatomy encourages us to look it up on YouTube. She feels that the videos are much better than how she can explain it to us and she actually plays some of them in class. Even for psychology class. The teacher would play something off YouTube so it explains it better to us.

The student also discussed how she utilizes the voice recorder on her mobile device for study,

> I do a voice record for memorizing all the anatomy information. I go over them and make my notes. So I bring my phone in class and if I am sitting around I am listening to my voice memos and I am listening to my own notes over the phone. It is just another tool for me to use as opposed to looking at the information. I know I am also listening to it and that just helps memorize better.

She also describes how she records instrumentation demonstrations done by her clinical instructor,

> Like when I am in the clinic and the teachers are going over something, I ask them if they would allow me to record them when they are giving me hands on instructions. Like when I am getting a demo on instrumentation, I record it and so that I can go back and I can look at it being done properly.

One student described how students are part of a Facebook group to communicate with each other and share information,

> As soon as all of us know there is something we like one of us will message the teacher but we have created Facebook group that we are alone and as soon as something happens or someone has noticed something they will post it on the Facebook group and then we all know about it.

She also describes how she uses Google docs for group work,

> We work in groups we have what they call a project it is just like an ongoing notes. We are all encouraged to go on to the Goggle docs and add things to notes.

Another student commented on how her mobile device and the use of Wiki's facilitated group work,

> For like group presentations, we had this wiki project and you actually made a wiki page and there was a blog besides it if you could put a file in that blog and every one could proof read it and you could submit it on the website of the school; instead of having to meet up or whatever.

Another student admitted that she brought her iPad into every class. She also described how this facilitated group work,

> For example in one of my head and neck classes we use an activity on the internet of the human skull that you label, or they also do this, I don't know what it is called it is on Google and all the students can go on and edit a document and then at the end we are all going to use it just to help study.

Strategies to overcome barriers. Student participants also described some of the strategies they employed to overcome some of the barriers they experienced. One student

described how his class was able to convince their professors to allow mobile devices both in the classroom and clinical environment,

> When started first semester they (educators) had few apprehensions about mobile devices but then by the second semester we were able to rationalize our point of view and they said okay fine if you can maintain infection control, you have your plastic sleeves on it all the time and you are not using it for personal things like Facebook and stuff like that... Then it is okay.

With regards to slow Wi-Fi, students simply start to use their own data plan to overcome this barrier. However, they feel that the college should allow for easy access to free Wi fi. A student commented,

> The institution should have a good Internet connection in the building accessible to all students at all times.

All seven student participants incorporated mobile devices into their learning and felt that mobile technology enhanced their learning experience both in the classroom and in clinic. Mobile devices allowed students to direct their learning anytime, and anywhere. They felt that it helped them access information that enhanced and clarified concepts within the classroom. They also felt mobile devices helped improve their time management and communication with both faculty and students. Students felt that educator's lack of familiarity with technology along with technological difficulties in accessing free Wi-Fi Internet as barriers. However, based on their descriptions, they were pro-active and employed innovative solutions to some of these barriers.

This chapter describes data from the online survey and telephone interviews. PDA use by both dental hygiene educators and students were listed see Figure 20. In

addition, benefits, barriers, and strategies for integration of PDAs into current teaching were highlighted and described. Table 21 lists the benefits and barriers.

Figure 21. PDA use by dental hygiene educators and students

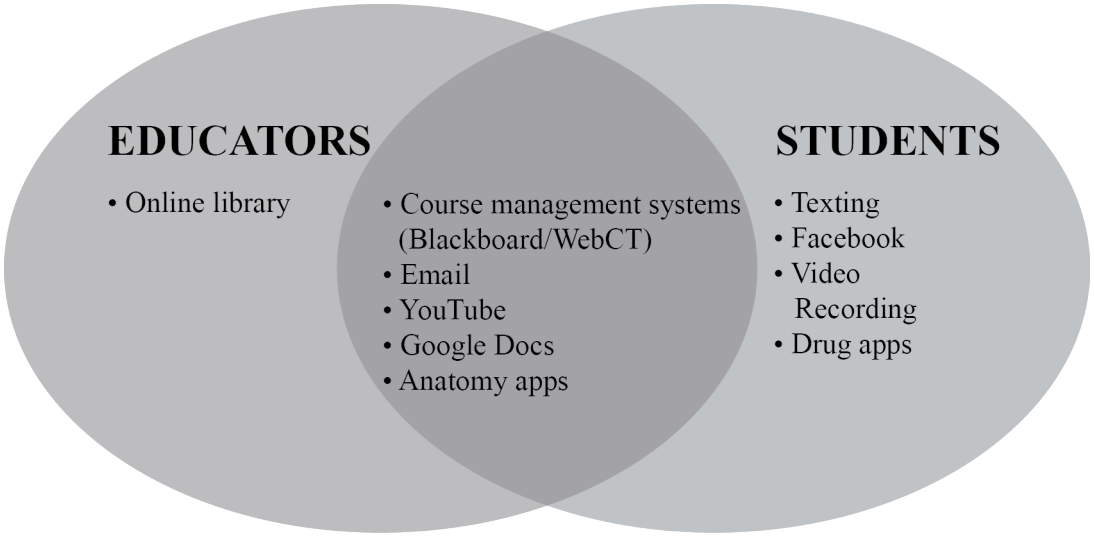


Table 8

Summary of Benefits and Barriers for Educators and Students

	Educators	Students
Benefits	• Access information anywhere, anytime. • Learner based education • Fosters curiosity, and interactive, collaborative learning. • Improved communication with students. • Potential to improve dental hygiene practice.	• Access information anywhere, anytime. • Improved time management. • Enhanced communication with educators. • Improved learning experience. • Enhanced patient education.
Barriers	• Distraction • Faculty mindset • Technological difficulties • Ban on use in the clinic.	• Distraction • Educators' lack of familiarity with technology. • Disruption with Wi-Fi Internet connection.

Chapter 5 – Discussion

In this chapter, an interpretation of results relating to existing literature is presented. Key findings are explained and implications to dental hygiene practice and education are outlined.

Educator's Use of PDAs and their Perceptions

The sample of educators who participated in the survey represented an experienced group that provided information from both teaching and clinical practice perspectives. Despite limited use of PDAs by dental hygiene educators, they felt that PDAs must be incorporated into their teaching. Participants thought that educators who integrated PDAs into their lessons were better able to understand and connect with their students. They recognized that PDAs such as smartphones and tablets have become an important part of students' lives and integrating them into their teaching was key to student success. An educator described that she felt it was imperative to incorporate PDAs into student learning as she had noticed more often that students are interacting with them in class.

Educators felt PDAs had a role in the classroom and that students are more actively involved in courses that incorporated PDAs. Educators who have tried to incorporate PDAs into their class commented on how the use of PDAs improved collaboration of students while working in small groups. They felt class lessons became more interesting for students and increased their participation.

Although educators perceived value in the use of PDAs in education, they indicated that PDAs were not fully integrated into their teaching and that many educators were resistant to it. Many felt that this was due to educators' lack of experience in

integrating technology into their teaching. For example, many dental hygiene educators felt that students were more likely to skip classes if course material were available online. Interestingly enough, students agreed. This perception is not unusual and has been a shared concern for many educators looking to incorporate technology into their lessons (Stone, 2012). However, the concern has been described as a misconception. The methodology of educators' online posts relative to their classroom activity is key. For example, posting only supplemental material with the promise of experiential learning content in class can engage students and motivate them to attend. This concept has been termed the "flipped classroom" where educators provide material online prior to class thus freeing class time for interactive collaborative learning (EDUCAUSE, 2012). According to Stone (2012), facilitating the "flipped classroom" in small college classrooms can in fact improve class attendance. Although the "flipped classroom" is emerging, the technique can easily be mismanaged. Effective technique requires added preparation and new skill for the educator (EDUCAUSE, 2012).

Educators were also unsure about their role in teaching students' how to manage mobile devices. An educator commented on how students have become "tech social" and not necessarily "tech savvy" and require proper instruction on how to use their devices appropriately for education. Educators felt that guidelines must be adopted to identify who is responsible for helping students learn how to use their mobile device for educational purposes.

Despite this, educator participants felt it was their responsibility to train students in the use of PDAs for learning. However, they felt that they did not have the time to do so especially if the device were to break down. Dental hygiene educators acknowledged

their lack of comfort incorporating PDAs into their teaching. Limited training and time to learn how to use applications impeded their use with students. Also, an educator described how many others felt that incorporating PDAs into their teaching would mean having to restructure course content. This deterred them from integrating PDAs into their lesson plans.

For the most part, educators felt that it was the colleges' responsibility to provide training on the use of technology. They did not consider it a professional responsibility to learn how to integrate technology use into their teaching. This may be due to the fact that some colleges have introduced a mobile technology initiative requiring teachers to incorporate mobile technology into their teaching without requesting feedback from faculty. This finding is similar to that reported by Georgina and Olson (2008). The authors studied faculty self-perceptions of integrating technology in higher education. They found that faculty felt that it was the institutions' responsibility to provide training. This was due to the fact that most institutions integrated technology without input from faculty, segregating them from the process. As a result, faculty lacked ownership. Berryhill and Durrington (2009) studied instructional technology in higher education and emphasize the need for professional development and faculty training to increase technology adoption. This finding is also supported by Cibulka & Crane-Wider (2010) who studied the integration of PDAs into nursing education. The authors report that providing training for nursing students and faculty was the most important element for successful adoption of PDAs into curricula. These findings illustrate and support the needs of dental hygiene educators. They are open to integrating PDAs into their teaching

however feel that they require administrative support and training in order to facilitate this.

There is a significant disconnect regarding the use of PDAs in the clinical teaching environment. PDAs were predominantly banned due to privacy and infection control issues. However, educators felt that PDAs belonged in the clinical teaching environment. One wonders who developed these policies and why.

Both privacy and infection control issues around PDA use in the clinical environment have also been described in medical and nursing practice literature (Braddy, & Blair 2005; Stroud, McAlearney, Schweikhart, & Medow, 2005). The safety of personal patient information stored on PDAs may be at risk due to loss or theft of hardware, hacking of software, and shoulder surfing (CDHO, 2012). In medical practice, issues emerged about physicians' disregard for security by leaving PDAs accessible to others (Stroud, McAlearney, Schweikhart, & Medow, 2005). With regards to infection control, there is risk of the colonization of microbes on a PDA and therefore there is concern for cross-contamination when used in the medical or clinical environment. (Braddy, & Blair 2005; Hassoun, Vellozzi, & Smith, 2004).

These concerns are inherent within dental hygiene practice and the clinical environment. For example, an educator described a breach of patient privacy by a dental hygiene student's use of a smartphone device. The student was proud of her patients' treatment results and posted a photo of her patient on Facebook. This ultimately introduced a ban of PDAs in the clinical environment at one program. Another educator expressed the lack of protocol set in place to ensure infection control that will allow the entry of PDAs into the clinical environment.

The current ban on PDA use in the dental hygiene clinical teaching environment is due to the absence of best practice guidelines. Dental hygiene administrative faculty have therefore banned PDA use until further information on best practices are established. Although these barriers exist, educators emphasized the need for collaboration amongst other health professionals and dental hygiene educational institutions to discover best practices.

Previous work on the use of PDAs in nursing practice reveal that the issue of privacy and patient confidentiality may be dealt with by ensuring that PDAs are password protected and that a data encryption program is installed. In addition, the protection of information must ultimately be the responsibility of the health care provider (Predhomme, 2012). The Canadian Medical Association (CMA) stress that medical students, residents, and practicing physicians must be aware of the risks involved with social media use. A key issue is maintaining patient confidentiality. Identifiable information, including images should not be shared online or on any other form of online communication.

The Board of the College of Dental of Hygienists of Ontario (CDHO) described guidelines for the use of electronic health records, mobile technology, and the protection of patient's information (CDHO, 2012). These guidelines were taken from the Office of the Information and Privacy Commissioner of Ontario. The guidelines stress the importance of password protected PDAs, and data encryption. In addition, dental hygienists working with mobile technology must be cognizant of the apparent risks when working in public. They should avoid the use of public Wi-Fi networks or "hot spots" that allow easy access to information from other devices. With regards to infection

control, research has revealed that simply cleaning a PDA with seventy percent isopropyl alcohol is effective in eliminating bacteria (Hassoun et al., 2004).

Guidelines presented in the nursing, medical, and dental hygiene literature are applicable and may provide some resolve to the current ban of PDAs in the clinical teaching environment. Ultimately, both educators and students must be informed on the appropriate use of technology in the health care setting. Moreover, dental hygiene students must also be taught critical protocol with regards to the use of social media and the protection of patient privacy and information. This learning experience will ultimately affect professional practice.

Overall, there was a discrepancy between educators' use of PDAs and their perceptions of use. Educator participants valued the use of PDAs in the classroom and the clinical teaching environment but most did not integrate them or were prohibited from doing so. Authors that studied technology acceptance amongst educators have also reported the inconsistency between perceived benefit and technology adoption. Despite the benefits of mobile technology in education, there has been limited integration into practice due to lack of effective professional development, school policies that do not support mobile learning, and educators' beliefs about the role of technology in the curriculum (Aldunate, & Nussbaum, 2013; Moran, Hawkes, & Gayar, 2010). These findings are similar to results in this study. Educators felt that unfamiliarity with technology, lack of training and administrative support, and the ban on use of PDAs within the clinic were significant barriers to use.

Students' use of PDAs and perceptions of use

Students' use of PDAs and the associated applications was more diverse than that of their educators. For example, they frequently used text messaging as well as Facebook to support communication and learning experiences with other students. Dental hygiene educator participants mainly used course management systems to communicate with students. These findings are similar to research done by Guidry and BrckaLorenz (2010) who compared student and faculty academic technology use across disciplines. The authors found that students reported more use of some technologies than faculty. In addition, students and faculty used course management systems more often than any other technology. It was suggested that this was due to students' use of tools that were not required but were useful in communication with other students for study. For example, students may create Facebook page to connect and communicate when they are unable to meet and discuss group work. In addition, course management systems are used most often as they were required and supported by the program and institution.

Conclusions by Guidry and BrckaLorenz (2010) shed some light on findings from this study. Several institutions that participated in this study used WebCT/Blackboard as a required course management system. This is why both educators and students used the course management system as their primary form of communication and main resource tool. For the most part, educators did not promote the use of applications or resources that were not required.

Student participants felt strongly about incorporating PDAs into their learning despite minimal guidance from faculty and the ban of PDA use within the clinical teaching environment. A few students described how they were able to convince faculty

to allow PDAs within the clinic. These students described how instant access to information helped improve patient care. The PDA allowed students to save time by accessing pertinent information such as physician information, and oral effects of particular drugs their patient was on. These students, although not the norm, felt strongly about the use of PDAs and were proactive and able to present a favorable case for PDA use within the clinic. They also found innovative ways to apply PDA utilities that enhanced their learning. For example, a student described how she gained permission from her instructor to use her camera on her smartphone and record her instructor perform clinical demonstrations. A playback of these videos aided her home study.

Although a few interview participants described how they favored the use of PDAs in clinic, it was interesting to learn that many students felt PDAs did not belong in the clinic. This finding may be influenced by the fact that most students were prohibited from using PDAs within the clinical environment. Similarly, Cibulka, & Crane-Wilder (2011) report that nursing students felt that some educators discounted the use of PDAs in the clinical environment. Behavior from their educators became a barrier to student use. The authors therefore emphasized the importance of role modeling by educators. These findings stress how dental hygiene educators and ultimately administration affect the perceptions of students' use of technology in their learning process.

Barriers, Benefits, and Strategies for Implementation

Short answer survey questions and telephone interviews contained added detail on current mobile technology use and the perceptions of use by both dental hygiene educators and students. Barriers, benefits, and strategies for overcoming these barriers were highlighted. Findings from this study are similar to findings from previous work

done on PDA use in nursing, dental, and dental hygiene education. One of the main distinctions of this study was the restriction of students' use of PDAs within the clinical teaching environment.

Barriers.

Dental hygiene educators felt that they experienced several barriers to incorporating mobile technology into their teaching, however many students felt that they did not experience these barriers. Many educators felt that mobile device use was a distraction for students in class particularly in a Wi-Fi environment. They believed that students used them for personal communication and to access social media sites such as Facebook while in class. Students agreed that PDAs often became a distraction in class when students used PDAs to access information unrelated to class. However, students felt the main barrier was educators' lack of familiarity or comfort with technology. According to students, the educators required a lot of assistance when working with technology. For example, a student described how her teacher asked for assistance from students when uploading course information on Blackboard. As a result, students often doubted educators' effort. They felt that educator's age was a factor with resistance to change.

Students felt that the lack of comfort with technology caused educators to prohibit their use. They also felt that they lacked support from educators in PDA use as many educators were not familiar with the programs or applications that the educators recommended. These findings were similar to those found by Farrell and Rose (2009). Nursing students did not feel they received the support they required because faculty did not have adequate experience and knowledge on PDA use. Covington & Claudepierre,

(2006) also found that students' felt they received minimal guidance from educators and they felt this was a barrier to using PDAs in their learning.

Dental hygiene educators agreed with students' perception in this area as many felt that faculty mindset was a major barrier to successfully integrating mobile devices into their teaching. They felt that a majority of faculty did not promote the use of mobile devices due to their lack of familiarity and versatility with technology and associated applications. They also felt that faculty age was a factor in the slow adoption of technology. Dental hygiene educators also acknowledged their lack of familiarity with PDAs and indicated that limited training and time to learn how to use applications was a barrier. The lack of time to learn how to use PDAs was also a barrier for nursing educators. Nursing faculty in a study by Swan, Smith, Frisby, Schafer, & Hanson-Zalot in 2012, also felt they needed more instruction on how to incorporate technology into their lesson plans, classroom activities, simulations, and clinical rotations.

Both dental hygiene educators and students felt that interference of the access to free Wi-Fi was a barrier to incorporating mobile technology. An educator commented that IT departments have underestimated network load at the beginning of the school year. Students are generally connecting two to three different devices to Wi-Fi and the infrastructure supporting Wi-Fi cannot handle it. Smith & Caruso (2010) studied undergraduate student use of technology and also identified this as a concern. The authors found that the ubiquitous ownership of wireless devices such as smartphones by students demands that educators understand the impact of 3G and 4G cell networks on existing Wi-Fi systems. The authors stress that more and more students are expecting to use their mobile device on campus to support their education. It is essential that dental

hygiene educators, administration, and supporting IT departments attend to the demand of Wi-Fi connectivity.

Although most students had data plans associated with their mobile device, cost was described as a barrier for students by both educators and students. Dental hygiene educators felt that students might be limited in their access to the newest technology and data plan due to cost. Contrary to this perception, students admitted to having the latest technology and felt that this was a standard that they must be able to keep. They felt however that the institution should provide them with free access to the Internet. Cost of hardware, and lack of technological support was also viewed as major barriers for nursing students and educators in other studies (Anonson et al., 2008; Cibulka & Crane-Wilder, 2010; Garret & Klein, 2008; Whitman-Price & Kennedy Godwin, 2012). Technological difficulties were also identified as a barrier in nursing, dental, and dental hygiene literature however, most were associated to the PDA device such as battery usage and loss of software (Brubaker et al., 2009; Cibulka & Crane-Wilder, 2010; Garret & Klein, 2008; George & Davidson, 2005; George et al., 2010). Technological difficulties described by dental hygiene educators and students involved the unpredictability of Wi-Fi access within the institution. Educators and students felt that disruption to free Wi-Fi greatly impacted the classroom.

Benefits.

Both dental hygiene educators and students described several benefits to incorporating mobile technology into their teaching and learning. Overall, both educators and students felt that instant access to information anytime, anywhere was the main advantage. Educators felt that PDAs connection to the Internet opened students up to a

whole new world of information. Students felt that PDAs within the classroom allowed them to look up information that was not clear to them during a lecture. They also felt that it allowed them to do work when and where it was most convenient for them. In addition, students felt that they were able to communicate better with their peers and educators. This was an asset especially when students worked in groups and were required to contact classmates with whom they normally do not keep in touch with. The PDA helped them communicate with faculty on days that they were off and required clarification on a particular subject. Students also felt that PDAs helped them manage their time better. Immediate access to course management systems that had updated assignment due dates and schedule changes was convenient and saved time. One student who was permitted to use her iPhone while treating her patient also commented on how treatment of her patient was improved since she was able to look up information that her patient did not have and did not know. These advantages were also described by nursing, dental hygiene, and dental students (Brubaker et al., 2009; Hudson & Buell, 2011; & Park et al., 2010).

Educators and students felt that mobile technology could enhance how dental hygienists practice. The ability to access information immediately was the primary advantage. They felt that obtaining information on a physician's address, oral implications of current medications, and oral health care aids could help improve overall care. Students also described how their mobile device use intrigued and motivated their patients to learn more about their oral health. A student who was permitted to use her smartphone in the clinic described how her patient asked her to look up oral health information for him when he noticed she was researching information on her smartphone.

Another student commented that she used her smartphone as a motivator showing You Tube videos to her patient on proper brushing and flossing techniques.

A nursing student also found this advantage as in described case study. The nursing student found that using a PDA to look up information with a patient helped them learn more about their condition and as a result, became more involved in their care (Johansson, Petersson, & Nilsson, 2011).

Strategies for implementation.

Educators and student participants also described strategies they felt would help over come barriers to the use of PDAs. Educators felt that proper guidance for student use rather than banning PDAs was important. In addition, the need for collaboration and increased communication with faculty to find best practice solutions was also described. Students for the most part did not describe strategies they felt were required to overcome specific barriers. They did however describe specific situations where they experienced a definite barrier and how they managed the situation. For example, a student described how during a group presentation, she used her phone's data plan as a "hot spot" to access the Internet when the school Wi- Fi was not working. In other words, her smartphone became a router for other mobile devices to connect to the Internet. Her group was able to complete their presentation despite the poor Wi-Fi connection.

Authors of previous work on the use of PDAs in both dental and dental hygiene education did not describe strategies to overcome existing barriers. Authors of nursing literature however, outline several strategies based on an established previous history of integrating PDAs into current curricula (Cornelius & Gordon, 2006; George et al., 2010; Scollin, Healy-Walsh, Kafel, Mehta, & Callahan, 2007). This includes comprehensive

training for both students and faculty. Also, administrative and institutional support with a core informatics team was key (Cornelius & Gordon, 2006). Assigning or finding a faculty champion supporting both students and faculty use of PDAs was also outlined as a significant strategy to support the integration of PDAs into nursing curricula (George et al., 2010; Scollin, Healy-Walsh, Kafel, Mehta, & Callahan, 2007). These strategies seem highly applicable to dental hygiene education.

Overall, there appear to be several conflicts between current use of PDAs and views of use by both educators and students. Educators value the use of PDAs within the classroom and clinic however they have not been able to integrate PDAs into their teaching. This was predominantly due to lack of familiarity with technology and their expressed need for training. They also saw the need to integrate PDAs within the clinical teaching environment however, most schools have banned clinical use of PDAs.

Educators felt that students' required instruction or guidance on how to use PDAs for educational purposes. Contrary to this, students' seemed much more comfortable with PDA use and their use of applications was consistently more diverse than that of their educators. The age of educators was considered a factor in the slow adoption of technology. The significant disconnect between educators and students prohibit the growth of PDA use in dental hygiene education.

PDA use by dental hygiene educators and students is viewed favourably. However, work is required to help both educators and students integrate PDAs into education. It appears that dental hygiene students are actively integrating PDAs into their learning. Despite the push by students, educators feel that they are unprepared to guide

their students into proper use of PDAs in both the classroom and clinic and indeed prohibit them in many clinical settings.

The findings from this study support previous dental hygiene, dental education, and nursing education research. Overall, the new finding is the inability through prohibition for most dental hygiene students to use PDAs within the clinical environment. This becomes a major barrier that impedes their clinical knowledge acquisition and patient care.

There appears to be a wealth of information and many best practice guidelines to help both dental hygiene educators and students understand the appropriate use of PDAs within the clinical environment. Future work involving the collaboration of governing bodies and dental hygiene educators to facilitate best practice guidelines for PDA use within the clinical environment for both students and practicing dental hygienists is needed. This information would specify how dental hygienists should use PDAs within their practice environment.

Chapter 6 - Conclusion

Implications for Dental Hygiene Practice

The results from this study reveal preliminary findings of PDA use in dental hygiene education. In this study, both dental hygiene educators and students favor the use of PDAs in a teaching and learning environment. Several benefits, barriers, and strategies for implementing PDAs into current curricula were highlighted. Findings were similar to previous work done in nursing, dental, and dental hygiene education. A major difference between this sample and previous findings from both nursing and dental literature, was the inability of both educators and students use of PDAs within the clinical teaching environment because of rules relating to privacy and infection control issues. Although there has been some discussion of remedies to over come these barriers in the nursing and some from a dental hygiene perspective, the ban of PDA use in the clinical environment impedes work to integrate PDAs into full practice.

Results from this sample reveal that the most significant barrier to successful implementation of PDA use was faculty mindset and their unfamiliarity with technology. This has ultimately influenced the ban on PDA use within the clinical teaching environment and students' mindset on how PDAs should be used in clinic. It may be prudent to employ strategies that have been previously described in nursing literature. Identifying a faculty champion for change to support both student and educator use of PDAs is key in the proper adoption and acceptance of PDAs into current curricula. Results from this study reveal a subset of educators who feel strongly about PDA use in the education of dental hygiene students and have started to integrate PDAs into their teaching methodology. These educators are potential champions for change and their

value must be recognized and supported. In addition, introducing faculty support through administration with training and education is also necessary for faculty to become more familiar with new technology.

As the dental hygiene hygienists work more in independent settings, it is apparent that the use of PDAs in the clinical environment may help dental hygienists provide optimal oral health care. This is achieved through the ability to access pertinent information at the point of care. For example, the dental hygienist can research the oral side effects of patient medication and how that may impact their oral health. Communication with other health professions that guide treatment is also enhanced through the use of PDAs. Dental hygienists can use the PDA to communicate with a patient's physician to verify information regarding their patient's medical history. However, the ban of PDA use within the clinical teaching environment impedes the ability for dental hygienists to learn how to use PDAs appropriately.

Issues involving privacy of patient information and infection control are important to consider within the context of dental hygiene practice. Collaboration with governing bodies is key in establishing best practice guidelines for PDA use. Teaching dental hygiene students about the appropriate use of PDAs within the clinical environment is vital in the age of technology. Guidelines must enforce respect for patient confidentiality and ways to protect this information. This should include the role social media plays in the relationship between the health care provider and patient.

Current entry to practice guidelines encourages the use of technology to support student learning. Incorporating PDAs into dental hygiene education supports this guideline. The goal of dental hygiene education is to prepare students to transition into

an interprofessional practice setting. As other health professions such as nursing use PDAs, it is important to ensure that dental hygiene students are familiar with PDA use relative to the needs of their practice.

A mixed method approach was used in this study to identify the current use of PDAs and perceptions of use by both dental hygiene educators and students. Quantitative data provided details on the current use of PDAs in dental hygiene education and practice. Qualitative descriptive methodology provided a methodological framework for describing and analyzing follow up telephone interviews. Authenticity, credibility, criticality, and integrity were maintained to enhanced rigor. Participants were informed of the voluntary nature of the study and that their identity was confidential. Therefore they were allowed to speak freely and their perceptions were accurately represented. Data collection and analysis were done simultaneously and the author allowed for codes to emerge from the data. The process was also recorded in a methodological journal that allowed the researcher to reflect on her role as both clinician and researcher. The journal also permitted the researcher to reflect on decisions made throughout the research process. The researcher maintained constant reflection on any bias that emerged during interview and analysis to ensure criticality and integrity.

Limitations and Future Research

The results of this study provided a preliminary description of PDA use and perceptions of PDA use by both educators and students. Results from the study reveal a strong preference for the use of PDAs in dental hygiene education, it may be argued that participants were limited to those who favored the use of PDAs. In addition, the overall

response rate was low and therefore it may be argued that findings from this study may not be applicable to the general population.

It is apparent that further research is required to investigate the use of PDAs in dental hygiene education and practice. The current ban of PDA use in the clinical environment impedes work to integrate them into full practice. The study may expand to include dental hygiene schools outside of Ontario. This may shed light on the current use of PDAs within the clinical environment. Future work may also include collaboration with governing bodies to create best practice guidelines for the clinical use of PDAs. In addition, dialogue amongst educators must be encouraged to discover and promote champions for change.

Conclusion

Mobile technology such as PDAs are increasingly used in the education of health care providers. There is a growing body of literature exploring the use of PDAs such as smartphones, tablets, and pocket PCs in nursing education including the benefits, barriers, and strategies for successful implementation. Very little work has been done to study the adoption of PDAs in dental hygiene practice and education. As more dental hygienists work in independent settings, the use of mobile technology at the point of care is essential to provide optimal oral health care. The findings from this study sheds light on the current use of PDAs in dental hygiene education and describes the perceptions of use by both dental hygiene educators and students. Results reveal that PDA use in dental hygiene education is still in its infancy. Despite this, both educators and students value the use of PDAs in their teaching and learning and feel that their use can improve dental hygiene practice. Educators' lack of comfort with technology and the ban on clinical use

were significant barriers. Although there has been some discussion of remedies to over come these barriers in the nursing and some from a dental hygiene perspective, the ban of PDA use in the clinical environment impedes work to integrate PDAs into full practice. The study may expand to include dental hygiene schools outside of Ontario. This may shed light on the current use of PDAs within the clinical environment. Future work may also include collaboration with governing bodies to create best practice guidelines for the clinical use of PDAs. In addition, dialogue amongst educators must be encouraged to discover and promote champions for change.

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Appendix A
Ethics Approval Athabasca University

MEMORANDUM

DATE: November 1, 2012

TO: Lizelle Tucci

COPY: Dr. Caroline Park, Professor, CNHS (Supervisor)
Janice Green, Secretary, Athabasca University Research Ethics Board
Dr. Simon Nuttgens, Chair, Athabasca University Research Ethics Board

FROM: Dr. Sharon Moore, Chair, CNHS Research Ethics Review Committee

SUBJECT: **Ethics Proposal #CNHS-12-03-Tucci-L:** *"Mobile Technology in Dental Hygiene Practice and Education"*

Thank you for your revised application submitted on October 30, 2012, arising from the "Conditional Approval" decision dated October 29, 2012. Your cooperation in revising and furnishing additional information requested was greatly appreciated.

On behalf of the Athabasca University CNHS Ethics Review Subcommittee, I reviewed the resubmission, and am pleased to advise that this project has been granted **FULL APPROVAL** on ethical grounds.

Please note that while approval has been granted from Athabasca University, you may also be required to make further submissions for ethical review at the institutions where you will be conducting the research. Requirements regarding this process should be sought out from each of the institutions where you will be conducting the research and any additional ethics approvals will need to be received prior to recruitment. If additional ethics approvals are needed from the educational institutions, you will need to account for this in your research timelines as these approvals will take additional time.

Prior to recruitment, please provide for file purposes only (review not required):

- Ethics approval from any of the sites you are conducting research at (if required by the institution)

The approval for this study "as presented" is **valid from the date of this memo for a period of 12 months.** If necessary extension of approval can be requested by completing and submitting an 'Interim' Ethics Progress Report one month prior to expiry of the existing approval.

A **Final Ethics Progress Report** (form) is to be submitted when the research project is completed. Progress reporting forms are available online at http://www.athabascau.ca/research/ethics/.

As you progress with implementation of the proposal, if you need to make any changes or modifications please forward this information to the Research Ethics Board as soon as possible. If you have any questions, please do not hesitate to contact sharon.moore@athabascau.ca

Appendix B
Introductory Recruitment Letter

Dear (Program director/coordinator),

I am a Masters in Health Studies student studying at Athabasca University. I currently work as a clinical dental hygiene instructor at George Brown College.

For my Masters thesis, I am exploring the use of mobile technology in education. My intent is to recruit faculty and students from accredited Ontario dental hygiene schools.
I would like to invite the faculty and students at (School name) to participate in a mixed methods study. Participants will complete an online survey and may be invited to participate in a follow- up telephone interview. The telephone interview will be recorded.

Participation is voluntary and participants may withdraw from the study at any time and for any reason.

Due to confidentiality of faculty and student personal information, your support is integral to this information being disseminated to them. This will involve sending the consent form and survey via email to your faculty and students on my behalf.

Please note that the study has received approval from the AU REB.

If you are interested in this study or have any questions or concerns, you may contact me or my supervisor via e-mail or by phone.

Lizelle Tucci

Principal investigator:
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Appendix C
Information Letter for Participants
And Informed Consent

Principal investigator:
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Title of Project: Mobile Technology in Dental Hygiene Education and Practice

Purpose of this Study:
The goal of this study is to explore the current use of, and perceptions about personal digital assistants (PDAs), (such as Smart Phones and tablet computers), from the perspective of dental hygiene educators and students providing key information to inform dental hygiene curricula and practice.

Procedures:
As a participant, you will complete an online survey that will be emailed to you. The survey will take approximately twenty minutes to complete. At the end of the survey you will be asked if you would like to participate in a telephone interview. If you wish to take part in the interview, I will ask you questions about your use of PDAs in dental hygiene education. The telephone interview will take between thirty to sixty minutes. The interview will be recorded and I may take some notes. During the interview you may choose not to answer certain questions. Participation is voluntary and you can withdraw at any time and for any reason up until data analysis has begun.

Risk/Discomfort:
No risks or discomforts will be associated with participation in the survey or interview. If at anytime you wish to withdraw from the interview, it will be terminated immediately.

Benefits:
While there is no specific benefit to you as a participant, it is hoped that the results from this study will provide important information for the successful adoption of PDAs into current dental hygiene education and practice.

Alternatives to Participation:
Participation in this study is voluntary. You are free to withdraw from the study at any time and for any reason up until data analysis has begun.

Confidentiality:
The survey will be confidential. All information collected during the study period will be kept strictly confidential and will be stored in a locked file cabinet. You will be identified through identification numbers. Data will be kept for 5 years as stipulated by AUREB. Publications or reports from this study will not include personal information of the participant.

Contact information:
If you have any questions or concerns about this study you may contact me by email at elle.tucci@gmail.com or by phone at 647 961 5077.

I have read this entire form and I understand it completely. All of my questions regarding this form or this study have been answered to my complete satisfaction. I agree to participate in this research.

I understand by typing my name in the box below that I am signing this form and therefore providing informed consent for this study.

(Name of Participant)

Please print or save a copy of this page for your records.

Appendix D

Title of Project: Mobile Technology in Dental Hygiene Education and Practice

Online survey for dental hygiene faculty

(Survey was adapted from the ECAR Student and Information Technology in Higher Education survey, 2010 and the George Brown College mobile device survey.)

Demographic

1. How many years have you worked as a dental hygiene educator?
   - Less than 3
   - 4-6
   - 7-9
   - 10 or more

2. Age
   - 20-30
   - 31-40
   - 41-50
   - 50 or more

3. What is your predominant role as a dental hygiene educator?
   - Clinical instructor
   - Classroom theory
   - Both

4. What is your employment status?
   - Part-time
   - Sessional
   - Full-time

5. Do you also work in a private dental practice?
   - Yes
   - No

Mobile Technology Use

1.Do you use a…
Please check all that applies.

	for your personal life	for academic purposes	for both personal & academic purposes	don't use
..smartphone?				
..tablet?				
..Pocket PC?				

2. Do you have a mobile Internet data plan on your smartphone, tablet, or Pocket PC?
- Yes
- No
- I'm not sure

3. Please indicate which operating system you use for your smartphone, tablet, or Pocket PC.
- Blackberry
- iOS (Apple)
- Android
- Symbian
- Windows mobile
- I don't know

4. Please indicate whether or not you use the following form of communication with your students.

	Currently use in my teaching	Plan to use in my teaching next semester	Don't use/no plans to use
Email			
Text messaging			
Instant messaging/online chatting			
Twitter			
Facebook			
LinkedIn			
Other social network sites			
Social studying sites (Cramster, CourseHero)			
Phone like communication over the internet (Skype, G-chat)			
Course learning management system (WebCT/Blackboard)			

5. Please indicate whether or not you use the following resources/ tools with your students.

	Currently use in my teaching	Plan to use in my teaching next semester	Don't use/no plans to use
Course learning management system (WebCT, Blackboard)			
E-portfolios			
E-textbooks			
Web based word processor, spreadsheets, presentation software (Google documents, Prezi)			
Wikis (Wikipedia, course wiki etc.)			
Blogs			
Recommend an article or information online by tagging/bookmarking/"liking"			
Online forums or bulleting boards			
Podcasts and webcasts			
Web based videos			
Video sharing websites (YouTube, etc.)			
Photo sharing websites (Flickr, Snapfish etc.)			
Simulation or educational games			

6. Within the past academic year, have you asked your students to use their mobile devices to facilitate classroom and or clinical learning?

- Yes
- No
- I'm not sure

7. Within the past academic year, how often have you asked your students to use their mobile devices to facilitate classroom and or clinical learning?
(only if answered yes to question # 6)

- Almost every class/clinic
- At least once
- A few times per year

8. In what ways have you asked your students to use their mobile devices to facilitate classroom and or clinical learning? *(only if answered yes to question # 6)*

- Encourage students to use the datebook to manage their schedule
- Encourage students to use the address book to save contact information
- Encourage student to use medical and dental reference for clinical use
- Encourage students to use clinical tools
- Encourage students to use apps for client tracking
- Encourage students to communicate and interact with each other via email, chats forums, discussion boards etc.
- Encourage students to access information on the Internet
- Use custom apps for teaching

- Encourage students to access electronic resources/libraries
- Use Blackboard/WebCT
- Email/ text me
- Play audio and video podcasts
- Use e-books
- Play educational games
- Use mobile assessments (quizzes)
- Poll/survey using mobile devices
- Encourage students to create and share audio, photos, videos
- Incorporate social/professional networking activities into teaching
- To access STU-View
- Send reminders and notifications of homework, tests, quizzes, exams, class cancellations
- Encourage lecture capturing

9. How did you evaluate the impact of mobile learning?
(only if answer yes to question # 6. Multiple answers allowed)

- Informal observation of students
- Informal feedback from students
- Student survey
- I have not evaluated the impact

10. Based on your evaluation(s), how effective have mobile devices been in facilitating student learning? *(only if gave answer to question # 9)*

- Very effective
- Effective
- Somewhat effective
- Not at all effective

11. Specify how you feel about the following statements.

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1. Professors/instructors should incorporate the use of mobile devices in the classroom to impact students' academic success.					
2. Mobile devices don't belong in a classroom.					
3. Mobile devices don't belong in clinic.					

4. It is the professor/instructor's responsibility to provide students with adequate training for the mobile technology used in courses.					
5. Mobile technology has a role outside the classroom, to assist					
6. Professors/instructors should use new and cutting-edge technologies in their					
7. Students get more actively involved in courses					
8. Students are more likely to skip classes when materials from course lectures are available					
9. The use of mobile technology encourages					
10. Professors/instructors who incorporate mobile devices in their teaching are better able to					
11. It is the responsibility of the college to ensure that professors/instructors are trained in the use of mobile					

12. Have you experienced barriers in incorporating mobile devices/ technology in your teaching?

- Yes
- No
- I don't know/ I'm not sure

13. List the barriers you have experienced in incorporating mobile devices/technology in your teaching.

14. List the benefits you have experienced in incorporating mobile devices/technology in your teaching.

15. List the software and apps that you currently use.

16. List software and apps you have recommended students use to facilitate classroom learning and in completing clinical competencies.

The researcher may ask you to participate in a telephone interview. Please indicate if you are interested in participating by providing contact information below

Online survey for dental hygiene students

(Survey was adapted from the ECAR Student and Information Technology in Higher Education survey, 2010 and the George Brown College mobile device survey.)

Demographics

1. What year of study are you currently in?
   - First year
   - Second year

2. Age
   - 15-19
   - 20-30
   - 31-40
   - 41-50
   - 50 or more

3. Sex
   - Male
   - Female

Mobile Technology use

1. Do you use a…
   Please check all that applies.

	for your personal life	for academic purposes	for both personal & academic purposes	don't use
..smartphone?				
..tablet?				
..Pocket PC?				

2. Do you have a mobile Internet data plan on your smartphone, tablet, or Pocket PC?
   - Yes
   - No
   - I'm not sure

3. Please indicate which operating system you use for your smartphone, tablet, or Pocket PC Blackberry
   - iOS (Apple)
   - Android
   - Symbian
   - Windows mobile
   - I don't know

4. Please indicate whether or not you use the following form of communication with your professor/instructor and other students.

	Currently use	Plan to use	Don't use/no plans to use
Email			
Text messaging			
Instant messaging/online chatting			
Twitter			
Facebook			
LinkedIn			
Other social network sites			
Social studying sites (Cramster, CourseHero)			
Phone like communication over the internet (Skype, G-chat)			
Course learning management system (WebCT/Blackboard)			

5. Please indicate whether or not you use the following resources/ tools.

	Currently use	Plan to use	Don't use/no plans to use
Course learning management system (WebCT, Blackboard)			
E-portfolios			
E-textbooks			
Web based word processor, spreadsheets, presentation software (Google documents, Prezi)			
Wikis (Wikipedia, course wiki etc.)			
Blogs			
Recommend an article or information online by tagging/bookmarking/"liking"			
Online forums or bulleting boards			
Podcasts and webcasts			
Web based videos			
Video sharing websites (YouTube, etc.)			
Photo sharing websites (Flickr, Snapfish etc.)			
Simulation or educational games			
Address book			
Calculator			
Drug reference			
Medical/ Dental reference			
Clinical tools			
Client tracking			

6. Within the past academic year, have you been asked by your professor/ instructor to use mobile devices?

- Yes
- No
- I'm not sure

7. Within the past academic year, how often do you use mobile devices to facilitate classroom and clinical learning?

- Daily
- Weekly
- Monthly

8. How effective have mobile devices been in facilitating your client teaching/learning?

- Very effective
- Effective
- Somewhat effective
- Not at all effective

9. Specify how you feel about the following statements?

	Strongly Agree	Agree	Neither Agree nor Disagre	Disagree	Strongly Disagree
1. Professors/instructors should incorporate the use of mobile devices in the classroom to impact students' academic success.					
2. Mobile devices don't belong in a classroom.					
3. Mobile devices don't belong in clinic.					
4. It is the professor/instructor's responsibility to provide students with adequate training for the mobile technology used in courses.					
5. Mobile technology has a role outside the classroom, to assist with or supplement classroom learning.					
6. Professors/instructors should use new and cutting-edge technologies in their teaching.					
7. Students get more actively involved in courses that use mobile technology.					
8. Students are more likely to skip classes when materials from course lectures are available online.					
9. The use of mobile technology encourages collaborative learning.					
10. Professors/instructors who incorporate mobile devices in their teaching are better able to understand and connect with their students.					
11. It is the responsibility of the college to ensure that professors/instructors are trained in the use of mobile devices/technology.					

10. Have you experienced barriers in incorporating mobile devices/ technology in your learning?

- Yes
- No
- I don't know/ I'm not sure

11. List the barriers you have experienced in incorporating mobile devices/technology into your learning.

12. List the benefits you have experienced in incorporating mobile devices/technology in your learning?

13. List the software and apps that you currently use to facilitate your learning experience.

The researcher may ask you to participate in a telephone interview. Please indicate if you are interested in participating by providing contact information below.

Appendix E

Interview Guide for Dental Hygiene faculty and students

1. How do you feel mobile devices can improve how dental hygiene students learn?

2. How do you feel mobile devices can improve dental hygiene practice?

3. Do you use mobile devices for teaching/ learning? If not, why?

If yes -

4. What mobile devices have you incorporated into student learning?

5. How have you incorporated mobile devices into student learning?

6. What software/ apps have you used to facilitate classroom and or clinical learning?

7. What are the benefits of incorporating mobile devices into classroom and clinical learning?
   Are there any drawbacks?
   If using them in clinic, how do clients respond to them being used?

8. What are the barriers you have experienced in incorporating mobile devices into classroom and or clinical learning?

9. What strategies have you employed to help over come these barriers?