

A case study for evaluating nursing and health sciences student satisfaction with e-Learning

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Abstract

An increased demand for e-learning in nursing and health sciences education is emerging and not enough is known about factors determining nursing student satisfaction with e-learning, therefore studies clarifying how to design and implement efficient e-learning programs to increase student satisfaction are necessary. This case study helps fill this gap by investigating the factors influencing nursing students' satisfaction with e-learning and the relationship between satisfaction and GPA in healthcare higher education. A web-based questionnaire collected data on various aspects of e-learning and 140 students from UOIT participated. Statistical analysis was completed and responses to open-ended questions were explored using thematic open-coding. Results revealed the most highly influential factors on nursing student satisfaction being perceived liking and perceived usefulness, while usability and communication & teaching factors having less predictive power to the student satisfaction. Another important finding is that any potential student that wants to pursue studies in a health related program in the university where e-learning is part of the program, who has a high level of satisfaction will be able to obtain a good GPA. Major barriers in using e-learning were identified in the area of communication, course management, feeling of being disconnected, and technology issues. In conclusion, we believe the findings of this study add a new perspective on satisfaction factors with e-learning for nursing students and describe the link between their satisfaction level and GPA. Further research is required to explore how e-learning program design can address the barriers to e-learning identified in this study and further explore the conclusions of this study to other nursing and health sciences programs at other universities.

Key words: e-learning, nursing student, health sciences student, student satisfaction, GPA

Chapter 1

Introduction

With the expansion and development of information technology in recent years, the use of e-learning has rapidly increased. E-learning is becoming omnipresent in higher education and continuing education and it is already established as an attractive practice supplementing traditional face-to-face teaching in healthcare according to Siassiakos et al. (2008).

E-learning is an all-encompassing term to describe learning supported by the use of information and communication technologies which now includes also the use of mobile technologies such as personal digital assistants, mobile telephones and MP3 players (New Media Consortium, 2008). It is suited to distance learning, but it can also be used in conjunction with face-to-face learning, whereby it is often referred to as blended learning (e.g., Röhrig et al., 2014; Ingrassia et al., 2014). In education, it is common to create an e-learning environment, often in conjunction with a managed information system, to develop a managed learning environment that can support programs through a user interface that is standard throughout an institution; an example of such an environment is Blackboard, which is a popular learning management system adopted by many universities (Blackboard, 2006). Distance learning, flexible learning, and open learning (Trait, 2003) are all broader terms that incorporate e-learning, but include instructional situations where educators and students are physically separated.

E-learning is part of the new dynamic that characterizes educational systems at the start of the 21st century, resulting from the merge of different disciplines, such as computer science, communication technology, and pedagogy (Sangrà, Vlachopoulos, &

Cabrera, 2012). There are different perspectives in defining e-learning; from a technology driven perspective, e-learning is the use of electronic media for a variety of learning purposes that range from add-on functions in conventional classrooms to full substitution for the face-to-face meetings by online encounters (Guri-Rosenblit, 2005), or is the use of technology to deliver learning and training programs (McCarthy, 2011); from an educational oriented perspective, e-learning is the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services, as well as remote exchange and collaboration (McCarthy, 2011).

To distinguish e-learning from traditional education, it's generally accepted that traditional education consists of an educational environment where primary methods used are classroom settings with an educator giving a lecture, while students listen, take notes, and ask questions. Interaction between student and the professor has been considered an essential learning element within this educational environment (O'Malley and McCraw, 1999). Mayer (2003) proposed how to understand the science of e-learning and discussed extensively how electronic environments compare to classroom environments. He concludes that e-learning has all the elements to match the benefits of traditional education, and provide even more benefits under certain conditions.

The major benefits of e-learning including increasing students' motivation and satisfaction, reduced instruction time and convenience (Lewis & Price, 2007) have become extensively recognized. According to Bouhnik and Marcus (2006), major strengths of e-learning include freedom to decide when each online lesson will be learned, no dependence on the time constraints of the lecture, express thoughts, and ask questions, the accessibility of online course material at the students' own time and

possibly pace, time and money savings and increasing the quality of learning.

Furthermore, considering the rapid adoption of mobile technologies and the current emphasis of mobile computing, the evolution of e-learning, namely mobile learning (m-learning), has the capability to significantly transform healthcare higher education. By providing the knowledge and tools for nurses willingness to operate increasingly complex products and process designed for patient care, m-learning is revolutionizing the way students are accessing learning (Pearlson and Saunders, 2010).

The effective use of e-learning is dependent on levels of computer literacy. This has been identified as an international issue negatively affecting both the development and use of e-learning in nursing (Jackson et al. 2000, Boyle & Wambach 2001). E-learning is viewed as one way to support the development of nursing professionals (Department for Education and Skills (DfES), 2003). In Canada, the health care reform through the mechanisms of providing new professional licensing standards which encourages continuous education will stimulate the growth of e-learning and also the creation of customized nursing educational products in order to move mobile learning development forward in Canadian healthcare education. The Canadian Nurses Association, the governing body for registered nurses, recognizing the nurses' pursuit of life-long learning, has created programs for continuing education for nurses that offer a variety of continuing education opportunities that nurses can partake from the comfort of their own home and for continuing competence. This helps promote ongoing safe, ethical and competent practice while offering nurses opportunities to pursue and achieve professional growth throughout their careers (Canadian Nurses Association website. (2014, October 29). Continuing Education. Retrieved from

<http://www.nurseone.ca/en/professional-practice/continuing-competence>). Given the many benefits of e-learning include the convenience it provides nursing students/trainees and practitioners the use of e-learning is increasing within nursing education (Kala et al., 2010) and also to comply with regulatory body requirements for continuing education for nursing professionals.

Atack and Rankin (2002) found that more exposure to e-learning during undergraduate studies and a good satisfaction level with e-learning will greatly help overcome barriers of traditional continuing education, like class schedule faced by registered nurses for maintaining professional competence. E-learning programs must be designed considering individuals' needs and interests, and more importantly, it involves a multidisciplinary approach (New Media Consortium, 2007). Specifically for designing e-learning for nursing programs, other aspects have to be considered by the higher education institutions. For example what are the categories of nursing students and their unique learning needs which include specific clinical skills, suitability to their IT skills level, how to use e-learning to support their clinical learning, what is best approach enabling collaboratively use of e-learning and more (Moule et al., 2011). Although e-learning, including the m-learning option, has many advantages, incorporating it into nursing educational programs raise challenges (Kala et al., 2010) including privacy related issues, perceptions that e-learning cannot teach you to be a nurse practitioner, overall resistance to change, providing group support needed for engagement in e-learning, quality learning materials or creating an effective learning environment where nursing students experience a high satisfaction level with e-learning .

Rationale and Aims

Within the scope of this work, I will present a case study aiming to investigate the factors influencing nursing students' satisfaction with an e-learning system, in light of the using a conceptual framework based on basic Technology Acceptance Model (TAM) framework (proposed by Davis (1989)), in a way that contributes in highlighting the combination of factors which affects student satisfaction and relationship between satisfaction and GPA in healthcare higher education. There are a number of under-researched areas related to student experiences with e-learning and considering that positive student outcomes are the goal of any educational program (Thompson, 2007) , the student experience area of meaning and measurement of student needs and satisfaction with e-learning offers opportunities for research.

Many factors can impact students satisfaction with educational programs, including perceived-ease of use and perceived usefulness which have positive effects on satisfaction and usage intention (Calli et al, 2013), or lack thereof, based on the TAM, originally proposed by Davis (1986). It is worth understanding first what satisfaction and dissatisfaction implies with respect to educational experiences. Student satisfaction is an aggregate of feelings or affective responses to distinguishable factors while interacting with the e-learning system (Shee & Wang, 2008). Learner dissatisfaction is often associated with learning environments where students lack the tools to be competent and successful, lack choice to learn in their own way, or understanding of the rationale for learning experiences, and feel there are learning barriers and their environments are not user friendly (Niemiec & Ryan, 2009). Furthermore, considering that e-learning environments often exhibit some inadequate technology and tools, usability issues

affecting perceived-ease of use, or other barriers towards useful learning, greater research and analysis regarding the factors that have the potential to reduce learner dissatisfaction and increase satisfaction with e-learning is required.

Few systematic reviews of e-learning and its effectiveness have been conducted among student nurses by meta-analytic methods; therefore it is important to investigate the impacts of e-learning including satisfaction among nursing students. A review conducted by Lahti et al. (2014) investigated the impact of e-learning on satisfaction, knowledge and skills among nurses and nursing students compared to traditional education methods. One of the review assumptions was that e-learning has a positive impact on learners' satisfaction with education (Lahti et. al, 2014). However, it was not possible to find reliable statistical information to support this assumption, and in general there is a lack of evidence regarding the impact of e-learning within nursing education. Other studies (Wutoh et al., 2004) have also described participants' satisfaction related to educational methods and results indicated better outcome for e-learning. The qualitative analysis on satisfaction also showed that students are more satisfied with e-learning (Tsai et al.,2004). Mcvey et al. (2009) also recounted similar effects on satisfaction in their study on the use of e-learning (also Cook et al., 2008).

While some prior results suggest that individualized e-learning approaches are more effective than traditional interventions (Lancaster and Stead, 2005), Lahti et al., (2014) review found that e-learning is not a superior learning method to traditional learning methods and a meta-analysis of e-learning approaches by Cook et al., (2008), concluded that an e-learning intervention and traditional instruction are not significantly different.

Few studies (Bloom & Hough, 2003, Caison & al., 2008, Frith et al., 2003, Sit et al., 2005, Gormley et al., 2009) have explored healthcare students' experience of using e-learning. Considering that health-care systems are changing at a rapid rate (Ginsburg et al., 2008, Rosenberg., 2006) following the technology usage in healthcare and integrating technology in health services, both nursing students and experienced professionals require training to become more qualified to use these evolving systems (while e-learning is viewed as an effective alternative solution to support the needed training for this (Moule et al., 2011). Considering recent advancements in health information technology such as integration of mobile devices and Electronic Medical Records or remote patient monitoring, (www.himss.org/mobilehealthit, (2014, December 11). New Care Models in Mobile Health. Retrieved from <http://www.himss.org/resourcelibrary>), it is timely to investigate the attitudes of healthcare students in relation to e-learning. A national study of Australian nurses identified both limited pre-registration training, a lack of confidence with computers and reduced IT technical skills by registered nurses (Hegney et al., 2006), and a Canadian study showed that registered nurses required advanced computer literacy and additional computer skills to utilize effectively, in their current clinical workflow, these sophisticated healthcare systems including electronic patient record systems, telehomecare and telemedicine systems or electronic medication systems (Balen & Jewesson 2004; Gough et al. 2014; Johannesson et al. 2010).

One such longitudinal study was conducted within a laptop-based BScN program which explores the relationship of goal orientation profiles to comfort with technology and academic success (Goodman et al., 2005). Study results demonstrated that students

were predominately high in the mastery goal orientation profile, with males had a higher comfort level with technology, age was inversely related to comfort with technology, and grade point average (GPA) was inversely related to comfort with the use of technology. The study data did not support the hypotheses that today's students are uniformly well-skilled and comfortable with new technologies. Although this study was planned to continue to allow comparison of variables over time, the results from the remainder of the study are not currently available. Specific teaching interventions may be developed to accommodate varying learning and motivational styles in relation to comfort with technology (Goodman, B et al., 2005).

A reliable meta-analysis (Cook et al., 2008) of e-learning concluded that e-learning intervention and traditional instruction are not statistically significantly different. According to Cook (2009), no more no-intervention-controlled studies or comparisons with traditional instructional methods are needed but rather, studies clarifying how to use e-learning effectively to increase student satisfaction are necessary. In order to understand how to design and implement efficient e-learning, one area of interest is to examine various e-learning features and their impact on student's overall level of satisfaction, which is the primary focus of this study.

Objectives

The objectives of this cross-sectional study are to:

- (i) determine the combination of factors influencing nursing and health sciences students' satisfaction in an e-learning system;

- (ii) determine the relationship between student satisfaction level and their self-reported GPA scores;

Research questions

The proposed study conducted at UOIT, a laptop based university, will aim to answer the following questions about nursing and health sciences students' perceptions of e-learning:

1. What e-learning features found in e-learning system used at UOIT have impact on student's level of satisfaction and their education?
2. What are the barriers in increasing nursing and health sciences student satisfaction using e-learning?
3. What are the facilitators for increasing nursing and health sciences student satisfaction using e-learning?
4. What is the relationship between student's level of satisfaction and students GPA scores?

The first three questions will support determining the combination of factors influencing nursing and health sciences student satisfaction over the course of a four year undergraduate nursing and health sciences program with respect to an e-learning system objective. The last research question will provide a measure for the relationship between student satisfaction level and GPA scores.

Key terms

E-learning: E-learning refers to any type of learning situation when instruction content is delivered partially or totally electronically via Internet.

Blended-learning: blended learning approach can combine face-to-face instruction with computer-mediated instruction

Student satisfaction: is aggregate of feelings or affective responses to distinguishable factors while interacting with the e-learning system.

Perceived usefulness: the extent to which a learner believes using e-learning will improve his learning.

Perceived ease of use: the extent to which a learner believes using e-learning will be relatively painless or effortless.

Contributions of my research

My research thesis contributes to the body of research by providing a thorough literature review of the domain and importance of e-learning in higher education, e-learning evaluation tools, best practices of e-learning in nursing and health sciences education across the world, strengths and risks and evolution of e-learning and impact on student satisfaction. The exploratory analysis reveals highly influential factors on student's satisfaction, with an in depth model development and testing of the relationship between student satisfaction with e-learning and GPA. The conclusions of my thesis are including detailed recommendations for students, faculty and university based on finding from both qualitative and quantitative data analysis.

Chapter 2

Literature review

Definitions of e-Learning

There are many definitions in literature describing e-learning which includes online learning, computer based, web-based and information technology (IT) or information and communication technology (ICT)-based learning. These are e-learning methods definitions for higher education programs that are commonly used. Very broadly, e-learning refers to the use of various electronic technologies to support learning and teaching (EDUCAUSE, 2003). These electronic technologies can comprise a course, a program or even a whole degree delivered online (North Carolina Education Cabinet and Office of the Governor, 2014).

It is important to note that these definitions are the ones put forward by scholars and researchers that study the subject of e-learning around the globe. Given the varying definitions of e-learning in addition to the fact that e-learning is a relatively new concept, there is currently no consensus on what constitute e-learning despite the vast amount of research being done in the field.

Asynchronous learning is a type of e-learning where the students participate in the online courses at different times, normally at their own schedule (Chang et al., 2014a; Kunin et al., 2014). Such e-learning programs allow students to study and work towards a degree with minimal interference to their work and/or family life.

Blended e-learning, the e-learning programs take an instructional approach that combines online and in-person or face-to-face activities with the students (Röhrig et al.,

2014; Ingrassia et al., 2014). Here the students still have to visit the physical classroom and perform some of the activities there. This is a type of e-learning program that does not allow for full freedom within learning process.

The e-learning students may also be exposed to a computer-assisted instruction or CAI. This e-learning technique is a self-learning tool where the students educate themselves using online/offline materials provided by the educational establishment that offers the e-learning program (Schwartzman et al., 2014; Lois et al., 2014).

Computer-based training or CBT is similar to asynchronous learning with the difference that the students take all courses offline, using their personal computers (the instructional material may be on a flash drive, DVD, CD, etc.). . This form of learning is also offered over the Internet (Chang et al., 2014b; Chambon et al., 2014).

An e-learning program may also be delivered through computer-mediated communication where all of the interactions occurs through networked telecommunication systems such as email, chat or instant messaging (DiNapoli et al., 2014; Palasinski et al., 2013). With cyber-learning, the use of virtual reality in the computers and the computer networks is the core of the e-learning process (Eriksson & Salzman-Erikson, 2013; Dutt et al., 2013). In such programs, the students are required to have strong computer skills to be able to participate in the classes and complete any homework.

Digital educational collaboration refers to the whole process including the conception and implementation of an e-learning program (Whitmore, 2005). Here, a mind-set of the students is put to the test: if they are capable of collaboration with the professors and other students online, they will be able excel in their studies.

Distributed learning is a system conceived to bring the same program and the educational material to all of the students at the same time (Esmailpour et al., 2014; Chasparis & Shamma, 2013). Here, all the students can participate in the learning process (e.g., a lecture) at the same time regardless of their location.

Informal learning is an autodidactic technique that offers the ability to learn by oneself, setting one's own objectives (Li et al., 2014; Davies et al., 2013). Such an e-learning program requires a strong skill set from the student including self-motivation, time management, working with tight deadlines, amongst others.

Mobile learning, or m-learning (Davern et al., 2014; Mather & Cummings, 2014), is viewed as learning using any mobile device, such as a PDA, mobile phone (e.g., Apple iPhone), tablet (e.g., Apple iPad), or other portable devices (e.g., Apple iPod, Sony PlayStation Portable, etc.). m-learning is considered as an extension of e-learning, or enhancing the formal education, which is often seen as face-to-face teaching and standard lectures, by adding more channels for delivering education, to learner-centered perspective when focus is not on device anymore but on the mobility of learner. According to Koole (2009), m-learning is the process resulting from the interaction of mobile devices and technologies, learner capacities aspect, and the social aspects of learning (see Fig. 1). m-learning can also be defined as any type of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of learning opportunities offered by mobile technologies (Biggs and Justice, 2011).

Technology-enhanced learning or TEL, stands for the integration of innovative technology in teaching and learning (Kemp & Day, 2014; Sandars, 2013). Here, the

educators are required to be creative in delivering the study material to the students in the most pro-active and efficient way.

Multi-modal instruction refers to a number of different ways to present the learning material including written, verbal, and animated forms (Seitz et al., 2014). This type of e-learning program is suitable for medical studies, engineering studies, geological studies, and other types of studies where animated reality helps to better imagine the concepts.

Online education involves an evolution of a computer coupled with a global approach to the ideas and culminated in the application of the technologies to the exchange of these ideas (Loria-Castellanos, 2014; Hart, 2014). This evolution can be seen in how education is evolving around the globe and the speed at which the number of e-learning programs are appearing on an annual basis.

Social media learning is about acquiring skills and knowledge through collaborative social technologies including online radio, wikis and regular, and microblogs (Pal, 2014; Green et al., 2014). An example of such technologies is YouTube, where online classes for virtually any subject are available. Large companies publish their podcasts with information and lectures by experts in a number of different fields and many business consulting firms hold their online presentations where they give entrepreneurs advice as to how to succeed with their ventures.

Virtual education makes use of the pedagogical and distance education principles and offers an opportunity of simultaneous and non-simultaneous communications (Halfer & Rosenheck, 2014; Borhani et al., 2011). Here students benefit from the e-learning

programs that help them stay motivated and choose their area of interest that they can pursue towards a degree.

Virtual learning environments or VLEs, systems for delivering learning materials to students via the web, allow for improved learning practices that make use of the Internet and a personal computer (Butina et al., 2013; Ahern & Wink, 2010). The students are required to have a good grasp of the technologies to be able to excel at an e-learning program using this study method. A webinar is an online seminar where both the organizer and the participants are exposed to the same content simultaneously in real time (McCool et al., 2014; Hutten-Czapski, 2014). Such an e-learning method is often used for example, by companies to share information to a large audience dispersed geographically in a real time.

Web-based training or WBT, is any type of learning where the instructions and data/information are made available on the Internet (Uslu et al., 2014; Stoner et al., 2014). Such e-learning may be used by educational establishments, governments, and private companies for educational purposes.

Importance of e-Learning

Some of the major advantages of e-learning include: flexibility, cost-effectiveness, capability to gather students from widespread locations who can participate in lectures and group discussion in real-time, also bring instructors with expertise not locally available (North Carolina E-learning Commission, 2014a), and satisfaction (Lahti et al, 2014).E-learning is not only a tool for education, it has become “a cornerstone for building inclusive knowledge societies” (UNESCO, 2014).

Requirements for e-Learning Students

Despite the fact that e-learning is becoming almost ubiquitous in the early 21st century, it is not necessarily suitable for everyone. Due to the fact that e-learning offers flexible schedules for students, self-discipline is the most important requirement for people willing to pursue education through e-learning. Similar to face-to-face classic form of education, e-learning demands students to be tenacious and persistent in their studies (Ontario E-learning Consortium, 2014). Students are not alone when taking e-learning courses; they may be working in groups with other students, have to share opinions and discuss course topics virtually, while face-to-face interaction is replaced by a virtual meeting space such as an “online classroom management system” (North Carolina E-learning Commission, 2014a). Assignments, tests, and exams are scheduled in advance and deadlines for submitting assignments have to be respected as it would be done when taking courses in a “real classroom”. Strong organizational skills and auto-discipline are important for those who choose to pursue education via e-learning (North Carolina E-learning Commission, 2014a).

Aside from the required mental capabilities such as self-discipline and organizational skills, other factors play important role in successfully pursuing e-learning as identified by Musa & Othman (2012). These include internet speed, instructor participation in discussion groups, learning by participation, placing course material in e-learning website on timely manner, among another 19 factors. In other words, one cannot pursue e-learning without satisfying these pre-requisites and will most likely not be accepted into an e-learning program without them.

The following are the requirements in terms of information literacy and preparedness that a learner must possess in order to be successful in e-learning (North Carolina E-learning Commission, 2014b). “Setting goals and deadlines” for oneself is a general pre-requisite for any type of studies and work, yet in the case of e-learning it is especially important as the very core of e-learning is founded on self-motivation and self-discipline. Having “a really good reason” to pursue e-learning studies implies that motivation is the necessary component when taking e-learning courses. Keeping oneself motivated during the e-learning study process is the founding pillar for successful e-learning, and thus cannot be underestimated. This together with the need for a flexible schedule may be “a really good reason”.

Being able to “finish the projects” that one starts is another pre-requisite that is a logical continuation of the first two. It requires both self-discipline and motivation. Positive attitude is the key here along with self-discipline and motivation, not quitting when “things get difficult” and “keeping oneself on track and on time” implies that organizational skills are important for self-discipline and motivation and for getting things done. In e-learning there is no one to keep the student on time and remind them about deadlines that have to be met.

The next group of requirements refers to learning techniques that an e-learning student has to have developed prior to starting an e-learning program. One requirement refers to the amount of time and effort that a student takes to learn. With little to occasionally no support from outside it is vital a student is independent enough in their learning. One important way to perceive information in e-learning is through listening. A potential student has to have skills for learning by listening when choosing e-learning

courses. Similar to listening, reading is the key in e-learning. A potential student has to have strong reading capabilities to succeed in e-learning courses or reading to “learn it best”.

Problems may arise along the way and there may not be a ready-to-use solution available immediately or access to a professor to help out. It is important for an e-learning student to be independent enough to tackle problems and possess good problem solving skills. Learning to “figure things out myself” is a logical continuation of the previous requirement and involves application of problem-solving skills and concentration. Working in a team and by oneself means that participation in group discussions will require team-player skills, while individual assignments will require working alone skills. Both are equally important. Willingness to work through email or have virtual discussions with people one “might never see” is about feeling comfortable about virtual communication without seeing or hearing their opponent. Such communications will occur often during e-learning.

The third group of requirements refers to organizational skills of a potential student. Having a place “to read and work”... with no distractions, a quiet space at home or a library open late are possible alternatives. Lack of these alternatives creates complication for a potential student. Even a usually quiet place may have distractions from time to time and being able to “ignore distractions” when there is no other place to work will allow him to complete the work regardless

A pre-determined amount of time has to be spent weekly on e-learning. If a student cannot dedicate such amount of time on a weekly basis successful e-learning may

be problematic. Thus being willing “to spend 10-20 hours” weekly on studies is another requirement for e-learning. Strong organization skills are required. A written or electronic agenda will have a student keep track of their studies and deadlines or in summary keeping records of progress and deadlines and proper work planning.

This requirement is a logical continuation of the previous one and again requires an agenda and realization of the importance of the studies and keeping up with the deadlines. Have people “close-by” to help and “not try to distract” the student. Therefore, it is important to have support people around on board. They should be understanding and allow a student their time and space to work regularly on their assignments, readings, etc. Being comfortable to email others when a question arises implies being comfortable about virtual and written communications that is another pillar for e-learning.

The fourth group of requirements refers to a potential student being technologically savvy. The requirements include good computer skills. A personal computer is not a novelty for an e-learning student and they have been working with a computer for a significant period of time prior to starting their studies. A potential student has been using the Internet for studies and/or work prior to starting their e-learning courses thus being comfortable searching something on the Internet and being comfortable searching for data and downloading them is also important.

Similar to the previous requirement, a student knows how to research, find and download the necessary data and information as per requirements of an e-learning course. New software may be required to be installed and used as part of an e-learning course. A potential student should know how to install software on their own or know where to

look for assistance. An access to a tech savvy person who can help resolve computer issues in a timely manner is an important requirement and has to be taken into account when taking e-learning courses thus having access to a tech-savvy person who can help resolve computer issues is another requirement for e-learning.

Finally, a student is required to have a certain set of technological capabilities to make e-learning happen. E-learning sessions make use of videoconferencing which requires a fast and high bandwidth Internet connection due to large amount of video data sent and received both ways. Protecting a student's computer and those of others with whom a student is dealing with virtually is important, so anti-virus software installed on the computer is a must thus an anti-virus software has to be installed on a student's computer and

To be able to participate vocally in videoconference proper audio equipment is required including a reliable Internet browser that can play audio and video files and to be able to play a videoconference without interruptions a proper Internet browser should be installed and verified prior to engaging in the first videoconference and also having a headset with a microphone or a microphone and speakers for videoconferencing.

As we can see in this section, e-learning is an educational technique that has become important and many educational institutions have decided to deliver education with this tool. E-learning is becoming more and more recognized across higher education institutions. However, this form to deliver education requires attention to procure a good performance and allow students to leverage all the techniques to be as good as any

student in a traditional program. This issue is addressed by pre-screening the students to detect weakness in their capacity to perform within this new design of education.

Technology Acceptance model (TAM)

The theoretical Technology Acceptance Model (TAM) framework (Davis, 1989) describes the internal behavior of a person towards the usage of new technology. TAM proposes that an intention to accept technology is determined directly by attitude, perceived usefulness, and perceived ease of use. Furthermore, perceived usefulness influences behavioral intention indirectly through attitudes, while perceived ease of use influences behavioral intention indirectly through both attitudes and perceived usefulness (Davis, Bagozzi, and Warshaw 1989). Perceived usefulness has been defined as an individual's perception that the utilization of a particular technology will be beneficial in an organizational setting over a current practice. Perceived ease of use is the perception by an individual that the utilization of the new technology will be relatively painless or effortless (Davis et al. 1989). The attitudinal component of the model measures an individual's affective response toward adopting a new technology, and the behavioral intention component of the TAM represents an individual's intentions to utilize a new technology (Davis, Bagozzi, and Warshaw 1989). There are several studies in e-learning using TAM, which used the new variables for content to extend TAM with different perspectives (Calli et al., 2013, Moon & Kim, 2001), another one extended the TAM approach with teaching materials and design of learning contents variables, while Premkumar and Bhattacharjee (2008) incorporated the e-learning presentation features, including text, audio, video and combinations of these into TAM.

Another example is Lee (2006) who expands the model by adding content quality, computer self-efficacy, perceived network externality and course attributes. Liaw (2008) offers a new approach that integrates a multidisciplinary approach from a technology acceptance model (TAM), social cognitive theory (SCT), theory of planned behavior (TPB) perspective, and integrates multimedia instruction (audio, video) and multimedia effectiveness. Calli et. al, (2013) are extending the TAM by adding other variables like multimedia content effectiveness, including here interactive animations, audio and video conference, text-based and visual materials effectiveness in e-learning.

Review of e-Learning Evaluation tools

Literature review of evaluative studies of e-learning has shown that methods of measuring learners' attitudes to e-learning are problematic and instruments are not always reliable (Lewis, Davies, Jenkins and Tait, 2005). Since the 1980s, there have been substantial changes in the capacity and incidence of e-learning use in higher education, and therefore some instruments designed to analyze their usage, responses to, and attitudes with e-learning may have lost their validity over time. Stronge and Brodt (1985) developed the Nurses' Attitudes towards Computerisation (NATC), a 20 items self-report questionnaire with a reliable 6-factor scale, and this is the only instrument that was repeatedly tested in healthcare education and practice. The NATC instrument was adapted or revalidated several times over years (Jayasuriya & Caputi, 1996) but it is now considered dated and has proved more reliable with nurses working in hospitals than with nursing and health sciences students.

The report of a Canadian cross-sectional study of registered nurses also critiqued the Stronge and Brodt instrument (McBride & Nagle 1996) following a review of

previous reported uses of the NATC scale. Also Jayasuriya & Caputi (1996) described another 22 item instrument (the Computer Attitude Scale (CATT)), where not a single item was derived from Stronge and Brodt (1985) NATC items. In a Canadian study of registered nurses, authors developed a new 18 item scale (Attitudes Towards the Internet) based on combining few items from NATC scale with other scales (Cragg et al., 2003).

A U.S study conducted by Duggan et al. (2001) identified a lack of instruments to measure student attitudes towards e-learning and researchers developed and validated an 18-item scale, Attitudes to the Educational Use of the Internet (ATEUI) (Wilkinson et al., 2008). In a study of Registered Nurses (DeBourgh, 2003), a 59-item Student Satisfaction Survey based on an existing instrument was used with added items on computer-mediated communication on student satisfaction with e-learning. A 27-item Questionnaire for User Interface Satisfaction QUIS was developed by Chin, Diehl, and Norman (1988) and has been used for evaluating Web-based e-learning systems (Johnson, Zhang, Tang, Johnson, & Turley, 2004; Segall, Doolen, & Porter, 2005). The QUIS has five scales which describe a user's reactions to the software, screen, terminology and system information, learning and system capabilities. In a comparative evaluation study for student satisfaction in a multiplatform e-learning system using two e-learning systems.

Future measurement tools are needed to address the information literacy and preparedness for online education of nursing students, as well as their basic information and communication technology skills, as these have been already identified as current issues impacting use of e-learning in nursing education (Jackson et al. 2000, Boyle & Wambach 2001). The quality of instruments is variable, with little evidence of progressive development and validation to date and no instrument has demonstrated high

reliability in measuring student attitudes towards e-learning over more than one group. However, studies are emerging which address the use of e-learning by different populations (e.g. Sit et al., 2005).

Results from evaluation tools

McBride & Nagle (1996) questioned the validity of the NATC scale since their findings could only explain 50% of the variance for the Registered Nurses and 48% for the students which can be attributed in part to the age of the scale (Wilkinson, While and Roberts, 2009). The 18 item Attitudes Towards the Internet scale had good reliability and was validated (Cragg et al. (2003). A study by DeBourgh (2003) revealed that technical aspects were mentioned as the most frequent source of negative attitudes from students. However, they concluded that the quality of the instructor remained the most important factor in satisfaction with e-learning.

The findings of Duggan et al. (2001) after the AETUI instrument was used in few studies suggest that students who are in control of their learning have positive attitudes towards e-learning. A comparative evaluation study for student satisfaction in a multiplatform e-learning system using two e-learning systems, using the modified version of the QUIS, and six scenarios for evaluation, proved that overall student satisfaction score is higher for a multiplatform e-learning system than the traditional e-learning system (Goh et al., 2008).

Most of the studies have been cross-sectional (e.g. Duggan et al., 2001, Bloom & Hough, 2003) or pre and post- test studies (Atack & Rankin, 2002). However, very few longitudinal studies have employed repeated measures, and the pre and post-test

intervention studies were of single units or modules of e-learning with resulting small sample sizes (Wilkinson et al., 2008).

Best practices of E-Learning across the world

A systematic review identified barriers for students in the effective utilization of e-learning (Cook, 2007), including a lack of IT skills and the availability of inadequate technology. This indicates that a blended delivery method of courses, with access to e-learning, may provide one solution for an effective learning experience. The results of another study conducted by Gormley et al., (2009) suggests that students who used and valued e-learning were also more likely to attend clinical attachments to examine patients. This study also revealed that clinical skills textbooks are not as popular as e-learning. DeCaro et al. (2014) presents a review of digital technologies and e-learning in nursing education and health professions and analyze education through e-learning technologies for nursing and health professional students in developed countries. They conclude that e-learning in nursing academic education is a valid alternative to traditional learning and they found an improvement of ability, when compared to traditional learning.

Farrington (2014) conducts a case study of blended e-learning and facilitated workshop training courses to improve end of life care in nursing and residential care homes in English speaking countries. He evaluates the impact of the course on understanding and confidence in delivering end of life care in one nursing home using pre- and post-course questionnaires, documentary analysis, semi-structured interviews, and observation of course workshops. He concludes that blended e-learning courses have

the potential to generate positive change in the understandings and confidence about End of Life Care.

Jawaid and Aly (2014) studied most of the modalities of e-learning applied to medical, dental, nursing and any health undergraduate program in Pakistan. Their study presents a description of e-learning and analyse their advantages and limitation. They found practical implications of the advantages and limitations of the modalities of e-learning.

McCutcheon et al. (2014) make a comparison between online or blended learning paradigm as a potential to enhance the teaching of clinical skills in undergraduate nursing in the England. They produce this study for the concern about reductions in practice opportunities. Especially since online and blended teaching methods are widely used but their effectiveness in teaching clinical skills is limited. They conclude that online learning for teaching clinical skills is no less effective than traditional means and remark the lack of evidence for blended learning approach effectiveness in teaching clinical skills in undergraduate nurse education.

Evatt et al. (2014) evaluated the capability of nursing students to use electronic health record for patient admission into hospital, using only e-learning in Atlanta, U.S.A. They found that using only e-learning did not produce the best results. Thus, they proposed a hybrid instructional method consisting of e-learning and a 20-minutes slide presentation. They conclude that with this face-to-instruction technique, the nursing students significantly improved nursing documentation.

Van de Steeg et al. (2014) conducted a study to determine if e-learning is effective in delirium care in The Netherlands. Delirium is a condition in older hospitalised patients, but it is common for healthcare professionals to fail to recognise patients suffering from delirium. They found that nurses enrolled to the delirium e-learning course showed a greater quality in delirium care. This study improved the recognition of patients at risk and proves that value of e-learning for hospitals in delirium care.

Georg and Zary (2014) develop a methodology to improve the process of comprehension of nursing students in Stockholm, Sweden. The method developed was a virtual patient nursing model in an iterative manner. Their results show that virtual patients can help in the development of clinical reasoning skills. This virtual patient nursing design and activity models allow the systematic development of different types of virtual patients and establish pedagogical designs of technical solutions.

Liu et al. (2014a) develop a methodology adapted for continuing education of nursing of case management in psychiatric nurses of Taiwan. They used simulated learning modules, self-assessment questions, learning cases, sharing experiences and learning resources. They found positive evidence on this educational resource for nursing continuing education compared with the traditional students. Liu et al. (2014b) document the effectiveness of the digital case management of the methodology developed by Liu et al. (2014a) in Taiwan. They describe how nurse educators and informatics educators work together through eight phases of the program. Their findings on knowledge and confidence levels of the students that took the program compared with those that used

only traditional education indicates that education technology provides a more flexible and effective method for continuing education programs.

Morente et al. (2014) develop an adaptive self-learning e-learning tool for pressure ulcer assessment and treatment in Málaga, Spain. They evaluate the performance of students with post-test questionnaires for diagnosis and treatment. They conclude that the e-learning tool is an effective instrument for training and its potential positive impact on clinical decision-making.

Cho and Shin (2014) conduct a study to identify effectiveness of the Good Research Practice program in South Korea for nurses and nursing students. They compare the levels of knowledge and perception of research ethics before and after the program of 30 hours of blended learning (online and off-line). The results provide positive statistically significant differences in both knowledge and perception. However, the concepts of professional nursing ethics, moral issues and bioethics were often confused and not clear. Thus, the authors suggest including this program as a new blended-learning to improve research ethics in nursing research in Korea.

Jang et al. (2006) evaluate the blending learning program for undergraduate students in South Korea. Their study relies on the assumption that electrocardiography application requires a face-to-face learning and e-learning. They remark that motivation is not a factor, since face-to-face students were equally active just like web-based learning. Nevertheless, they found that students in a blended program perform better and that learning satisfaction was positive.

Carbonaro et al. (2008) present a research study for the integration of e-learning technologies in an interprofessional health science course. The strength of the study consists of design methods used to redesign a course from a 100% face-to-face delivery format to a blended learning format where 70% of the instruction was delivered using new virtual classroom technology. Results of the study showed that blended learning format increased learning satisfaction.

Veredas et al. (2014) indicates that pressure ulcers are one of the most challenging problems that nursing professionals have to deal with in their daily practice in Málaga, Spain. They introduce an information and communication technology (ICT) course for undergraduate students. Study has found that traditional education and e-learning produce a comparable efficacy. Rostad et al. (2014) conducted an interdisciplinary project to design a graduate program for Advanced Geriatric Nursing in Oslo, Norway. The program employed a model of instruction, learning and pedagogical framework for e-learning. The authors present the implementation of the program on a pre-existing already e-learning environment. Researchers concluded that e-learning programs offer learners more control over their learning experience, opportunities for repetition, and permits more individualized learning compared to traditional teaching methods (Health and medical informatics, 2014).

Zogas et al. (2013) report a research project performed on Greek universities about e-learning for Health Informatics. The authors compare the Greek e-learning educational system with other European countries. They present the differences and disadvantages of the Greek model with other countries and conclude that Greek Health Informatics requires large improvement in the area of e-learning programs design.

This literature review shows the characteristics and importance of education of students with new technologies and methodologies. Across the literature review was possible to identify e-learning techniques, tools and approaches that are currently used by universities across the world. Our literature review aimed to review mostly new research articles, related to e-learning programs effectiveness and factors influencing the quality of e-e-learning as the result of technologies improvements.

Strengths and Risks of E-Learning

The methods and techniques involved in e-learning, the need to prepare educators, the inherent compromise of students to be autonomous, and the fast evolution of technology, combine to make e-learning a new environment with challenges and opportunities. Iowa State University (2014) and the University of Illinois (2014) offer an overview of this situation. These two Universities are chosen as references for e-learning due to the fact that they are at the forefront of e-learning development in the United States and in North America. These two universities have the largest and the oldest e-learning programs within the United States. Both are in the list of the first 100 universities in the United States and around the world.

There are a number of advantages of e-learning, according to the Iowa State University and to the University of Illinois. Some of these advantages are connected with the convenience and the ubiquitous manner. Thus, the first advantage is that a student can take a course from any place anywhere around the world where he or she has a proper Internet connection. Depending on the program, students may take courses either on a fixed schedule or any time they want or are available to take courses. Hence, another advantage is the availability of the e-learning courses at any time, be it 1 p.m. or 1 a.m. The

course materials are also available to students at any time and on continuous basis, so they can read and re-read lecture material and take the time they need to reflect on the study material.

In addition, the class work can be scheduled around a student's work and family life. The student does not need to spend time away from the family, in after work hours, in a classroom, but rather can enjoy their family's company and do their classroom and homework at home. It is important to note that due to the fact an e-learning student can do their classes and homework from home, their time and financial costs are minimized as the students does not need to pay accommodation to live away from home to study, does not need to spend on transport to travel daily to the e-learning educational establishment. They even save costs on meals and other costs as all work is done in a home setting.

The virtual environment of e-learning allows sharing of the resources and ideas and leads to dynamic interactions between the educators and their students. The creativity stems from the freedom of perception, reflection, thought, and sharing of intellectual material produced by the professors using their knowledge and experience and by the students taking their time to create a value-added of their own.

Another advantage of e-learning concerns more senior or more junior groups of students compared to the average age at an e-learning program. For example, a fifty-year-old person working towards their Master's degree in a group of thirty-year-olds may feel uncomfortable due to the age difference. E-learning eliminates these and other barriers including differences in dress codes, physical appearance, disabilities, race, and gender.

E-learning requires a completely new and different approach to instruction and to presenting the learning material to the students that an educator cannot see in front of him or her. The educator thus has to compensate for this lack of visual contact with their audience and offer a different, more enriched way of communicating the learning material to make sure the message gets through to the audience without the visual contact. Due to the fact that an e-learning educator does not have visual contact with their students, it is important for them to pay more attention to what students say during the class. Thus, class discussions become centered on the students' concerns rather than the textbooks' chapters. Yet another advantage of e-learning is the ability to invite the distinguished experts to participate in the classes and lectures. These distinguished experts can be invited from anywhere around the world to add their important opinion on the subjects being taught in an e-learning class. The greatest convenience of the e-learning programs here is that the experts do not need to find room in their busy schedules for travelling and the costs incurred when travelling. Another convenience of e-learning for the students is that they are free to choose studies in accordance with their level of knowledge and as per their interests. A student can pick and chooses their courses and therefore they can pursue only those courses that are of interest to them and those courses that they feel will be useful in their professional live after graduating with their degree. Meeting e-learning educators and classmates remotely in a chat room is another advantage of e-learning. Students can freely discuss issues with the educators and other students any time that they are online. This is an advantage compared to a traditional way of studying where professors and other students are only available during the fixed hours. The fact that the educators and the students work in a virtual environment in an e-learning program, allows for one-on-one

communication between them. This is an advantage compared to large lecture rooms where some people may be less likely to be actively participating in the discussion as they are shy to ask questions in front of a large audience listening and watching them.

While participating in e-learning studies, the students have to learn to use Internet and other technologies proficiently to be able to excel at an e-learning program. They develop skills that will be very useful further in their professional lives and careers after graduating with a degree from the program. An e-learning program requires self-discipline from the students. It also allows them to improve their self-knowledge, self-confidence and responsibility when doing online courses as they attempt to deal with the challenges of an e-learning program. They become self-confident as they overcome the difficulties and succeed in their studies. They become more responsible as they have to manage their professional and study lives and juggle priorities on a daily basis to be able to cope with the workload. The students can concentrate on the new information and the skills they acquire during their e-learning studies rather than continue working on the material they have already mastered.

An e-learning program provides students greater freedom in deciding what subjects to pursue, thus the students are free to choose those subjects that they have not mastered yet. The advantages described below are complemented by the risks associated with e-learning. The risks associated with e-learning are described in more detail below. Every e-learning program requires strong self-discipline and motivation. If a student does not have these skills or cannot develop them during the program, the student may fail to perform satisfactorily on the e-learning courses. The feeling of isolation due to the fact that there is no physical classroom and there is no face-to-face contact with the professors and

other students. Such students are again better off with a traditional way of studying unless they can adapt to this new way of studying and communicate with the educators and other students on a regular basis to compensate for this “isolation”. Due to the flexible schedule of an e-learning program, the educators may not be available at any time, especially when studies are overnight. This requires students to either communicate with the professors via email only or to schedule online chat sessions with the professors in advance. This presents another challenge to the students when doing the e-learning programs. The state of the communications technologies around the world differs from country to country, from city to city and even from a city block to another city block.

It is important for the e-learning students to realize this limitation when they start their e-learning studies and to ensure a proper Internet connection that will allow them to participate in the classes and complete their assignments. Mastering a personal computer and the e-learning programs software is another important pre-requisite for the students to be successful at an e-learning program. If a student does not have these skills when starting a program, they have to develop these as quickly as they can, otherwise performing simple tasks will be taking more time than there is available. This eventually may lead to poor performance during the e-learning studies. Some courses that require physical interaction with the equipment, the instrumentation, and/or other materials cannot be done online. Such courses as chemistry, physics in a laboratory setting require a traditional, physical classroom. The user-friendly and reliable technologies may be limiting to the transfer of knowledge. For example, such classes as mathematics, geometry, engineering, physics, chemistry and others require an extensive use of a blackboard. This may not al-

ways be contemplated in the commercial software packages available for e-learning, and thus the software may be limiting to the transfer of knowledge.

Another problem along the same lines is that some of the subjects cannot be taught online as the very nature of these subjects requires physical interaction with the equipment or the materials. These are: public speaking that requires a face-to-face contact with the audience; applied medical studies such as surgery and dental hygiene that require interaction with a patient, and sports that require interaction with the sports equipment.

Another limitation to an e-learning program is the capabilities of the educators. The more senior educators who have been working in a traditional classroom setting for the past several decades may find it more challenging to work in a virtual classroom setting. The natural way of dealing with such a challenge is being uncomfortable and to reject these changes. The more professors reject these changes, the fewer professors are available to teach at an e-learning program. Another risk for e-learning programs might come from the universities' program administration, when too many students are enrolled in the e-learning programs without adequate support offered to these students. As a result, the students may become de-motivated and withdraw from these programs.

Student's satisfaction with e-learning

Student's satisfaction with e-learning should be considered an important output of any educational processes. Effective e-learning processes and completion of these processes successfully has positive impact on student satisfaction (Taplin et al., 2011). A comparative study evaluated the effectiveness of communication methods used in e-

learning courses on student's satisfaction and motivation to complete the course (Frith et al., 2003). Instruments for the research included demographic data, two examinations on course material, a course satisfaction scale, and calculation of completion rates. Results indicate significant group differences for student satisfaction with the e-learning (Frith et al., 2003) an indicator that improved communication strategies can increase student's satisfaction with e-learning.

Another study proposed a new model for e-learning research and applications by adding variables such as perceived playfulness, satisfaction and multimedia content effectiveness to TAM approach and analyzed the usage intention with perceived playfulness and multimedia content effectiveness incorporated into this new model (Calli et al., 2013). Study results revealed that perceived playfulness had positive effect on satisfaction (Lin et al. 2005) .Other findings of the same study showed that multimedia content effectiveness has relatively low positive effects on perceived usefulness and satisfaction, while effective multimedia content materials have a positive influence on both satisfaction and perceived usefulness (Calli et al., 2013).

Another finding of research is a strong positive effect of perceived usefulness on satisfaction (Lin et al, 2005) and this indicates that managers of e-learning systems should consider students' perceived learning performance and effectiveness. Moreover, learning satisfaction has a notable effect on usage intention. The study concludes that a successful e-learning environment should be designed such that it aligns with individual learner needs and interests, and efficiency of such an e-learning environment should be evaluated and re-evaluated for any further enhancements.

Evolution of e-learning and impact on student satisfaction

More recently, new mobile technologies are providing support for mobile learning or m-learning which it is commonly considered as an extension of e-learning. as previously described, m-learning seeks to use mobile technology such as smart phones in the same way in which e-learning uses personal computers and wired communication technologies. M-learning based on mobile devices has created opportunities for new approaches to teaching and learning. In this new mobile environment, new applications and educational models need to be created and tested to confirm (or reject) their validity and usefulness (Ortega et al., 2010). Recent applications developed for smart phones and other mobile devices allows access to patient histories and physical examinations, medication and problem lists, allergies, and even to receive urgent patient questions through messaging, and provides access to drug reference database and clinical protocols. This can actually be the catalyst for increasing the m-learning in healthcare higher education.

A study for evaluating student satisfaction with e-learning systems, proved that overall student satisfaction score is higher with a learning system that can deliver learning content to mobile devices than the traditional e-learning system (Goh et al., 2008). Other studies indicate that healthcare students believe that podcasts are more effective revision tools than their textbooks and their own notes in helping them to learn. It also indicates that students are more receptive to the learning material in the form of a podcast than a traditional lecture or textbook (Vogt at al., 2010). More research is needed to validate m-learning interventions where the delivery of learning content to students is accomplished through the use of mobile technology including podcasting, serious games,

simulations, medical reference-ware which appears to have significant potential as innovative learning tools and offers the advantages of flexibility in when, where and how it is used.

What are the promises of m-learning? It promises to deliver learning in real time wherever the learner happens to be and not at a fixed location thus fulfilling the learner centric philosophy, enables a more contextualized learning, focuses on knowledge that is dependent on location and situation and takes advantage of the fact that mobile devices use in healthcare has exploded (Cahoon, 2002) primarily in the area of search on drugs, calculations and dosages, m-health and medical simulations. Nurses are already using smartphones and PDA for clinical applications to order test results, keep patient history, patient manager, progress notes and assessments, tasks list, memo pads, calendars, clinical reference, clinical protocols, prescription information. These mobile devices are preferred because they are portable, light, convenient, and offer drug reference database help to reduce medical errors (Park, 2006). M-learning can leverage this increased usage of mobile devices in order to deliver more efficient training, learning in real time, plus the cost and time savings for continuous education. It also reduces learning curve for clinical applications which range from decision support tools, eRX, EMR, CPOE running on mobile devices (Ambient Insight Research, 2010). M-learning can be used to prepare before attending a class and this is a way for learner to get familiar with material and class time is efficiently used to go into advanced concepts (Biggs and Justice, 2011).

The value derived from employing m-learning in healthcare education includes increased safety by reduction in medical errors, safer than memory by means of quick drug reference database, checking clinical protocols, verify prescription info and overall

access to up to date information (Kenny et al., 2009). The medical applications created for mobile devices are lightweight, concise, convenient and highly portable, and provide uncluttered and straightforward user interface, numerous embedded videos with significant reduced cost compared with printed version with DVD (Dala-Ali, Lloyd, & Al-Abed, 2011). Another valuable benefit adding value to m-learning is access to shared resources including knowledge base with up-to-date information, rare cases, simulations and best practices (Kenny et al, 2009). M-learning enables real-time communication and collaboration, provides learner orientation, helps with previous knowledge reuse and facilitates learning about collaborative patient health management.

Through m-learning, users learn how to establish collaboration and how to proceed in emergency procedures. Ultimately it generates new learning opportunities for novice and rare cases. M-learning also provides the opportunity for the educator, peers and resources to collaborate at the point-of-care, especially when indirect supervision models are used, to support the healthcare students' safety and evidence-informed practice (Kenny et al., 2009). It can provide efficient learner orientation and reuse of previous knowledge thus reducing the need for trainer or teacher support.

The major barriers in using m-learning include the lack of preparedness for adoption of m-learning, user technical expertise and expectations, difficulties in measuring the effectiveness of learning in terms of impact on grades or productivity, evaluating student satisfaction, infrastructure costs, problems associated with quality of simulations and accuracy issues. Representation on mobile devices still has many problems including difficulties to read or understand, slow data entry, small screen size, “poverty” of texting for visual learners etc. Some mobile devices such as the Apple iPad

are better suited for m-learning considering its ability to flip quickly through multiple pages, and zooming in on certain parts of the screen (Sharples et al., 2009). Other obstacles in using m-learning are the wireless connectivity since some healthcare organizations does not allow or have limited the use of wireless devices on the premises for avoiding risks of causing medical equipment to malfunction, quality of Wi-Fi connections and services on mobile devices.

There are social barriers in the adoption of m-learning caused by learning in isolation and loss of personal touch. M-learning is not for everyone and raises some difficulties to set it up; the learner may face technological failures such as a limited (and draining) battery, or when the learner doesn't have enough time to learn concerns related to confidentiality or learner perceptions that m-learning cannot teach you to be a healthcare practitioner;

Also there are as many barriers in m-learning usage and adoption including overall resistance to change, gaining acceptance for this new model of learning, finding ways to change the attitudes towards m-learning through training (Pearlson & Saunders, 2010, p.125-127). There are many risks associated with m-learning programs caused either by poor quality of learning products including poorly designed mobile applications without a user-friendly interface, poor Information System's implementation and compatibility issue between mobile devices and learning applications and failure to deliver at the learners expectations level. Another risk is to enforce m-learning at the institution level without initial evaluation of the organization readiness for m-learning adoption and optimal ways to use m-learning to effectively increase learning outcomes. To mitigate these risks, the higher education institution has to develop the appropriate

learning strategies based on the in-depth analysis and evaluation of the learners needs aligned with the organization strategic learning goals (Perry, 2010).

The ethical dimension is critically important for m-learning and includes learning about the importance of establishing a professional ethical practice. M-learning is a good way to provide the training required for understanding the issues of confidentiality related to breach of patient information occurring through unauthorized access to patient information. It provides the appropriate opportunity for information security education, training and awareness (Pearlson & Saunders, 2010, p. 260-264) for ethics and information security healthcare issues around how to protect patient information data, importance of implementing and following security policies and practice using mobile devices which are easy to loss or suffer damage. Mobile technologies are providing increased security feature nowadays including sensitive information encryption on the device and through the wireless connections, use of different user's security profiles but there are still many gaps in terms of security of information and user has to be aware of them and has the appropriate training on this matter conveniently though m-learning.

M-learning in healthcare education is comprehensive and it is not just about learning using portable devices, but learning across contexts and should be considered as a complement in higher education. At a higher level, an implementation plan for m-learning should include a solution for technology or infrastructure, should take into the consideration different learner group needs, what types of learning content should be supported and select effective methods of m-learning delivery. The security and privacy policies have to be part of the implementation plan with a mandatory training requirement for users which can be conducted on mobile devices themselves.

The barrier of measuring m-learning effectiveness can be overcome by measuring multiple dimensions of learning like learner level of satisfaction, enrollments and actual usage obtained through regular surveys for the system's users. A dramatic change in the way for practicing for healthcare is attainable in the foreseeable future by examining the ways in which mobile learning can be applied in the workday of the nurses, surgeon or surgical trainee (Dala-Ali et al., 2011) and other healthcare practitioners and understand what is the best way to customize learning products to the specific learner needs and his learning path.

A key element for future development is a collaborative approach (Perry, 2010) in m-learning through use of learning platforms with integrated back-end systems which will allow learners to connect with various data sources and connect with one another so they can share ideas and resources. Changes in the World Wide Web, with a shift to more social-networking activity in education and to web-based delivery to these small, ubiquitous portable devices will dramatically increase opportunities for m-learning in healthcare (Larvin, 2009).

Conclusions

The literature review for e-learning, highlights a few gaps around the fact that not enough is known about either the preparedness of nursing students for e-learning or factors determining their student satisfaction with e-learning including improving communication strategies that can increase student's satisfaction with e-learning, or the positive effect of perceived usefulness on satisfaction (Bhattacharjee, 2001; Lin et al, 2005). It's clear that further research is needed to determine the best communication strategies to enhance student learning and to determine the long term effects of e-learning

on students, and that designers of e-learning systems should consider students' perceived usefulness when designing e-learning programs.

My proposed comparative study will help fill this gap by determining the combination of factors influencing nursing students' satisfaction. Accordingly, the study aims to employ reliable methodology to measure learners' attitudes towards e-learning, use validated and reliable instruments, examine a larger sample size, include participants using more than one module of e-learning. Furthermore, it is imperative to develop and validate new instruments to explore nursing and health sciences students' experiences with e-learning. Currently, few instrument have demonstrated high reliability in measuring student attitudes towards e-learning over more than one group and new instruments which measure students' ability and confidence in using e-learning tools are required, as shown by Wilkinson et al. (2008).

Chapter Three

Design and methods

3.1. Introduction

This chapter presents the design of the research and how all the theoretical elements were incorporated to produce the instruments and methods used in the study, the ethical approval and the time schedule. There is a detailed discussion of the analysis of the data collected and the strengths and limitations of the study.

3.2. Conceptual Framework

The study targets nursing and health sciences students from all four years of the collaborative nursing and health sciences undergraduate program at UOIT. The online surveys were used to collect quantitative and qualitative data. The study begins with the questionnaire available via a web portal and then the data analysis was performed.

A cross-sectional design was chosen for this case study, since such a design can be used to investigate many exposures and output variables of interest. However, as described by Martin (2007), such a design has some limitations including the participant selection bias and problems with reverse causality. In order to minimize selection bias, participants were recruited from each of the four years of the undergraduate nursing and health sciences program. The conceptual framework include a conceptual model as illustrated in Figure 1.

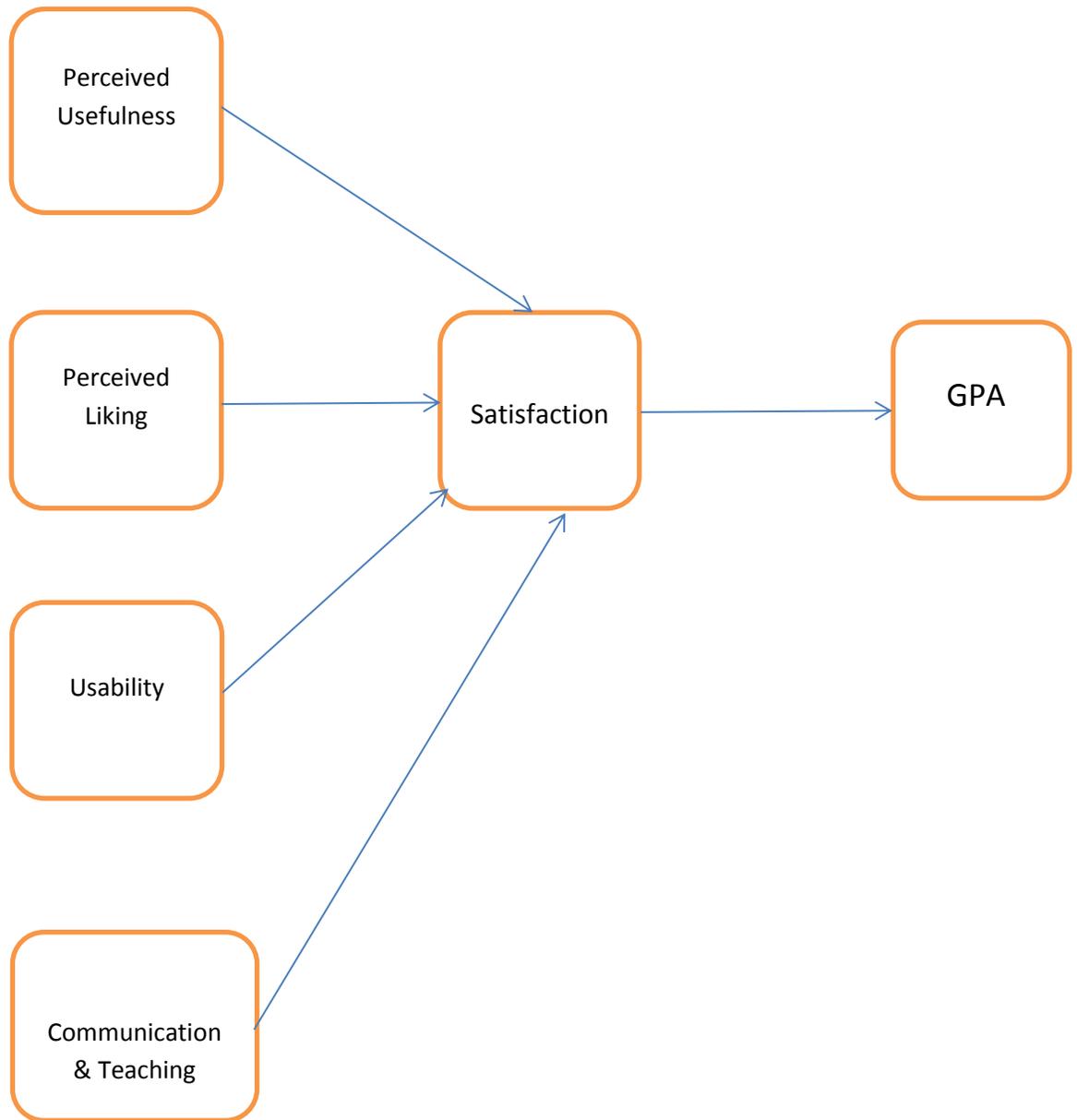


Figure 1. Conceptual Model

3.3. Ethical approval

The study was approved by the Research Ethics Board (REB 09-150) at UOIT, where the study was conducted. The study met the Tri-council standards and participants had the right to withdraw anytime and answer only questions they wish to, based on the written informed consent form which will contain a highlighted area indicating how participants can withdraw from the study. There were no consequences if a participant decided to withdraw from the study. The principal investigator arranged for secure and confidential storage of study data. Each participant was assigned a numeric code that was used on the survey. No names were attached to the number. The principal investigator has kept raw data and aggregate data for the duration of the project. After project was completed, participant information and survey results were deleted from the secure storage server and any tapes of the interview and emails were deleted or destroyed. There is no plan to keep the data for secondary research purposes. No additional monitoring was required for this project.

There were no physical, psychological or social risks associated with participation in any phases of this study. No deception was involved during the study and there was no potential that participants felt coerced into contributing to this research. Overall, there were minimal risks to the participants that were involved in this study. Considering the increased demand for e-learning in nursing and health sciences education, measuring the experience and attitudes of students towards the increased use of e-learning provides more evidence for effective curriculum improvement, and this is considered a great benefit of this study. The recruitment materials included letters of invitation, posters, class presentations and email correspondence.

3.4. Time schedule

The case study started in September 2010, and questionnaire (see Appendix A) was administered at the beginning of first term. The questionnaire was available via a web portal and was delivered in Phase 1 of the research study. There was no paper-based version of the questionnaires. The principal investigator was responsible for making the survey website available to the recruited participants. One week after the target deadline for questionnaire, a reminder e-mail was sent to participants. Two weeks after the deadline another reminder email was sent that respondents had one more week to complete the surveys before the results were analyzed. A summary of study key steps with timelines is available in Appendix H.

3.6. Instrument

The questionnaire was adapted from previous scales used in the e-learning research field (Gormley et al., 2009, DeBourgh G.A., 2003, Calli et al, 2013, 2000;Loiacono et al., 2002; Moon & Kim, 2001; Paechter et al., 2010;) and it was developed using a five-score Likert-type scale and open ended questions. The questionnaire captured demographic information, perceived usefulness, and perceived ease of use with questions adapted from Davis (1989), overall e-learning satisfaction score, communication dimension such as mode of delivery, perceived collaboration, perceived pedagogy, etc. The questionnaire was tested with an initial pilot group of graduate students (n = 10) in Health Sciences, to collect feedback about survey readability, test-retest for reliability (See **Appendix A** for sample questionnaire questions).

Open-questions consisting of four to five questions were included in the survey delivered to UOIT students to obtain further qualitative data in order to provide an understanding of the specific conditions under which an e-learning environment becomes facilitative .Both qualitative and quantitative analyses were used to interpret the case study data. For data collected using questionnaires, quantitative methods including Pearson's correlation analysis and step wise multiple regressions were used to establish the required statistics.

The list of variables is presented in **Appendix B**. The variable *id* is not accounted as an important factor because this was only a tag produced by the system to identify

each one of the participants. There are 35 variables in the questionnaire and in order to analyse the data it is important to change all the strings of text into some numerical values.

Appendix A shows the questionnaire with numerical values.

3.7. Data Collection

A convenience quota sample (non-random) matching university nursing and health sciences student population distribution were used. Based on the current student population of 120-150 that are enrolled in each year of the program, the sample target is 30- 40 students for each year. The total sample target for the study is somewhere between 100 – 150 participants. Open-ended questions were included in the survey to obtain further qualitative data to understand the specific conditions under which an *e-learning* environment becomes facilitative.

Inclusion criteria are as follows: participants in this study included undergraduate students in the nursing and health sciences program (Faculty of Health Sciences) at the University of Ontario Institute of Technology from all four years of the program, who are enrolled part-time or full-time, have more than one course involving e-learning in their curriculum, and are exposed to use of computers in health and clinical simulations. The e-learning courses at UOIT include a blended learning approach with at least 50% of course content delivered online including class lectures, clinical simulations, discussion forum, quizzes or 100% online delivery.

Recruitment for the study involved inviting students by email using a letter of invitation, class visits and discussion with professors to post the letter of invitation on the WebCT course management system accessible to all students, sending regular newsletter

to nursing and health sciences students which might influence other students to join the study, offering incentives such as a chance to win an iPhone, and twenty dollar gift cards amongst others. For those expressing interest in participating in the project, an information session describing the research objectives in more detail were organized. An online consent form was enclosed with the online survey. The principal investigator ensured that all online and written consent was obtained during the study.

3.9. Data Analysis

All the data were collected electronically via the web portal of the survey. All data were ordered in a table format using Microsoft ExcelTM. The treatment of all the data was done with statistical software “R”. The software R is a statistical data analysis tool used for statistical and mathematical data treatment as well as graphic representation of the analysis. It is an open source programming language. R’s major advantage is that it works under any operating system that currently exists. The currently available version v3.1.2 combines statistical and mathematical algorithms present in all of the traditional statistical software packages. R software was preferred because it is open source and freely to everybody to conduct any type of statistical analysis without having access to the costly traditional alternatives.

3.9.1. Quantitative Analysis

Quantitative analysis in this research is designed to answer the research questions established in Chapter 1 with question one talking about e-learning features considered by students to have most impact on student satisfaction. Question two defines barriers to increase satisfaction of nursing students with e-learning. Question three refers to facilitators that increased the use of e-learning platform of UOIT. Finally, question four

seeks to define the relationship between student level of satisfaction and their GPA scores. For the multiple variable analysis, the best form to analyze the performance of the model is the use of the technique called Analysis of the Variance (ANOVA). The results of ANOVA are evaluated and gave series of values that indicate if the coefficients of the linear regression are good or have a bad performance. Each statistical test uses its own statistical function to evaluate if the hypotheses are true or false. The values obtained from the statistical tests indicate if the model is good or not.

3.9.2. Qualitative Analysis

The survey's responses to four open questions exploring e-learning features used and reasons to use these, motivations to use e-learning, inhibitors of e-learning use for learning and preferences for group or independent learning, were manually coded by researcher as follows: data was manually coded using participant Id Code generated automatically by the survey tool when participants answered the questions using format “id#” and Question number. Subjects were automatically assigned id codes 1 to 140. Then survey's responses were followed by manual data clustering. Each data cluster went through analysis of content to extract the emerging themes. Quotes from participants were used to illustrate the major themes.

3.10. Strengths

The novelty of this study manifests itself in the use of a sample derived from all years of an undergraduate degree program and use survey open-ended questions design approach for additional in-depth qualitative analysis. The strengths of this design includes the in-depth analysis of both quantitative and qualitative data collected, and the results of

the study could become a baseline for future studies conducted at the same university at a later date as longitudinal data becomes available.

3.11. Limitations

Possible limitations of this study include selection bias, samples derived from one institution only and extending the conclusions of the study to other nursing and health sciences programs at other universities or to nursing and health sciences programs delivered 100% online. However, as described by Martin (2007), such a design has some limitations including the participant selection bias and problems with reverse causality. In the interest of minimizing the selection bias, participants were recruited from each of the four years of the undergraduate nursing and health sciences program. In order to address the potential issues with problems with reverse causality, the data analysis for this study included correlation analysis, correlogram and factor analysis performed using all the Likert Scale variable questions.

Chapter Four

Results and Analysis

4.1. Questionnaire

The questionnaire was delivered to students of Health Sciences, Bachelor of Science in Nursing and Medical Laboratory Science and 140 students took their time to participate. A quick preview of the original data can be seen in the Appendix G. Quantitative data were analyzed through descriptive statistics including linear regression, univariate, bivariate and multivariate analysis.

Table 1 summarizes the distribution of the students that are part of the programs: Health Sciences, Bachelor of Science in Nursing and Medical Laboratory Science. Table 2 summarizes other demographic data for the students who participated into the case study.

Table 1. Sample distribution across the program

Program	n (%)	In year	n (%)
Health Sciences	66 (48.89)	1st	9 (13.64)
		2nd	15 (22.73)
		3rd	20 (30.30)
		4th	19 (28.78)
		N/A	3 (4.55)
Bachelor of Science in Nursing	64 (47.41)	1st	13 (20.31)
		2nd	20 (31.25)
		3rd	15 (23.44)
		4th	16 (25.00)
Medical Laboratory Science	5 (3.70)	1st	2 (40.00)
		2nd	1 (20.00)
		3rd	2 (40.00)

Table 2. Other Demographic data

Variables	Number(N)	n%
Gender		
Female(F)	108	80%
Male(M)	23	17%
No Answer	4	3%
Age		
17-19	32	24%
20-24	71	53%
25-29	11	8%
30-34	5	4%
35-39	4	3%
40-44	6	4%
No answer	6	4%
Number of e-learning courses taken		
0	26	19%
1-3	80	59%
4-6	34	25%
Number of blended-learning courses taken		
0	15	11%
1-3	74	55%
4-6	49	36%
Last Known GPA score		
0-1.0	1	0.7%
1.1-1.99	4	3%
2.0-2.69	9	21%
2.7-3.69	79	59%
3.7-4.3	23	17%
No answer	1	0.7%

4.2 Quantitative Analysis

4.2.1. Introduction

All quantitative analysis is performed using linear regression applied to the dataset gathered as a result of sending questionnaires of e-learning students. The analysis is performed in several steps. These are the definition of variables, conversion of data from text strings to numerical values (categorical or continuous), descriptive statistics calculations (Table 4), correlation of variables (Figure 4), linear analysis, bivariate analysis, and multivariate analysis.

The correlations of variables in the form of correlograms try to answer research question one by computing which factors share common signals between the students. Barriers to increase satisfaction with e-learning are to be found among variables showing negative correlations into correlograms, and which load into factors that don't add satisfaction on the students, thus those factors account for barriers. The enablers for increased use of e-learning platform are identified using bivariate analysis, where the GPA scores are attempted to be explained for each one of the factors, but only the best related factors contribute to explain the GPA scores. Multivariate analysis answer research question four by finding the more important factors that influence GPA of students.

4.2.2. Descriptive Statistics

The first step is calculating the descriptive statistics of each variable. The list of all the statistics used is presented in Table 3. For a detailed definition of each one of the statistics, please see the Appendix B. In Table 4, there is a summary of all the variables with their main statistics.

Table 3. List of descriptive statistics

Statistics	Description
nbr.val	- Number of numerical values
nbr.null	- Number of times the variable takes 0 value
nbr.na	- Number of Not Available values
min	- Minimum
1st Qu	- First quartile equivalent to 25% of the range
3rd Qu	- Third quartile equivalent to 75% of the range
max	- Maximum
range	- Range of the variable
sum	- Sum of the values
skew	- Skewness

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kurtosis	- Kurtosis
median	- Second quartile equivalent to 50% of the range
mean	- Average of the variable
SE.mean	- Standard error of the mean value
CI.mean.0.95	- Confidence Interval of the Mean at 95% of confidence level
var	- Variance
std.dev	- Standard deviation
coef.var	- Coefficient of Variation

Table 4.List of descriptive statistics calculated

	nbr.val	nbr.null	nbr.ra	min	1st Qu	3rd Qu	max	range	sum	skew	kurtosis	median	mean	SE.mean	CI.mean.0.95	var	std.dev	coef.var
completed	140	20	0	0	1	1	1	1	120	-2.02	2.09	1	0.86	0.03	0.06	0.12	0.35	0.41
time	140	18	0	0	2.98	7.91	34.73	34.73	880.4	2.04	5.99	4.75	6.29	0.48	0.95	32.21	5.67	0.90
age	134	32	6	0	1	1	6	6	171	1.70	2.66	1	1.28	0.11	0.23	1.74	1.32	1.03
gender	136	111	4	0	0	0	1	1	25	1.61	0.61	0	0.18	0.03	0.07	0.15	0.39	2.11
program	135	66	5	0	0	1	2	2	74	0.41	-0.83	1	0.55	0.05	0.10	0.32	0.57	1.04
inyear	135	0	5	1	2	4	4	3	355	-0.12	-1.24	3	2.63	0.09	0.18	1.13	1.06	0.40
elearning	129	24	11	0	1	1	2	2	134	-0.03	-0.60	1	1.04	0.06	0.11	0.41	0.64	0.62
blended	132	14	8	0	1	2	2	2	164	-0.24	-0.68	1	1.24	0.05	0.11	0.40	0.63	0.51
GPA	140	4	0	0	3	3	5	5	401	-1.00	2.22	3	2.86	0.07	0.14	0.72	0.85	0.30
comfort	137	12	3	0	1	2	3	3	241	-0.40	-0.38	2	1.76	0.07	0.14	0.71	0.84	0.48
webct	120	6	20	0	2	3	4	4	277	-0.18	-0.39	2	2.31	0.09	0.19	1.07	1.04	0.45
easy	120	3	20	0	3	3	4	4	349	-1.32	2.30	3	2.91	0.08	0.16	0.74	0.86	0.30
like	118	2	22	0	2	3	4	4	321	-0.74	0.17	3	2.72	0.09	0.17	0.87	0.93	0.34
communicate	118	3	22	0	1	3	4	4	273	-0.01	-1.09	2	2.31	0.10	0.20	1.24	1.11	0.48
teacher	120	3	20	0	2	4	5	5	340	-0.51	0.11	3	2.83	0.09	0.19	1.08	1.04	0.37
useful	118	4	22	0	2	3	4	4	315	-0.87	0.70	3	2.67	0.09	0.17	0.87	0.93	0.35
resources	112	0	28	1	2	3	5	4	318	-0.41	0.23	3	2.84	0.08	0.15	0.66	0.81	0.29
skills	117	0	23	1	3	4	4	3	399	-1.33	2.04	4	3.41	0.07	0.13	0.52	0.72	0.21
outcomes	116	1	24	0	2	3	5	5	324	0.16	0.28	3	2.79	0.09	0.17	0.86	0.93	0.33
overall	118	1	22	0	3	3	4	4	355	-1.05	1.77	3	3.01	0.07	0.14	0.62	0.79	0.26
desirable	117	1	23	0	2	3	4	4	300	-0.33	-0.66	3	2.56	0.09	0.18	0.92	0.96	0.37
communication	118	8	22	0	1	3	5	5	257	0.05	-0.87	2	2.18	0.11	0.22	1.41	1.19	0.55
learning	118	0	22	1	2	3	5	4	333	-0.01	0.74	3	2.82	0.08	0.15	0.69	0.83	0.30
approaching	117	1	23	0	3	4	4	4	362	-1.15	2.24	3	3.09	0.07	0.14	0.60	0.78	0.25
encourages	113	7	27	0	1	3	5	5	275	-0.19	-0.90	3	2.43	0.12	0.23	1.55	1.25	0.51
direction	116	1	24	0	2	3	5	5	316	-0.65	1.19	3	2.72	0.07	0.14	0.62	0.79	0.29
pleased	118	0	22	1	2	3	5	4	315	-0.26	-0.33	3	2.67	0.08	0.16	0.79	0.89	0.33
quality	120	0	20	1	2	3	5	4	307	-0.22	-0.25	3	2.56	0.08	0.16	0.74	0.86	0.34
peers	120	7	20	0	1	3	5	5	284	-0.21	-0.84	3	2.37	0.11	0.21	1.39	1.18	0.50
features	120	19	20	0	1	1	1	1	101	-1.85	1.43	1	0.84	0.03	0.07	0.13	0.37	0.44
motivation	120	12	20	0	1	1	1	1	108	-2.63	4.98	1	0.90	0.03	0.05	0.09	0.30	0.33
inhibitions	120	24	20	0	1	1	1	1	96	-1.48	0.20	1	0.80	0.04	0.07	0.16	0.40	0.50
preferences	101	69	39	0	0	1	2	2	41	1.32	0.47	0	0.41	0.06	0.13	0.42	0.65	1.60
focus	120	72	20	0	0	1	1	1	48	0.40	-1.85	0	0.40	0.04	0.09	0.24	0.49	1.23
email	120	72	20	0	0	1	1	1	48	0.40	-1.85	0	0.40	0.04	0.09	0.24	0.49	1.23

The following **explanatory variables** and their significance is explained below. The variable “completed” informs of the persons who did complete the entire questionnaire. Although not a very large sample, I have a high level of completeness for the responses collected.

The variable “time” represents the average time that an individual took to complete the questionnaire. This average time is six minutes. The first and the third quartiles give us the expected time range it takes to complete the questionnaire, that is, between three and eight minutes. However, this appears to support the clear understanding and good readability most individuals had of the questions.

The variable “age” stands for the median, which is equal to one; the average equal to 1.3; and the third quartile which is also equal to one. The third quartile corresponds to the age group of 20 to 24 years and shows that these programs are mostly taken by young persons.

The variable “gender” averages at 0.18., with males coded as 1. That is, 82% of the students are female and 18% are male. This clearly corresponds to the perception that health sciences programs are preferred by females.

The variable “program” represents the program of study of the respondents. This variable is mostly evenly distributed between the Health Sciences program (66 students or 49%) and the Bachelor of Science in Nursing program (64 students or 47%). Thus the results will not be biased between these two program areas. There were only 5 (4%) participants from the Medical Laboratory Science program; thus our conclusions are limited with respect to this program.

The variable “inyear” represents the participant’s year of program study. This has the mean value of 2.63, which corresponds to around half of the studies, with a median of 3 that is

close to the mean value. Then, the questionnaire was uniformly answered by the students from the first through the fourth year of studies, which further supports our ability to apply the conclusions to students in general across the faculty.

The variable “elearning” represents number of e-learning courses taken by a student. It has the mean value at 1.04 and the median is 1; the first and the third quartiles are 1. Thus, most of the students who answered the questionnaire were doing either their first, second, or third course using e-learning in their program.

The variable “blended” represents the number of courses a student is taking that have been designed to include both e-learning and face-to-face learning components. It has the mean value at 1.24, the median is 1; the first quartile is 1 and the third quartile is 2. Thus, there is a slight tendency of the students to take courses that offer a mixture of e-learning with traditional learning methods.

The variable “GPA” has an average of 2.9 and its median, its first and third quartiles are 3, which give us a sample of students that predominantly have a good GPA in the group [2.7-3.69] (see Figure 3). This can explain why the students took seriously the questionnaire and the majority of them responded all the questions. It also raises some concerns with respect to the under representation of lower performing students and may affect conclusions related to the barriers of using e-learning.

Grade	Percentage	Grade Points
A+	90 to 100	4.3
A	85 to 89	4
A-	80 to 84	3.7

B+	77 to 79	3.3
B	73 to 76	3
B-	70 to 72	2.7
C+	67 to 69	2.3
C	60 to 66	2
D	50 to 59	1
F	0 to 49	0

Figure 2. UOIT Grade point average (GPA)

The variable “comfort” represent the student’s comfort level with using technology for learning. This variable has a mean value of 1.76, the median of 2, the first quartile is 1 and the third quartile is 2, so we can see that the majority of the students feel between good (1) and very good (2) when they are using the technology for e-learning.

The variables webct, easy, like, communicate, teacher, useful, resources, skills, outcomes, overall, desirable, communication, learning, approaching, encourages, direction, pleased, quality, peers, features were evaluated with a 5 point scale. This scale reflects the level of satisfaction of the students and can be interpreted as established in Table 5.

Table 5. Equivalency between Likert scale and satisfaction levels

5 Points Scale	Satisfaction Level
Strongly Agree	Very Satisfied
Agree	Satisfied
Neither Agree / Disagree	Indifferent
Disagree	Not Satisfied
Strongly Disagree	Very Unsatisfied

The pattern that is observed is the proximity of the mean value to the median and that those values are enclosed by the 1st and the 3rd quartile. This tells us that students are really answering in an independent manner the questionnaire, without trying to provide false

expectations. This ensures that our data are not biased by false results and that our conclusions are true. The satisfaction level for each one of these variables is shown in Table 6.

Table 6. Satisfaction Level for each one of the variables

Variables	Satisfaction Level (1 Unused to 5 Very Satisfied)
webct	2 Indifferent
easy	3 Satisfied
like	3 Satisfied
communicate	2 Indifferent
teacher	3 Satisfied
useful	3 Satisfied
resources	3 Satisfied
skills	4 Very Satisfied
outcomes	3 Satisfied
overall	3 Satisfied
desirable	3 Satisfied
communication	2 Indifferent
learning	3 Satisfied
approaching	3 Satisfied
encourages	3 Satisfied
direction	3 Satisfied
pleased	3 Satisfied
quality	3 Satisfied
peers	3 Satisfied
features	1 Unused

The variables motivation, inhibitions, preferences, focus, email are open questions that will be used on the qualitative analysis.

4.2.3. Correlation of Variables

Statistical correlation is a technique used to show if two variables are related. The relationship between the variables can be positive or negative and the value indicates the strength of relationship. The measure of correlation used in this research is the Pearson correlation, which

values are between -1 and 1. The values are without units and the closest to 1 or -1 the stronger the relation between the factors. A value of 0 means no correlation at all.

Prior to introducing the linear regression, it is useful to calculate the correlations between variables. An easy way to compare those correlations is using a correlogram, where the values are represented by the intensity of the color. The standard scale of colors uses Red for positive correlated (0, +1] and Blue for negative correlated [-1, 0). Changing between white (correlation 0) for no correlation to the intense +1 or -1. Figure 4 shows the correlogram of the variables.

The strongest correlations as observed in Figure 4 are concentrated around the satisfaction variables. These variables are WebCT, easy, like, communicate, teacher, useful, resources, skills, outcomes, overall, desirable, communication, learning, approaching, encourages, direction, pleased, quality, peers, features. The color scale of the correlogram shows us that these are positively correlated (see Figure 4). For the variable GPA the strongest correlated variables are like, useful, overall, desirable, and pleased.

The diagonal of the correlogram has a value of 1 given that the diagonal represents the variable against itself (see Figure 4). By construction this is a symmetric matrix and therefore the upper and the lower diagonals are identical. This is the reason why the correlogram only shows the upper diagonal/triangle and the diagonal is filled with the names of the variables.

The white color in the right corner of the correlogram (see Figure 4) indicates that our open questions are not correlated at all with the completion of the questionnaire. For the purpose of our study we need to choose the variable that is more representative of the student satisfaction. As we define student satisfaction is aggregate of feelings or affective responses to distinguishable factors while interacting with the e-learning system.

According to this definition and to our correlogram, the best variables that reflect learner satisfaction are listed in Table 7.

Table 7. List of Satisfaction Variables

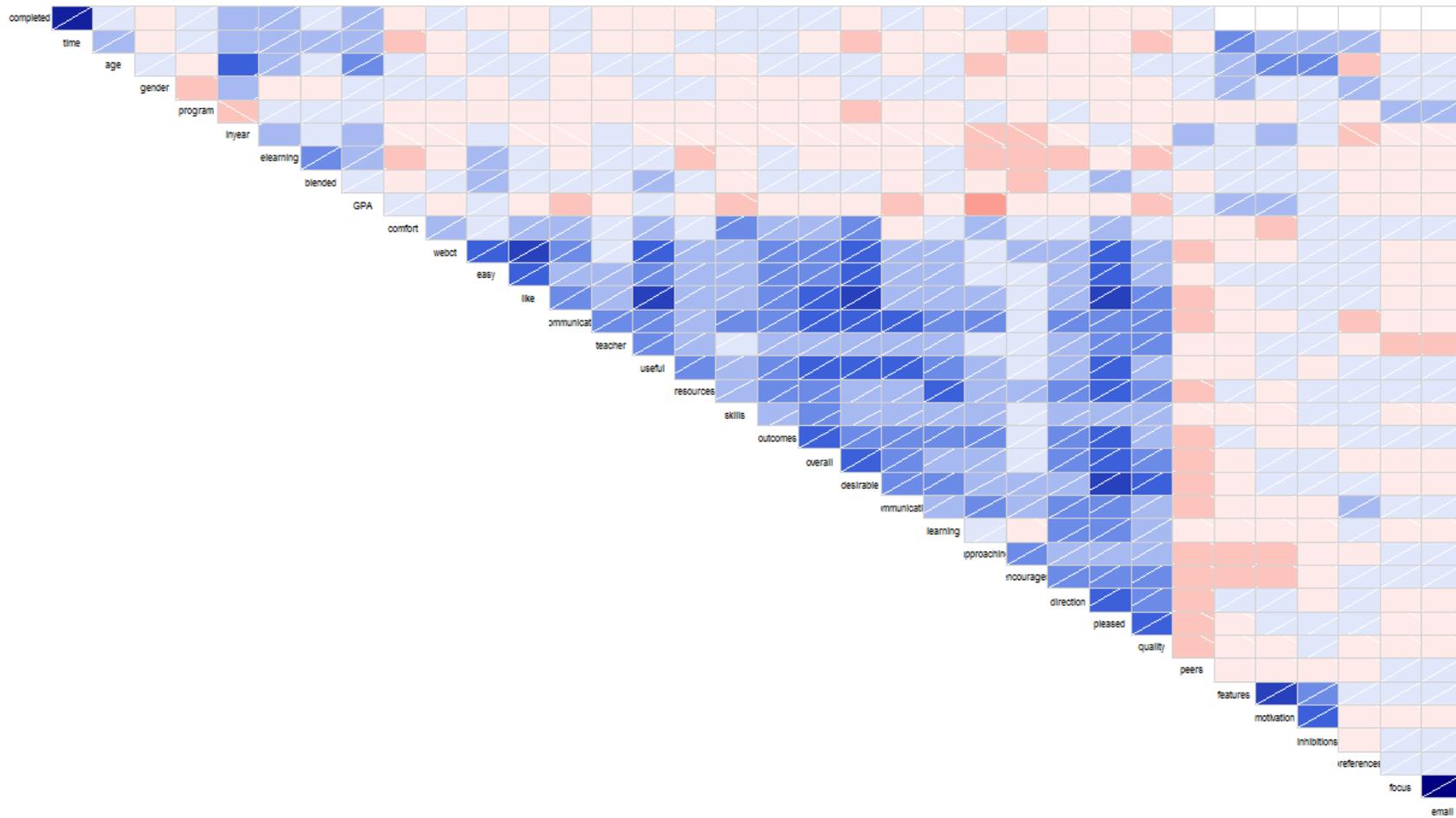
Satisfaction Level Variables
Easy
Like
Useful
Overall
Desirable

Evaluating nursing and health sciences student satisfaction with e-Learning

Figure 3. Correlogram of the variables with numerical values.

	time	age	gender	program	inyear	elearning	blended	GPA	comfort	webot	easy	like	communicate	teacher	useful	resources	skills	outcome	overall	desirable	communication	learning	approaching	encourages	direction	pleased	quality	peers	features	motivation	inhibitors	preferences	focus	email
time	1.00	0.02	0.12	-0.09	-0.01	0.16	0.26	-0.07	-0.39	-0.25	-0.16	-0.24	0.05	-0.08	-0.05	0.04	0.12	0.13	-0.13	-0.17	0.09	0.00	-0.13	-0.09	-0.05	-0.06	-0.04	0.00	0.25	0.02	0.03	0.33	0.03	0.03
age	0.02	1.00	0.07	0.08	0.33	0.23	0.11	0.36	0.06	-0.13	-0.05	0.15	-0.03	0.11	0.28	-0.13	-0.20	0.04	0.22	0.09	-0.02	-0.03	-0.05	-0.05	-0.15	-0.09	0.02	0.04	-0.12	0.20	0.14	-0.24	0.19	0.19
gender	0.12	0.07	1.00	-0.10	0.13	-0.12	-0.23	-0.05	0.04	-0.12	-0.27	-0.11	-0.14	-0.19	-0.26	0.03	-0.05	-0.15	-0.33	-0.10	-0.12	0.05	-0.21	-0.08	-0.22	-0.20	-0.09	0.22	0.16	-0.14	-0.01	0.18	0.07	0.07
program	-0.09	0.08	-0.10	1.00	-0.20	0.14	0.14	0.16	-0.26	-0.14	0.09	-0.09	-0.16	0.10	0.02	0.07	-0.21	-0.17	-0.06	-0.11	-0.01	0.02	-0.06	-0.05	0.11	-0.07	-0.06	-0.15	0.06	0.04	0.23	-0.01	0.11	0.11
inyear	-0.01	0.33	0.13	-0.20	1.00	-0.01	0.09	0.17	-0.02	0.03	0.06	0.12	-0.14	0.06	0.13	-0.20	-0.17	-0.07	-0.04	0.01	-0.08	-0.08	-0.30	-0.17	-0.30	-0.01	0.01	0.11	-0.08	0.17	0.06	-0.04	0.03	0.03
elearning	0.16	0.23	-0.12	0.14	-0.01	1.00	0.45	0.22	-0.05	0.12	0.30	0.24	0.13	0.17	0.33	-0.17	0.00	0.18	0.12	0.24	-0.03	0.12	0.03	-0.24	-0.29	0.10	-0.15	0.06	0.18	0.21	0.07	-0.08	-0.11	-0.11
blended	0.26	0.11	-0.23	0.14	0.09	0.45	1.00	0.21	-0.07	0.11	0.23	0.05	0.05	0.15	0.25	-0.05	0.02	0.07	0.19	0.10	-0.10	0.13	0.03	-0.18	-0.08	0.15	-0.03	0.01	0.11	0.21	0.00	-0.05	-0.28	-0.28
GPA	-0.07	0.36	-0.05	0.16	0.17	0.22	0.21	1.00	-0.12	-0.01	0.00	0.00	-0.34	-0.05	0.08	-0.09	-0.14	-0.11	0.07	-0.04	-0.28	-0.12	-0.28	-0.01	-0.09	-0.06	-0.07	0.08	-0.01	0.40	-0.01	-0.13	-0.07	-0.07
comfort	-0.39	0.06	0.04	-0.26	-0.02	-0.05	-0.07	-0.12	1.00	0.15	0.02	0.17	0.28	0.14	0.07	-0.10	0.32	0.14	0.15	0.23	-0.03	0.07	0.36	0.03	-0.07	0.11	0.18	0.04	-0.13	-0.26	0.09	-0.14	0.17	0.17
webot	-0.25	-0.13	-0.12	-0.14	0.03	0.12	0.11	-0.01	0.15	1.00	0.46	0.58	0.42	0.26	0.30	0.12	0.15	0.14	0.38	0.56	0.19	0.23	-0.01	0.01	0.16	0.43	0.19	0.03	-0.13	0.07	0.00	-0.10	-0.07	-0.07
easy	-0.16	-0.05	-0.27	0.09	0.06	0.30	0.23	0.00	0.02	0.46	1.00	0.58	0.27	0.34	0.64	0.20	0.33	0.29	0.55	0.60	0.19	0.28	0.13	0.11	0.19	0.53	0.27	-0.02	-0.01	0.21	-0.21	0.04	-0.21	-0.21
like	-0.24	0.15	-0.11	-0.09	0.12	0.24	0.05	0.00	0.17	0.58	0.58	1.00	0.37	0.45	0.66	0.15	0.16	0.30	0.51	0.71	0.29	0.19	0.05	0.04	0.10	0.64	0.29	-0.01	-0.12	0.18	-0.12	-0.12	-0.16	-0.16
communicate	0.05	-0.03	-0.14	-0.16	-0.14	0.13	0.05	-0.34	0.28	0.42	0.27	0.37	1.00	0.33	0.34	0.19	0.52	0.40	0.44	0.50	0.57	0.34	0.35	-0.03	0.18	0.47	0.31	-0.21	-0.26	-0.10	0.03	-0.20	-0.06	-0.06
teacher	-0.08	0.11	-0.19	0.10	0.06	0.17	0.15	-0.05	0.14	0.26	0.34	0.45	0.33	1.00	0.42	0.05	0.20	0.17	0.50	0.28	0.29	0.07	0.09	0.04	0.19	0.54	0.22	-0.06	-0.08	0.13	0.10	-0.07	-0.15	-0.15
useful	-0.05	0.28	-0.26	0.02	0.13	0.33	0.25	0.08	0.07	0.30	0.64	0.66	0.34	0.42	1.00	0.11	0.25	0.37	0.54	0.58	0.47	0.31	0.15	-0.06	0.15	0.58	0.23	0.09	-0.18	0.26	-0.18	-0.05	-0.07	-0.07
resources	0.04	-0.13	0.03	0.07	-0.20	-0.17	-0.05	-0.09	-0.10	0.12	0.20	0.15	0.19	0.05	0.11	1.00	0.18	0.30	0.18	0.12	0.33	0.51	0.24	0.19	0.48	0.39	0.38	-0.18	-0.05	-0.25	-0.19	0.13	0.02	0.02
skills	0.12	-0.20	-0.05	-0.21	-0.17	0.00	0.02	-0.14	0.32	0.15	0.33	0.16	0.52	0.20	0.25	0.18	1.00	0.24	0.36	0.25	0.14	0.20	0.28	-0.04	0.10	0.29	0.18	0.00	-0.06	-0.14	-0.12	-0.12	-0.11	-0.11
outcome	0.13	0.04	-0.15	-0.17	-0.07	0.18	0.07	-0.11	0.14	0.14	0.29	0.30	0.40	0.17	0.37	0.30	0.24	1.00	0.32	0.37	0.25	0.26	0.27	0.12	0.15	0.38	0.19	-0.23	-0.07	-0.24	-0.07	-0.01	-0.08	-0.08
overall	-0.13	0.22	-0.33	-0.06	-0.04	0.12	0.19	0.07	0.15	0.38	0.55	0.51	0.44	0.50	0.54	0.18	0.36	0.32	1.00	0.49	0.39	0.26	0.14	0.07	0.25	0.52	0.20	-0.11	-0.15	0.28	-0.07	-0.07	-0.14	-0.14
desirable	-0.17	0.09	-0.10	-0.11	0.01	0.24	0.10	-0.04	0.23	0.56	0.60	0.71	0.50	0.28	0.58	0.12	0.25	0.37	0.49	1.00	0.39	0.37	0.19	0.06	0.15	0.61	0.37	-0.14	0.01	0.19	-0.08	-0.09	-0.18	-0.18
communication	0.09	-0.02	-0.12	-0.01	-0.08	-0.03	-0.10	-0.28	-0.03	0.19	0.19	0.29	0.57	0.29	0.47	0.33	0.14	0.25	0.39	0.39	1.00	0.36	0.30	0.19	0.34	0.47	0.22	-0.13	-0.22	0.08	-0.09	0.09	0.14	0.14
learning	0.00	-0.03	0.05	0.02	-0.08	0.12	0.13	-0.12	0.07	0.23	0.28	0.19	0.34	0.07	0.31	0.51	0.20	0.26	0.26	0.37	0.36	1.00	0.21	0.08	0.38	0.43	0.25	-0.22	-0.13	-0.14	0.08	0.13	-0.16	-0.16
approaching	-0.13	-0.05	-0.21	-0.06	-0.30	0.03	0.03	-0.28	0.36	-0.01	0.13	0.05	0.35	0.09	0.15	0.24	0.28	0.27	0.14	0.19	0.30	0.21	1.00	0.32	0.26	0.28	0.21	-0.20	-0.19	-0.22	-0.21	-0.10	0.02	0.02
encourages	-0.09	-0.05	-0.08	-0.05	-0.17	-0.24	-0.18	-0.01	0.03	0.01	0.11	0.04	-0.03	0.04	-0.06	0.19	-0.04	0.12	0.07	0.06	0.19	0.08	0.32	1.00	0.47	0.25	0.35	-0.10	-0.01	-0.18	0.02	-0.03	0.16	0.16
direction	-0.05	-0.15	-0.22	0.11	-0.30	-0.29	-0.08	-0.09	-0.07	0.16	0.19	0.10	0.18	0.19	0.15	0.48	0.10	0.15	0.25	0.15	0.34	0.38	0.26	0.47	1.00	0.44	0.36	-0.24	0.08	-0.06	-0.10	0.11	-0.09	-0.09
pleased	-0.06	-0.09	-0.20	-0.07	-0.01	0.10	0.15	-0.06	0.11	0.43	0.53	0.64	0.47	0.54	0.58	0.39	0.29	0.38	0.52	0.61	0.47	0.43	0.28	0.25	0.44	1.00	0.46	-0.20	-0.06	0.04	-0.18	-0.04	-0.17	-0.17
quality	-0.04	0.02	-0.09	-0.06	0.01	-0.15	-0.03	-0.07	0.18	0.19	0.27	0.29	0.31	0.22	0.23	0.38	0.18	0.19	0.20	0.37	0.22	0.25	0.21	0.35	0.36	0.46	1.00	-0.22	0.06	-0.11	0.03	-0.06	-0.05	-0.05
peers	0.00	0.04	0.22	-0.15	0.11	0.06	0.01	0.08	0.04	0.03	-0.02	-0.01	-0.21	-0.06	0.09	-0.18	0.00	-0.23	-0.11	-0.14	-0.13	-0.22	-0.20	-0.10	-0.24	-0.20	-0.22	1.00	0.01	0.13	-0.06	0.02	0.06	0.06
features	0.25	-0.12	0.16	0.06	-0.08	0.18	0.11	-0.01	-0.13	-0.13	-0.01	-0.12	-0.26	-0.08	-0.18	-0.05	-0.06	-0.07	-0.15	0.01	-0.22	-0.13	-0.19	-0.01	0.08	-0.06	0.06	0.01	1.00	0.25	0.10	0.21	-0.05	-0.05
motivation	0.02	0.20	-0.14	0.04	0.17	0.21	0.21	0.40	-0.26	0.07	0.21	0.18	-0.10	0.13	0.26	-0.25	-0.14	-0.24	0.28	0.19	0.08	-0.14	-0.22	-0.18	-0.06	0.04	-0.11	0.13	0.25	1.00	-0.05	-0.02	-0.21	-0.21
inhibitors	0.03	0.14	-0.01	0.23	0.06	0.08	0.00	-0.01	0.09	0.00	-0.21	-0.12	0.03	0.10	-0.18	-0.19	-0.12	-0.07	-0.07	-0.08	-0.09	0.08	-0.21	0.02	-0.10	-0.18	0.03	-0.06	0.10	-0.05	1.00	-0.17	0.14	0.14
preferences	0.33	-0.24	0.18	-0.01	-0.04	-0.08	-0.05	-0.13	-0.14	-0.10	0.04	-0.12	0.04	-0.13	-0.12	-0.01	-0.07	-0.05	0.13	-0.10	-0.03	0.11	-0.04	-0.06	0.02	0.20	-0.02	-0.17	1.00	0.07	0.07	0.07	0.07	
focus	0.03	0.19	0.07	0.11	0.03	-0.11	-0.28	-0.07	0.17	-0.07	-0.21	-0.16	-0.20	-0.15	-0.07	0.02	-0.11	-0.08	-0.14	-0.18	0.14	-0.16	0.02	0.16	-0.09	-0.17	-0.05	0.06	-0.05	-0.21	0.14	0.07	1.00	1.00
email	0.03	0.19	0.07	0.11	0.03	-0.11	-0.28	-0.07	0.17	-0.07	-0.21	-0.16	-0.06	-0.15	-0.07	0.02	-0.11	-0.08	-0.14	-0.18	0.14	-0.16	0.02	0.16	-0.09	-0.17	-0.05	0.06	-0.05	-0.21	0.14	0.07	1.00	1.00

Figure 4. Correlogram of the variables (continued). b) color scale with red – negative correlated, blue – positive correlated and white – non-correlated.



4.2.4. Factor Analysis

Factor analysis is known as a set of approaches that analyses the ways in which the underlying constructs impact the answers to a survey questions on a certain quantity of measured variables (Hatcher, 1994). Factor analysis is done to determine the origins of the constructs that impact survey responses. To perform this type of analysis, it is necessary to define the characteristics of the correlations between the variables in question. Those variables that are highly positively or negatively correlated are often being influenced by the same events. Those variables that are less correlated, either positively or negatively, may be influenced by different events (DeCoster, 1998).

When doing factor analysis, it is important to identify the quantity of factors that a set of data has in common. The purpose is to define how strongly the variables are correlated to the external factors that influence them. Factor analysis is most often used when it to determine the origins of the constructs that impact survey responses in a particular research area. Another use is to verify what questions are correlated in a survey questionnaire; also, to evaluate the dimensions of a scale of measurement.

Factor analysis is used to determine the relationships between variables. The major feature of factor analysis is that the respondents answer different questions in a similar manner. This happens when the variable tested in each of these questions is one and the same. The respondents may answer to questions pertinent to the same subject under research similarly. This would mean that all of these questions are associated with the variable in question. Every time factor analysis is performed on a set of data, the number of external factors influencing the

variables is the same as the number of variables. The factors that exhibit a weaker correlation to the variables are not taken into consideration.

In this study we perform the factor analysis to the database of the questionnaire. The data collected in the form of tables' data can not show any pattern, relationship, trend or exception (De Veaux et al., 2012). Thus, the data need to be transformed to extract this statistical information. For this transformation the data need to be identified to know the type of data we have. This identification splits variables in two main types: categorical and quantitative variables (De Veaux et al., 2012). Categorical variables are all the categories we assign and all the answers to the questions we asked, these variables don't have a numerical meaning; examples of these variables are gender, program of the university or evaluating with a 5 points scale an attribute. Quantitative variables are all the variables measured with units; examples of these variables are the GPA, age or time spent in completing a questionnaire. Sometimes categorical variables are constructed with order without natural units and renamed as ordinal variables (De Veaux et al., 2012); example of this categorical variable is the 5 points scale (Strongly Disagree, Disagree, Neither Agree/Disagree, Agree, Strongly Agree) where it exists a natural order in the categories but there are no units for this variable, it is clear that strongly disagree is worse than disagree; disagree is worse than neither agree/disagree; neither agree/disagree is worse than agree; agree is worse than strongly agree.

In field studies, data are recorded in more than one variable per case or individual. In these databases we would like to establish a relationship between variables. Thus, we need to define the variables that explain our research question. The selection of variables determines the manner of how one or more variables affect another. The variables can be predictors or predictants. But more friendly names commonly used in studies are response variable and

explanatory variable (De Veaux et al., 2012). A response variable provides the outcome of the study and this is the reason that can be referred as dependent variable or predicted variable; with response variables we can predict or forecast the outcome of the study. The main difference between predict and forecast is the dimension of time. When the variable is recorded in time we can forecast and this is the base of time-series analysis. When the variable is static and represents only a snapshot of the phenomena we can predict and this is the base of any pooling used in research studies like the present study. The explanatory variable provides the information needed to understand the response variable; this is the reason that this variable is called independent variable or predictor variable. However, the terms independent, dependent, predictor, predictand, predicted may conflict with other terms especially when we establish the relationship between variables. Thus, explanatory variable and response variable are the preferable terms (De Veaux et al., 2012).

When we have research studies based on interviewing people is likely that some explanatory variables are associated (De Veaux et al., 2012). This association is known as correlation (Casella and Berger, 2001). The resultant explanatory variables are used to construct linear regressions (De Veaux et al., 2012). Given the nature of correlations, there are no limits in the number of variables correlated with our response variable. Sometime there is only one explanatory variable and we have a bivariate analysis, the presence of multiple explanatory variables is known as multivariate analysis. These models allow estimating values and are known as predicted values (De Veaux et al., 2012). As in any analysis remains the question of how good is the linear model produced between the explanatory variables and the response variable. The last step in finding linear relationships between variables is the evaluation of the performance of

the model constructed by applying of functions than in statistics are called statistics and used in hypothesis tests (De Veaux et al., 2012).

The importance of finding the correlation between variables is that this is a measure of the strength of the relationship between the variables (Casella and Berger, 2001; DeGroot and Schervish, 2002). The correlation only captures the linear dependence between variables (DeGroot and Schervish, 2002). This is exactly the type of dependence that we are interested in this research study. The correlation between variables can be measured using different metrics, for the purpose of this research study we keep the correlation of Pearson that varies between $[-1, +1]$ where the measure is dimensional and the sign represent if the variables are direct or inversely associated or correlated (Mendenhall and Sincich, 2012). When the value is zero we have two variables that are independent and not correlated. This correlation is used to discriminate variables that are associated with process or phenomena of interest from variables that even if they were considered the result could be biased and wrong. When planning and designing our study, we proposed the most variables that we believe may influence our response variable, but some variables that we proposed did not shown any association between them. This is the advantage of the graphical representation of the correlation of variables (DeGroot and Schervish, 2002; De Veaux et al., 2012). The correlograms are diagrams designed to display the correlation between variables. The color scale is a visual aid to identify more easily the variable more correlated either direct or inversely. These variables and their correlation values are summarized in Table 8. As seen, the correlations are around 0.5 and 0.7 which already can be considered as a strong correlation.

Table 8. Correlation between the variables chosen to study the satisfaction with e-learning.

	like	useful	overall	desirable	pleased
easy	0.58	0.64	0.55	0.60	0.53
like		0.66	0.51	0.71	0.64
useful			0.54	0.58	0.58
overall				0.49	0.52
desirable					0.61

The correlograms are also displaying some negative correlation between some variables, which represent factors that inhibit satisfaction with e-learning. Those factors should account for barriers to increase satisfaction with e-learning. Table 9 presents a summary of the variables with most negative Pearson-correlations (p-value >0.29).

The variable “gender”, averaging at 0.18 (82% of study participants are female), is negatively correlated with “overall” (easy to use) variable, which can indicate a tendency of female students to find overall that e-learning is slightly harder to use for learning.

The variable “GPA” is negatively correlated with “approaching” variable, which might indicate that students in this study, predominantly having a good GPA, prefer approaching the professor face to face rather than using e-learning communication methods. “GPA” is negatively correlated with “communicate”, which also a tendency to prefer communicating less with peers and instructor using online communication. But since there is under representation of lower performing students in this study, this may affect some conclusions related to the barriers of using e-learning.

Table 9. Negative Correlations between the variables identified as barriers with e-learning.

	Measuring instrument	gender	GPA
communicate (online)	I prefer to communicate with peers and instructor using e- learning tools of WebCT including chat, mail, discussion board, whiteboard etc		-0.34
overall (easy to use)	Overall, e-learning is easy to use for learning.	-0.33	
approaching (professor)	I am comfortable with approaching the professor for any concerns via e-learning communication tools of WebCT.		-0.31

According to Tabachnick and Fidell (2007) research, calculations may generate certain values indicating errors in the study's methodology. The first such case is the values being more than one. Such a case would demonstrate an incorrect sample size chosen for analysis. In contrary in the second case, some values for variables may be too low, less than 0.1. In this case, such values of variables show little correlation between the variables. Our research did not encounter any of these problems.

Table 10 presents a summary of the mean values, standard deviations and factor loadings where the factor analyzed were extracted from the Likert type variables satisfaction with e-learning.

Table 10. Summary of Likert type variables' means, standard deviation, and loadings.

Variables	Mean	STD	Loading	Factors
like	2.72	0.93	0.83	Perceived liking
useful	2.67	0.93	0.86	Perceived Usefulness
overall	3.01	0.79	0.86	Perceived Usefulness
desirable	2.56	0.96	0.451	Perceived liking

pleased	2.67	0.89	0.604	Perceived liking
webct	2.31	1.04	0.344	Usability
easy	2.91	0.86	0.450	Usability
communicate	2.31	1.11	0.236	Communication & Teaching
teacher	2.83	1.04	0.289	Communication & Teaching
resources	2.84	0.81	0.403	Perceived usefulness
skills	3.41	0.72	0.470	Usability
outcomes	2.79	0.93	0.331	Perceived usefulness
communication	2.18	1.19	0.465	Communication & Teaching
learning	2.82	0.83	0.416	Perceived usefulness
approaching	3.09	0.78	0.273	Communication & Teaching
encourages	2.43	1.25	0.381	Perceived usefulness
direction	2.72	0.79	0.452	Communication & Teaching
quality	2.56	0.86	0.336	Perceived usefulness
peers	2.37	1.18	0.241	Communication & Teaching

Table 11 summarizes the variables grouped by four distinct factors and variables having a loading into factors greater than 0.5 are highlighted. The variables like, useful and overall have loading factor greater than 0.8, which explains more than 60% of the variance. The variables desirable, easy, pleased, skills, direction and communication are greater than 0.5 and that explain more than 30% of the variance. The loadings into factors are corroborating with the correlation between variables, described and presented in the correlogram in the precedent section. Based on the all above findings, the set of variables (see Table 11) which showed high factor loadings (greater or equal than 0.5) are most important in describing perceived usefulness, perceived liking, usability and communication & teaching factors.

Furthermore variables outcome, quality, encourages, resources, learning, communicate, peers, teacher, approaching, webct are loading into their factors with loading less than 0.5 and because their factor loadings are small these variables are not very useful to describe respective factors. Thus, the revealed factors perceived liking, perceived usability, usability and communication & teaching do provide well enough statistical information to explain the student’s satisfaction with e-learning.

Table 11. Summary of the variables and factors with their loadings.

desirable	0.5	Perceived liking	Satisfaction	GPA 0.79
pleased	0.6			
like	0.8			
outcomes	0.3	Perceived usefulness		
quality	0.3			
encourages	0.4			
resources	0.4			

learning	0.4			
useful	0.9			
overall	0.9			
communicate	0.2			
peers	0.2			
approaching	0.3			
teacher	0.3			
communication	0.5	Communication & Teaching		
direction	0.5			
webct	0.3			
skills	0.5	Usability		
easy	0.5			

In Table 12 we present a summary of the linear approaches that explain the satisfaction coefficients as a function of each one of the student satisfaction factors. The coefficients provide the slope and can be interpreted as the tendency of the satisfaction as a function of the student satisfaction factor.

Table 12. Parameters of the linear analysis of the Satisfaction as a function of the satisfaction factors

Satisfaction	Coefficient			
	Estimate	Std Error	t-value	P-value
Perceived Liking	-0.071	0.078	-1.15	0.56
Perceived Usefulness	0.030	0.065	0.17	0.78
Usability	-0.029	0.076	-0.34	0.16
Communication & Teaching	-0.071	0.061	-1.09	0.20

Based on the all above findings, the perceived usefulness (0.78) and perceived liking (0.56) factors, have more predictive power to the variable of interest which is satisfaction with e-learning, while usability (0.16) and communication & teaching (0.20) factors have less predictive power to the satisfaction with e-learning variable. The parameter estimates for structural Model (see Figure 6) gives robust results for case study's research question number one and proves also that questionnaire was well designed.

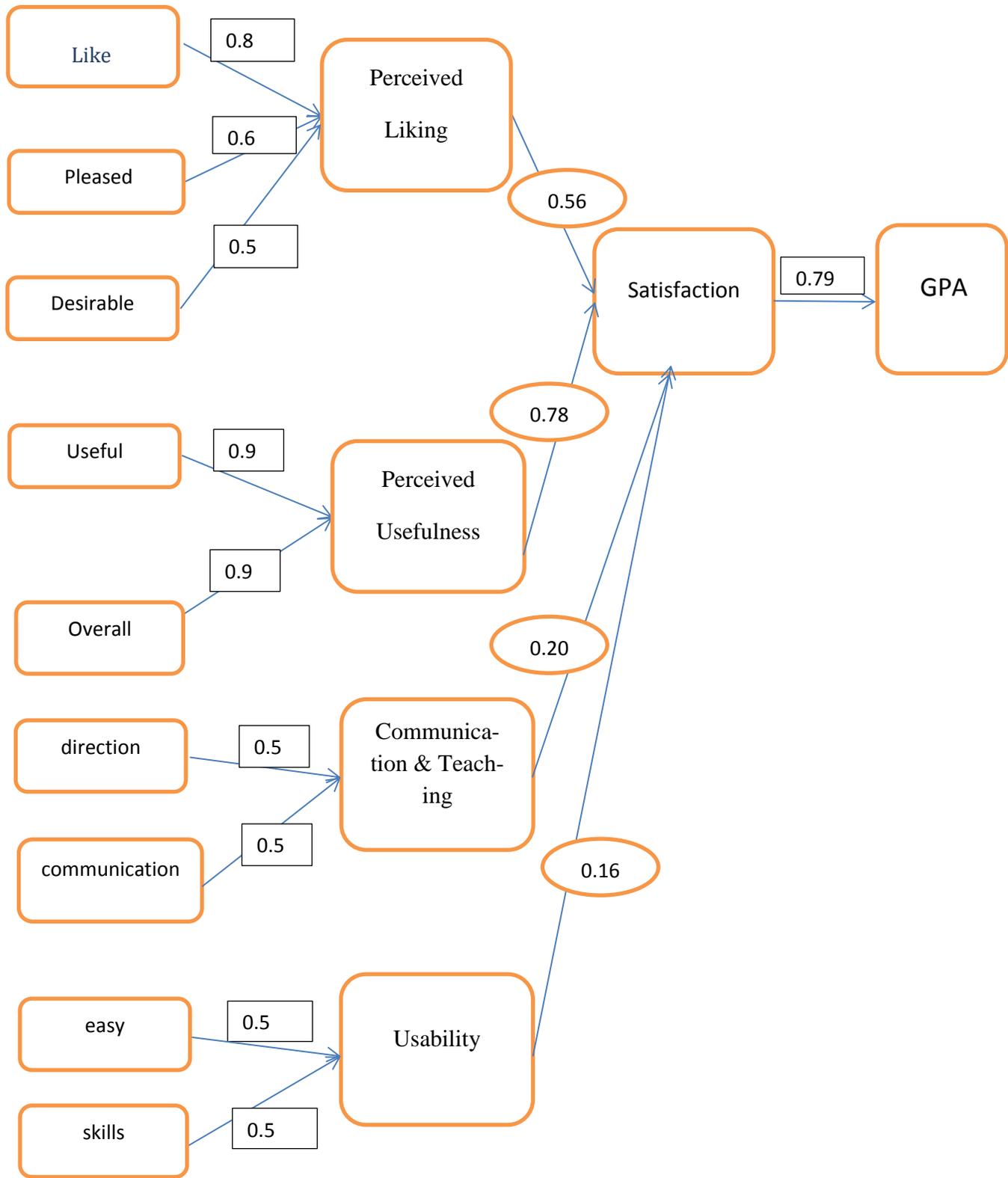


Figure 5. Parameter estimates for Structural Model

4.2.5. Linear analysis

The objective of any analysis that searches to produce a model is that any relationship found is repeatable. Thus, by construction we assume that under the same conditions, the same causes produced the same effect. The statistical modeling technique used is the *Linear Regression*. This method is used to describe the response variable as a function of several factors or predictors (MathWorks, 2014). When the number of factors increased, we have a more complex model known as Multivariate Regression Model or a Multivariate Linear Regression.

From our objectives and research questions we want to obtain a relationship between the GPA and the better correlated factors reflecting the student satisfaction.

From Table 12 we identified the most important factors for student satisfaction, thus we produce the linear approach in two steps: as a univariate analysis and as a multivariate analysis.

4.2.6. Bivariate analysis

This analysis is performed to identify the relationship between one variable and one factor. This analysis allows pairing the variable GPA with each one of the factors that aggregate to result into the student satisfaction variables. This analysis only uses one factor to describe our variable of interest. In Table 13 we present a summary of all the linear approaches that explain the GPA scores as a function of each one of the student satisfaction factors.

All the approaches are presented with the intercept and the coefficient, where the intercept means the value of the GPA when the factor is 0. From our p-value we can see that all the intercepts have a p-value smaller 0.001, which means that this intercept has a probability close 0 of having a null value.

The coefficients provide the slope and can be interpreted as the tendency of the GPA as a function of the student satisfaction factor. The p-value for all the coefficients is strong, which means that our linear approach is strong and that the values are capable of explaining the GPA.

Table 13. Parameters of the univariate analysis of the GPA as a function of the satisfaction factors.

GPA	Intercept				Coefficient			
	Estimate	Std Error	t-value	P-value	Estimate	Std Error	t-value	P-value
like	3.152	0.206	15.28	<0.001	-0.081	0.072	-1.13	0.26
useful	2.896	0.204	14.20	<0.001	0.020	0.072	0.27	0.78
overall	3.021	0.267	11.30	<0.001	-0.027	0.086	-0.31	0.76
desirable	3.134	0.194	16.12	<0.001	-0.075	0.071	-1.06	0.29
pleased	3.121	0.212	14.76	<0.001	-0.061	0.075	-0.82	0.42

4.2.7. Multivariate analysis

This type of analysis is the generalisation of the bivariate analysis, where more than two dependent factors are used to explain an independent variable. In our case, we perform a multiple linear regression analysis which use all the factors representative for student satisfaction. In this analysis we use more than one factor to explain the changes of our variable of interest. From the univariate analysis we know that each one of the factors is appropriate to explain the GPA. Therefore, when we aggregate all the student satisfaction factors, we can explain in a better way the GPA variable.

Table 14 summarizes the values of the linear approach between the variable GPA and the linear sum of the variables: intercept, like, useful, overall, desirable, pleased. The intercept has a p-value smaller than 0.001, which means that the probability that the intercept be 0 is almost

null. From the values of the coefficients the variables like, desirable and pleased are inversely proportional to the GPA, meanwhile intercept, useful and overall are directly proportional.

Table 14. Parameters of the multivariate analysis of the GPA as a function of the satisfaction factors.

GPA	Coefficient			
	Estimate	Std Error	t-value	P-value
intercept	3.127	0.297	10.53	<0.001
like	-0.048	0.118	-0.40	0.69
useful	0.097	0.102	0.95	0.34
overall	0.022	0.113	0.19	0.85
desirable	-0.061	0.104	-0.59	0.55
pleased	-0.081	0.118	-0.69	0.49

P-value of the multivariate approach: 0.79

The p-value equals 0.79 for GPA validates the structural model as follows:

$$\text{GPA} = 3.127 - 0.048 * \text{like} + 0.097 * \text{useful} + 0.022 * \text{overall} - 0.061 * \text{desirable} - 0.081 * \text{pleased}$$

On average, it has an error of 8.70%. Thus, our model is really good. In Figure 6 below we can see how good is the prediction of GPA with these variables, the error varies between -40 (underestimate) up to 40(overestimate). But on average, we are in 5.7% of error overestimating, thus we can see how good our structural model predicts.

GPA	like	useful	overall	desirable	pleased	Model	error (%)
4	1	2	3	1	2	3.1	-22
4	3	3	3	3	3	2.9	-27
3	3	3	3	1	3	3.0	1
3	3	3	4	3	3	2.9	-2
2	4	3	3	4	3	2.8	40
3	4	3	4	3	3	2.9	-4
3	3	3	3		3	3.1	3

Figure 6. Structural model prediction

The model proves that the GPA has in fact a relationship with the student satisfaction with e-learning. The intercept of the model provides the expected value of satisfaction of any student with e-learning, thus we can interpret these results of present case study as showing that any potential student that want to pursue studies in a health related program in the university where e-learning is part of the program will be able to obtain a good GPA.

4.3. Qualitative Analysis

The qualitative analysis was performed on the data collected from the open-ended questions of the survey related to features, motivation, inhibitions and preferences for group vs. independent learning. Even though, the level of participation for open ended questions was a bit less than for the rest of the questionnaire, the comments provided are very important and were qualitatively analysed. In Table 15 is showing the participation level.

Table 15. Participation Level on the open questions.

	features		motivation		inhibitions		preferences	
Empty	39	27.86%	31	22.14%	44	31.43%	35	25.00%
Filled	101	72.14%	109	77.86%	96	68.57%	105	75.00%
N / A	2	1.43%	2	1.43%	3	2.14%	2	1.43%
Participation	99	70.71%	107	76.43%	93	66.43%	103	73.57%

Table 16 summarizes satisfaction scores and shows how close the mean values and the standard deviation values are to the student satisfaction factors. These questions reflect the use of audio-visual tools in education. Since GPA depends on those factors we can assume that health sciences are more perceptive than analytic studies.

Table 16. Satisfaction with e-learning

Question	Factor	Mean	SD
I like using the e-learning format including case study, simulations, problem-based activities, questions database, multimedia, quizzes, assessments etc.	like	2.72	0.93
Overall e-learning is useful in reaching my learning goals.	useful	2.67	0.93
Overall, e-learning is easy to use for learning.	overall	3.01	0.79
I find using e-learning to be desirable for learning.	desirable	2.56	0.96
I am pleased with the course experience of using e-learning.	pleased	2.67	0.89

5-point Scale (0 to 4) with 4 representing Strongly Agree or Very Satisfied

For the question "I found I have extensively used these e-learning features including multimedia, case studies, resources, discussion boards, simulations, and online assessment for the following reasons", there were various patterns identified for student preferences , as per qualitative analysis methodology, as reasons for using various features of e-learning. First theme was related communication tools provided the benefits of convenience of communication. This

theme can be linked with the variables communicate and communication which showed strongest correlation with the satisfaction factors. Here is an example of what some participants were saying about the benefits of communicating with peers like convenience of email....email function is convenient because you have each and every student and can get a hold of anyone (id86) *or*....to chat with group members in my team(id20), while also making it more convenient to communicate with the professors....e-mail allows me to communicate with professors without having to travel to school(id50) or skip the office hours all together(id67).... easier to get time to communicate with a professor via email, rather than waiting in line to speak with them after class, or coming in on a day off for a meeting (id46)...professor is able to answer on their time if you aren't\ '[sic] able to attend their office hours (id86).

The second theme in reasons for using various features, indicated by 46 students, was to review the course material from anywhere at any time, seeking for clarity....reviewing lessons over again for clarity. Can go at my own pace and when time permits (id91), at students own pace....E-learning allows me to go at my own pace, and do my work when I have time in order to meet strict deadlines(id78), in the comfort of its home....One of my lectures are\ '[sic] virtually streamed online so that we can watch the lecture from the comfort of our own home (id22),in its own time.... able to view lectures or access learning material when I have time (id45) and review course material before class....listening to online lectures that are posted to know the material required for the class(101).

Following closely with the previous theme, a third theme emerged around opportunity to access resources for completing their assignments, submit the completed assignments, review other resources...Frequently use WebCT to understand the course syllabus and know which readings are required and many professors also post the learning outcomes online to help guide

our self-learning. There are links that are required leading to websites such as the CNO and RNAO to help guide the nursing students to readings. Video's are posted online for the nursing students to view (id48).The other major theme discovered was related to usage of the e-learning feature for taking quizzes and also prepare for tests and exams(id120)...to review course material by means of quizzes, matching, or practice questions prior to writing an in-class test or exam helps (id12).

The second question was: "What motivated you to choose an e-learning course? Common theme revealed as major motivator by many respondents was easy to use and useful for learning...E-learning gives me easier access to material that other students normally won't[sic] get the opportunity in traditional learning environments(id93);The second theme was again related to convenience and flexibility allowing students to balancing study workload with employment as few participants stated....flexibility in scheduling is the main reason for choosing an e-learning course(id109)... With my nursing placement I have a very chaotic schedule and so I am not able to commit to a lecture that is scheduled for the same day and time each week (id14) with students appreciating the flexibility to work in the same time and reduce the commuting to campus while making it a lot more easier to complete to work around a set schedule and also allowing students to manage family commitments.... easier to do (not having to find a babysitter for my children in order to attend class (id28), plus the increased convenience.... all lecture notes are posted on WebCT (id34) and ease of access...it was easily assessable, the learning is more clear cut since everything is at one place and I could do the work around my schedule (id77). Another theme emerged around student having to enroll into a mandatory course offered only online.... I am forced to by the courses that are mandatory for my degree in nursing (or no other choice was being offered (id49)...No choice, they were a part of my assigned courses (id34);

and yet again, e-learning course's mandatory status.... I did not choose an e-learning course to complete this program, e-learning courses are mandatory (id68).Fourth theme emerged as technology being the motivating factor in choosing e-learning....I am good with technology and so I feel that we should use the technology we are given (id82); technology is the way of the future(id65);

For the third question: "What inhibits your use of e-learning for learning?" common theme revealed as major inhibitor as....loss of face to face communication between peers but also between student and teacher (id43).... Disconnected from teacher communication(id76), especially around the need for some clarifications when....the course syllabus is unclear and the information on WebCT is unorganized (id29), for those...students require face to face interaction to be able to understand certain concepts(id122) and lacking the benefits of group learning.... I feel something is lost when there is no opportunity to hear other people's questions/discussions in class (id87), and further.... disconnect from peers, teacher, lack of class dialogue which encourage debate and clarify concepts (id64).

Another theme emerged around student having to enroll into a mandatory course offered only online.... I am forced to by the courses that are mandatory for my degree in nursing (or no other choice was being offered (id73)....No choice, they were a part of my assigned courses (id44); I did not choose an e-learning course to complete this program, e-learning courses are mandatory (id136).This "no choice" theme most likely didn't contribute to the overall student satisfaction with e-learning. Yet another theme surfaced and refers to technology issues ranging from slow internet connection to....poor internet access (when the internet cuts in and out) -lack of space to plug computer in on school premises during busy hours of the work week (id127),

to.... learning how to use platform(id101).... We are never properly explained how to use them, we are told where they can be downloaded and then thrown to the wolves to figure it out (id95).

A separate theme encompassing self-teaching and motivation with issues related to poor time management.... I usually never get around to listening/go through all the lectures when I have to listen/read them on my own time (id56), losing learning focus I find it very hard for me to learn on my own time. I need someone to teach me (id39), going through not getting timely help from the professor(id75).... you may not be receiving timely responses or grades, which makes it difficult to know your progress in the course (id52), to inability to build relationship with the professor or other students(id73).

The qualitative analysis revealed that most used e-learning features were communication tools (email, chat) for the convenience to contact professors or peers when needed in a timely manner, also course materials review at anytime and anywhere plus the easy access to other resource for completing assignments, quizzes, preparation for tests and exams. Multiple facilitators for e-learning were identified including the ease of use of e-learning , the ease of access to course materials and other course resources resulting in an overall positive attitude towards e-learning considered useful for learning, not lastly the convenience and flexibility for balancing study, work and even family commitments sometimes. Surprisingly the technology appears as facilitator factor in this section but also difficulties caused by frequent technology and connection issues, where resolution require extra time to find the right person to help instead of using that time for learning, were also viewed as a major barrier for using e-learning.

Other major barriers in using e-learning seem to be in the area of face to face communication with instructor where guidance and clarifications for course materials are not

enough using online communication and the ways teacher manage the course, delays in getting timely help or feedback from teacher, the feeling of being disconnected manifested between student peers and professor-student. Many students also expressed missing the benefits of group class debate and dialogue considered useful for learning. Furthermore the self-teaching and risk of losing motivation in the process, in were identified as yet another barrier for use of e-learning by some students.

Through the exploration of student preference for either group learning or independent learning, the majority expressed a preference for independent learning but stressed out that the right mix of group based and independent e-learning activities, each having its own definite benefits, seems very useful for e-learning ; while independent learning is suitable for students who prefer to complete the work at their own pace and time without need to synchronize schedules, rely or depend on other people finishing their work on-time, group learning considered from two different perspectives, online group learning and classroom based; while both forms can provide benefits such as better understanding of the material, learning from others, foster better communication and encourage dialogue, face to face group learning is preferred over online version mostly because of team-based structure of nursing profession, while students are acknowledging that being involved in online learning groups also benefit them for the chosen career since mobile technology is increasingly used in many healthcare organizations nowadays.

Chapter 5

Conclusions

The results of this case study, the first objective of which was to determine the combination of factors influencing the student satisfaction with e-learning and second objective of which was to determine relationships between the discovered satisfaction factors with e-learning above and GPA, established the most important factors impacting student satisfaction, explored and confirmed these factors relationship with student's GPA.

The present research data analysis revealed the most highly influential factors on nursing student satisfaction with e-learning to be: perceived liking, perceived usefulness, usability and communication & teaching of e-learning. This case study's findings are aligned with those of relevant findings from other research (Calli et al, 2013, Borhani et al., 2011) in the area of nursing higher education student's satisfaction with e-learning. Considering that students' satisfaction is very important output of any educational program and the major factors above have major influence on student satisfaction, therefore the author of e-learning programs for nursing higher education should definitely incorporate any learning features and processes at the level where all the above factors are consistently showing high levels of satisfaction throughout the length of the program and incorporate in the course design the specific nursing students needs for e-learning like clinical skills teaching, protecting confidential patient information or increasing safety by reducing medical errors.

Present study results also suggest that those students, who reported e-learning as useful and their overall satisfaction level was high, did also report having a higher GPA. The importance and relationship of the factors and correlation coefficients will allow the designers of

the e-learning program for nursing students to set a rich set of criteria based on the above factors to improve the e-learning system for an increased satisfaction with e-learning which will have a direct effect on those students GPA.

Communication by way of virtual communication including e-mail, discussion board, and live lectures has not gained widespread adoption for e-learning in nursing higher education. Students don't feel they can truly relate with teacher using chat discussion board student, and still prefer discussions with peer students, rather than discussing with teacher. Students rated on-line discussions, quizzes as facilitators for learning because these offer opportunities to interact with peers and teachers and also reflect on learnt material, but consistently mentioned that complementary in-class discussions and other face to face interactions is also beneficial for effective learning. The professor has to compensate for lack of visual contact with their audience and offer a more enriched way of communicating the learning material to make sure the message gets through to the students.

This current study qualitative analysis results indicates that blended e-learning courses have the potential to increase student satisfaction, supported also by Farrington (2014) findings where blended e-learning has capacity to generate positive change in the understandings and confidence about learning, Jang et al. (2006) who found that students in a blended program perform better and that learning satisfaction was positive.

The second objective of this study was determining the relationship between student overall satisfaction and their GPA scores and the evaluation and statistical multivariate analysis revealed that factors perceived liking are inversely proportional with GPA while perceived usefulness and perceived overall satisfaction are directly proportional with GPA.

All answers to the survey indicating a “Neither Agree/Disagree” equivalent to satisfaction level of “indifferent” are actual opportunities for eLearning program enhancements. These can be found in the area of how students find they learn best, e-learning based communication, teacher preparedness, and completeness of learning resources, improvement of learning outcomes.

Recommendations for nursing students

E-learning environments are not yet completely supported by current technology and 20th century learning methods are still used, therefore nursing students need to get more knowledge around self-teaching and maintaining motivation during the whole e-learning process. Many participants in this study expressed missing the benefits of group class debate and dialogue considered useful for learning, therefore all the students should seek active participation during in-class activities of e-learning course instead of engaging in non-related course activities. This kind of active engagement is recommended during the any online group activities as well. Another recommendation refers to providing ongoing feedback to instructor where any course objective are unclear or lecture materials requires more structure or clarifications.

The majority of nursing students expressed a preference for independent learning, but it is strongly recommended for the students to be able to successfully complete group based e-learning activities, also very useful for enriched learning and a good preparation for healthcare workplace processes, considering that most of nursing activities are not done in isolation.

Even in the case the student might have all the technology at home, they are still not used to use it effectively for learning. Mastering e-learning tools early on is an effective instrument for training and its potential positive impact on satisfaction level with e-learning later on during the

studies or future training. Therefore nursing student need to go through the process of assessing their IT skills level, suitability and preparedness for e-learning which can be easily assessed by using a subset of current study questionnaire before and during studies.

The findings from current study qualitative analysis is supporting students' ongoing need for online communication where same courteous approach it is recommended to be followed by students as in their face-to-face interactions with professors. It's also highly recommended to students to attend a regular communication component, if available, which will reduce one of the barriers identified in the use of e-learning programs.

Recommendations for faculty

Based on some major barriers in using e-learning identified through results of this case study, first recommendations for faculty is to try to offer timely help or feedback to students in regards to course syllabus, lecture materials, questions or how to use e-learning to support their clinical learning. Furthermore, our case study results reconfirm previous other studies findings where e-learning provides the better satisfaction level when integrated in a blended learning approach. Designing a blending program would support better teacher-student face to face communication for an improved process of support or guidance needed by students. Seen as a good solution for an effective e-learning experience for nursing student, the adoption of a blended delivery method of courses would remove some other barriers in use of e-learning, including needed clarifications for course materials, getting the benefits of class dialogue, feeling disconnected, loss of motivation, as identified by case study results.

Another set of recommendations refers to the proactive measures to reduce technology issues, such as slow internet connections, lack of documentation about how-to-use e-learning

platforms. Adoption of m-learning, which enables real-time communication and collaboration, provides learner orientation, helps with previous knowledge reuse and facilitates learning about collaborative patient health management, could provide the solution for some of the technical issues.

Since technical issues were yet identified as a barrier for e-learning, program designers need to establish pedagogical designs of technical solutions. Another improvement can be added around providing timely clarifications of the course material either through and questions and answers online session or by dedicating more time for this via online communication (discussion board, email, blog) and via in-class sessions, which can also successfully support group learning and class dialogue, as deduced from the barriers identified with e-learning courses.

In order to overcome another identified barrier in using e-learning related to the ways teacher manages the lecture and course materials, they should attend a specific training related to e-learning methods, processes and technical tools. Faculty should periodically try to better understand nursing student evolving needs by collecting periodic feedback through student satisfaction surveys with e-learning course.

Recommendations for university

The findings of this case study should encourage university's enhancements plans regarding e-learning programs and state-of-art digital technology to consider these as a priority for the future of education of nursing students, also supported by DeCaro et al. (2014) study findings, where e-learning for nursing students is an effective alternative to traditional learning. Higher education institutions should already prepare with enhancements to existing e-learning programs for the impending time when demand will increase, considering that results of this

study are showing that 60% of nursing students were already taking 1 to 3 e-learning courses and 74% indicated that were taking 1 to 3 blended learning courses.

By clearly identifying which are the categories of nursing students and their unique learning needs related to specific clinical skills, the university can set up or update the future road map containing the directions for e-learning programs.

The virtual communication feature of e-learning can be a facilitator for certain student's needs including rapid access to instructor or peers, but a barrier for some students who are not feeling comfortable with approaching the teacher by using the e-learning communication tools or those who prefer to discuss only with peer students rather than discussing with instructor. University program should offer some incentives to encourage student-teacher rich communication. Some of the study results are showing young student indifferences and these are indicating some needed program enhancements in the area of student-teacher communication in e-learning courses. Also establishing certain communication etiquette for the online communication of e-learning programs at the organization level can help in maintaining the online communication at the same level of importance as face to face interactions with the professors.

In order to overcome another limitation to an e-learning program related to educator's readiness for working in a virtual classroom setting, university could provide the training related to e-learning methods, processes and technical tools for the staff who have been mostly working in a traditional classroom setting, thus making possible to have more staff available for teaching.

Case study limitations and future research

Possible limitations of this study include selection bias, samples derived from one institution only. This case study was conducted with students who were active participants in e-learning studies. Because the research was conducted in one university, the sampling was a convenience one, thus is not possible to generalize the findings to students from other programs at different universities due to variations in Health Sciences and Nursing programs across Canada. Furthermore, other institutions may be using different e-learning packages or instructors decide to use e-learning package in different ways. This limitation is assessed to have very limited impact on the case study results based on the fact that participants program of study variable was mostly evenly distributed between the Health Sciences program (66 students or 49%) and the Bachelor of Science in Nursing program (64 students or 47%), thus the results were not biased between these two program areas. Future research should be conducted with different e-learning platforms including mobile platforms where probabilistic sampling can be used for generalizing the research findings.

Since nursing student's expectations of e-learning program were not considered mostly due to time restrictions, future research can expand the results of present study by enhancing the existing survey to a two-staged questionnaire where first stage include questions about student's expectation from e-learning, while second stage survey about satisfaction is delivered, then study can compare the expectations and satisfaction of e-learning students,

Another limitation is the validity of questionnaire which it was designed based on other similar instruments and then reviewed by faculty and peers for face validity. However it is a brand new questionnaire and it wasn't validated by prior research. This limitation is assessed to have very limited impact on the case study results based on literature review for e-learning evaluation tools

which guided the development of the current questionnaire to include mostly standard questions used during the most recent research on e-learning domain. Also considering that response rate was excellent and it was evenly distributed between all 4 years of undergraduate health sciences programs, and the parameter estimates for structural model are giving robust results, are representing strong indicators that questionnaire was well designed.

In conclusion, we believe the findings of this study add a new perspective on satisfaction factors with e-learning for nursing students and describe the link between their satisfaction level and GPA. Further research is required to explore how e-learning program design can address the barriers to e-learning identified in this study and further explore the conclusions of this study to other nursing and health sciences programs at other universities or to nursing and health sciences programs delivered 100% online.

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Appendix A. Questionnaire (Likert 5-type scale)

Key terms

E-learning: E-learning refers to any type of learning situation when instruction content is delivered partially or totally electronically via Internet.

Blended-learning: blended learning approach can combine face-to-face instruction with computer-mediated instruction

Student satisfaction: is aggregate of feelings or affective responses to distinguishable factors while interacting with the e-learning system.

1. Age: (drop down list)
2. Gender: (M/F)
3. Current program you are enrolled in: (text)
4. Current year in the program of enrollment: (drop down list)
5. Number of e-learning courses taken: (ranges 0, 1-3, 4-6)
6. Number of blended-learning courses taken: (ranges 0, 1-3, 4-6)
7. Last known GPA score : (a. n/a, b. 0 - 2.3, c. 2.4 - 3.3, d. 3.4 - 4.3)
8. What is your comfort level with using technology for learning? (scale 1-being the worst to 5-being the best)

9. I find that I learn best using e-learning tools like those available through WebCT.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
10. I find e-learning easy to use and review learning material.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
11. I like using the e-learning format including case study, simulations, problem-based activities, questions database, multimedia, quizzes, assesments etc.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
12. I prefer to communicate with peers and instructor using e- learning tools of WebCT including chat, mail, discussion board, whiteboard etc.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
13. I find my teacher is well prepared for course delivery through e-learning.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
14. Overall e-learning is useful in reaching my learning goals.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
15. The e-learning course provides the learning resources I need.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
16. I have necessary IT skills to easily operate the e-learning tools of WebCT.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree

17. Using e-learning can improve my learning outcomes.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
18. Overall, e-learning is easy to use for learning.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
19. I find using e-learning to be desirable for learning.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
20. I find that I can establish a better communication with the teacher using e- learning tools of WebCT like chat, mail, discussion board, whiteboard etc.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
21. I would be able to use satisfactorily the e-learning for learning outcomes.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
22. I am comfortable with approaching the professor for any concerns via e-learning communication tools of WebCT.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
23. I feel that e-learning encourages me to attend face-to-face course modules if applicable.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree
24. I find that professor provides enough direction for reaching my learning objectives.
- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree

25. I am pleased with the course experience of using e-learning.

- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree

26. I find that e-learning course content has high quality.

- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree

27. I find that I am disconnected from my peers during an e-learning course.

- a. Strongly Agree b. Agree c. Neutral d. Disagree e. Strongly Disagree

28. I found I have extensively used these e-learning features including multimedia, case studies, resources, discussion boards, simulations, and online assessment for the following reasons (open).

29. What motivated you to choose an e-learning course? (open)

30. What inhibits your use of e-learning for learning? (open)

31. Do you prefer independent or group based e-learning and why? (open)

The following answers for questions will be kept separate from the rest of questionnaire and it will be used only for collecting the contact information for the participants willing to participate in the focus group or in the draw.

32. Are you willing to participate in focus group interviews planned be conducted near the end of each term in November 2010 and March 2011? If you accept, you will receive an invitation letter with further details. (No/ Yes radio buttons with field for email address mandatory for Yes answers)

33. Are you willing to participate in a draw with prizes of one iPhone and five \$20 gift cards? If yes, please provide your email address to be able to contact you. (No/ Yes radio buttons with field for email address mandatory for Yes answers).

Appendix B. List of variables and their description

Variable	Description	Range	Assigned
completed	Completion of the questionnaire	Yes/No	1/0
time	Elapsed time to complete the questionnaire	min	min
age	Age: (drop down list)	17-19, 20-24, 25-29, 30-34, 35-39, 40-44	0/1/2/3/4/5
gender	Gender: (M/F)	Male/Female	1/0
program	Current program you are enrolled in: (text)	HSc, BScN, MLSc	0/1/2
inyear	Current year in the program of enrollment: (drop down list)	1, 2, 3, 4	1/2/3/4
elearning	Number of e-learning courses taken: (ranges 0, 1-3, 4-6)	0, 1-3, 4-6	0/1/2
blended	Number of blended-learning courses taken: (ranges 0, 1-3, 4-6)	0, 1-3, 4-6	0/1/2
GPA	Last known GPA score : (a. n/a, b. 0 - 2.3, c. 2.4 - 3.3, d. 3.4 - 4.3)	4 points scale	0/1/2/3
comfort	What is your comfort level with using technology for	5 points scale	0/1/2/3/4

	learning?		
webct	I find that I learn best using e-learning tools like those available through WebCT.	5 points scale	0/1/2/3/4
easy	I find e-learning easy to use and review learning material.	5 points scale	0/1/2/3/4
like	I like e-learning case study, simulations, problem-based activities, questions database, etc.	5 points scale	0/1/2/3/4
communicate	I prefer to communicate with peers and instructor using e- learning tools of WebCT including chat, mail, discussion board, whiteboard etc.	5 points scale	0/1/2/3/4
teacher	I find my teacher is well prepared for course delivery through e-learning.	5 points scale	0/1/2/3/4
useful	Overall e-learning is useful in reaching my learning goals.	5 points scale	0/1/2/3/4
resources	The e-learning course provides the learning resources I need.	5 points scale	0/1/2/3/4
skills	I have necessary IT skills to easily operate the e-learning tools of WebCT.	5 points scale	0/1/2/3/4
outcomes	Using e-learning can improve my learning outcomes.	5 points scale	0/1/2/3/4

overall	Overall, e-learning is easy to use for learning.	5 points scale	0/1/2/3/4
desirable	I find using e-learning to be desirable for learning.	5 points scale	0/1/2/3/4
communication	I find that I can establish a better communication with the teacher using e- learning tools of WebCT like chat, mail, discussion board, whiteboard etc.	5 points scale	0/1/2/3/4
learning	I would be able to use satisfactorily the e-learning for learning outcomes.	5 points scale	0/1/2/3/4
approaching	I am comfortable with approaching the professor for any concerns via e-learning communication tools of WebCT.	5 points scale	0/1/2/3/4
encourages	I feel that e-learning encourages me to attend face-to-face course modules if applicable.	5 points scale	0/1/2/3/4
direction	I find that professor provides enough direction for reaching my learning objectives.	5 points scale	0/1/2/3/4
pleased	I am pleased with the course experience of using e-learning.	5 points scale	0/1/2/3/4
quality	I find that e-learning course content has high quality.	5 points scale	0/1/2/3/4
peers	I find that I am disconnected from my peers during an e-learning course.	5 points scale	0/1/2/3/4

features	I found I have extensively used these e-learning features including multimedia, case studies, resources, discussion boards, simulations, etc.	5 points scale	0/1/2/3/4
motivation	What motivated you to choose an e-learning course? (open)	Open	1/0
inhibitions	What inhibits your use of e-learning for learning? (open)	Open	1/0
preferences	Do you prefer independent or group based e-learning and why? (open)	Open	1/0
focus	Are you willing to participate in focus group interviews planned be conducted near the end of each term in November 2010 and March 2011?	Yes/No	1/0
email	Are you willing to participate in a draw and provide your email address.	Yes/No	1/0

Appendix C. Definition of descriptive statistics properties.

Kurtosis, skewness, and normalization definitions were extracted from Matlab software manufacturer's website, MathWorks (www.mathworks.com), on September 20, 2014. The definitions are quoted below.

“Kurtosis is a measure of how outlier-prone a distribution is. The kurtosis of the normal distribution is 3. Distributions that are more outlier-prone than the normal distribution have kurtosis greater than 3; distributions that are less outlier-prone have kurtosis less than 3.

The kurtosis of a distribution is defined as

$$k = \frac{E(x - \mu)^4}{\sigma^4}$$

where μ is the mean of x , σ is the standard deviation of x , and $E(t)$ represents the expected value of the quantity t . kurtosis computes a sample version of this population value.

Note Some definitions of kurtosis subtract 3 from the computed value, so that the normal distribution has kurtosis of 0. The kurtosis function does not use this convention.

When you set flag to 1, the following equation applies:

$$k_1 = \frac{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^4}{\left(\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2 \right)^2}$$

When you set flag to 0, the following equation applies:

$$k_0 = \frac{n-1}{(n-2)(n-3)} ((n+1)k_1 - 3(n-1)) + 3$$

This bias-corrected formula requires that X contain at least four elements.”

“Skewness is a measure of the asymmetry of the data around the sample mean. If skewness is negative, the data are spread out more to the left of the mean than to the right. If skewness is positive, the data are spread out more to the right. The skewness of the normal distribution (or any perfectly symmetric distribution) is zero.

The skewness of a distribution is defined as

$$s = \frac{E(x - \mu)^3}{\sigma^3}$$

where μ is the mean of x , σ is the standard deviation of x , and $E(t)$ represents the expected value of the quantity t . skewness computes a sample version of this population value.

When you set flag to 1, the following equation applies:

$$s_1 = \frac{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^3}{\left(\sqrt{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2} \right)^3}$$

When you set flag to 0, the following equation applies:

$$s_0 = \frac{\sqrt{n(n-1)}}{n-2} s_1$$

This bias-corrected formula requires that X contain at least three elements.”

“The Normalization block independently normalizes each row, column, or vector of the specified dimension of the input. The block accepts both fixed- and floating-point signals in the squared 2-norm mode, but only floating-point signals in the 2-norm mode. The output always has the same dimensions as the input.

This block treats an arbitrarily dimensioned input U as a collection of vectors oriented along the specified dimension. The block normalizes these vectors by either their norm or the square of their norm.

For example, consider a 3-dimensional input $U(i,j,k)$ and assume that you want to normalize along the second dimension. First, define the 2-dimensional intermediate quantity $V(i,k)$ such that each element of V is the norm of one of the vectors in U :

$$V(i,k) = \left(\sum_{j=1}^J U^2(i,j,k) \right)^{1/2}$$

Given V , the output of the block $Y(i,j,k)$ in 2-norm mode is

$$Y(i,j,k) = \frac{U(i,j,k)}{V(i,k) + b}$$

In squared 2-norm mode, the block output is

$$Y(i,j,k) = \frac{U(i,j,k)}{V(i,k)^2 + b}$$

The normalization bias, b , is typically chosen to be a small positive constant (for example, $1e-10$) that prevents potential division by zero.”

The following definitions were extracted from The Institute for Statistics Education's website (statistics.com) on September 20, 2014:

First quartile equivalent to 25% of the range, Second quartile equivalent to 50% of the range,

Third quartile equivalent to 75% of the range are defined as “The 1st, 2nd, and 3d quartiles are the 25th, 50th, and 75th *percentiles* respectively.”

Percentiles are defined as “In a population or a sample, the Pth percentile is a value such that at least P percent of the values take on this value or less and at least (100-P) percent of the values take on this value or more.”

Standard error of the mean value is defined as:

“The standard error measures the variability of an estimator (or sample statistic) from sample to sample. There are two approaches to estimating standard error:

1. The bootstrap. With the bootstrap, you take repeated simulated samples (usually resamples from the observed data, of the same size as the original sample, taken with replacement), calculate the estimator for each resample, then find the standard deviation of all the resampled estimators.
2. By formula. If you know the standard deviation of the sample data, you can use it to calculate an estimated standard error. For example, the formula for the standard error of the mean is

$$STDERR = \frac{STDEV}{\sqrt{(N)}}$$

where STDEV is the standard deviation of the sample, N is the sample size.”

Confidence Interval of the Mean at 95% of confidence level is defined as:

“A confidence interval is an interval that brackets a sample estimate that quantifies uncertainty around this estimate. Since there are a variety of samples that might be drawn from a population, there are likewise a variety of confidence intervals that might be imagined for a given population parameter (though with the observed data you can see only one of them). A 95% confidence interval, for example, is one interval in a set of intervals. The property of this set of intervals is that 95% of the intervals in this set contain the population parameter. Likewise, a 90% confidence interval for the population mean is an interval which belongs to a set of intervals, 90% of which contain the population mean.”

Variance is defined as:

“Variance is a measure of dispersion. It is the average squared distance between the mean and each item in the population or in the sample.

An advantage of variance (as compared to the related measure of dispersion - the standard deviation) is that the variance of a sum of independent random variables is equal to the sum of

their variances.

Note: When using the sample variance to estimate the population variance, the divisor (n-1) is typically used instead of (n) to calculate the average. The latter results in a biased estimate; the former is unbiased.”

Standard deviation is defined as:

“The standard deviation is a measure of dispersion. It is the positive square root of the variance.

An advantage of the standard deviation (as compared to the variance) is that it expresses dispersion in the same units as the original values in the sample or population. For example, the standard deviation of a series of measurements of temperature is measured in degrees; the variance of the same set of values is measured in "degrees squared".

Note: When using the sample standard deviation to estimate the population standard deviation, the divisor (n-1) is typically used instead of (n) to calculate the average. The use of (n-1) allows to reduce the bias of the estimate.”

Coefficient of Variation is defined as: “the standard deviation of a data set, divided by the mean of the same data set.”

Correlogram definition was extracted from the QuickR website (<http://www.statmethods.net/>)
on September 20, 2014:

“**Correlograms** help us visualize the data in correlation matrices.

In **R**, correlograms are implemented through the **corrgram(x, order = , panel=, lower.panel=, upper.panel=, text.panel=, diag.panel=)** function in the **corrgram** package.

x is a data frame with one observation per row.

order=TRUE will cause the variables to be ordered using principal component analysis of the correlation matrix.

panel= refers to the off-diagonal panels. You can use **lower.panel=** and **upper.panel=** to choose different options below and above the main diagonal respectively. **text.panel=** and **diag.panel=** refer to the main diagonal. Allowable parameters are given below.”

¹<http://www.mathworks.com/help/stats/kurtosis.html>

¹<http://www.mathworks.com/help/stats/skewness.html>

¹<http://www.mathworks.com/help/dsp/ref/normalization.html>

Appendix D. R-Language Scripts

```
setwd("~/Survey")
```

```
answers <- read.csv("~/Survey/answers.csv")
```

```
View(answers)
```

```
attach(answers)
```

```
summary(answers)
```

```
library(pastecs)
```

```
stat.desc(answers)
```

```
library(psych)
```

```
describe(answers)
```

```
describe(sqrt(answers))
```

```
describe(log(answers+1))
```

```
library(corrgram)
```

```
corrgram(answers, lower.panel=NULL)
```

```
qqnorm(time, ylab = "Time", xlab = "Normal Probability",
```

```
      + main="Linear Scale: S = 2.04 K = 5.99")
```

```
qqnorm(sqrt(time), ylab = "Time", xlab = "Normal Probability",
```

```
+ main="SQRT Scale: S = -0.02 K = 0.53")

qqnorm(log(time+1), ylab = "Time", xlab = "Normal Probability",

+ main="LOG Scale: S = -0.61 K = 0.09")

options(digits=3)

cor(answers,use = "complete.obs", method = "pearson")

time = sqrt(time)

age = sqrt(age)

inyear = sqrt(inyear)

communicate = log(communicate + 1)

answers$time = time

answers$age = age

answers$inyear = inyear

answers$communicate = communicate

boxplot(answers, ylab = "Normalized Scale", las = 2)

grade1 = lm(GPA ~ like)

grade2 = lm(GPA ~ useful)

grade3 = lm(GPA ~ overall)
```

```
grade4 = lm(GPA ~ desirable)
```

```
grade5 = lm(GPA ~ pleased)
```

```
summary(grade1)
```

```
summary(grade2)
```

```
summary(grade3)
```

```
summary(grade4)
```

```
summary(grade5)
```

```
grade6 = lm(GPA ~ like + useful + overall + desirable + pleased)
```

```
summary(grade6)
```

Appendix E. Factor analysis scripts

```
loadings <- read.csv("~/Survey/loadings.csv")
```

```
View(loadings)
```

```
attach(loadings)
```

```
pc.cr <- princomp(~like+useful+overall+desirable+pleased,data=loadings,na.action =  
na.exclude, cor = TRUE)
```

```
pc.cr
```

```
summary(pc.cr)
```

```
loadings(pc.cr)
```

```
loadings <- read.csv("~/Survey/answers.csv")
```

```
View(answers)
```

```
attach(answers)
```

```
pc.cr <- princomp(~ time + age + gender + program + inyear + elearning + blended +  
comfort + webct + easy + communicate + teacher + resources + skills + outcomes +  
communication + learning + approaching + encourages + direction + quality + peers, data  
= answers, na.action = na.exclude, cor = TRUE)
```

```
pc.cr
```

```
summary(pc.cr)
```

```
loadings(pc.cr)
```

Appendix F. Model validation for GPA

completed	time	age	gender	program	myyear	stanning	blended	gpa_a	hcc	useful	evrwell	desirable	planned	Model	stres(s)	Intercept	3.127
1	3.828	1	0	0	4	1	1	4	3	3	3	3	3	3.0	-27	Intercept	3.127
1	2.630	1	0	0	4	1	1	3	3	3	3	3	3	3.0	-27	useful	0.097
1	4.728	0	0	0	3	0	1	2	4	4	4	4	4	2.9	-4	desirable	-0.081
0	0.400	1	1	0	4	1	1	2	3	3	3	3	3	3.1	3	planned	-0.081
1	4.889	1	0	0	4	1	1	3	3	3	3	3	3	3.0	-1		
1	7.008	1	1	0	2	1	1	3	3	3	3	3	3	2.9	-2		
1	3.777	1	0	0	3	1	1	3	3	3	3	3	3	2.9	-2		
0	0.000	1	0	0	4	0	0	2	4	4	4	4	4	3.0	-1		
0	0.000	1	0	0	4	0	0	2	4	4	4	4	4	3.0	-1		
0	31.065	1	0	0	3	0	0	1	3	3	3	3	3	2.9	-3		
1	5.995	1	0	0	3	0	1	3	3	3	3	3	3	2.9	-3		
1	5.995	1	0	0	3	0	1	3	3	3	3	3	3	3.1	3		
1	3.634	2	1	0	4	2	2	3	3	3	3	3	3	3.1	3		
1	10.005	2	0	0	3	0	0	3	3	3	3	3	3	2.9	-13		
1	12.117	1	0	0	4	1	2	2	3	3	3	3	3	2.9	40		
1	5.348	1	0	0	1	1	1	3	3	3	3	3	3	3.1	3		
0	3.377	0	0	1	3	1	1	3	3	3	3	3	3	2.9	-3		
0	0.000	1	0	0	1	1	1	3	3	3	3	3	3	2.9	-3		
0	0.000	1	0	0	1	1	1	3	3	3	3	3	3	2.9	-3		
1	33.475	1	0	0	4	4	4	4	4	4	4	4	4	2.9	-13		
1	5.827	0	0	1	4	4	4	4	4	4	4	4	4	2.9	-13		
1	5.948	0	0	1	3	1	2	4	4	4	4	4	4	2.9	-13		
1	5.948	0	0	1	3	1	2	4	4	4	4	4	4	2.9	-13		
1	5.948	0	0	1	3	1	2	4	4	4	4	4	4	2.9	-13		
1	5.948	0	0	1	3	1	2	4	4	4	4	4	4	2.9	-13		
1	4.137	0	0	1	1	1	1	3	3	3	3	3	3	3.1	2		
1	4.137	0	0	1	1	1	1	3	3	3	3	3	3	3.1	2		
1	6.233	1	0	0	4	2	1	2	3	3	3	3	3	3.0	80		
1	3.392	0	0	1	4	1	1	2	3	3	3	3	3	3.1	2		
0	0.000	1	0	0	1	0	0	1	3	3	3	3	3	3.1	2		
1	4.050	1	0	0	2	0	0	1	3	3	3	3	3	3.0	-1		
1	4.823	1	0	0	3	3	3	3	3	3	3	3	3	2.9	-27		
1	30.117	0	0	1	2	2	2	2	2	2	2	2	2	2.9	45		
1	6.823	0	0	1	2	2	2	2	2	2	2	2	2	2.9	45		
0	0.000	0	1	0	3	1	1	2	2	2	2	2	2	3.1	55		
0	0.000	1	0	0	3	1	1	2	2	2	2	2	2	3.1	55		
1	3.772	0	0	1	3	1	1	3	3	3	3	3	3	2.9	-2		
1	8.000	1	0	0	1	1	1	3	3	3	3	3	3	2.9	-2		
1	8.000	1	0	0	1	1	1	3	3	3	3	3	3	2.9	-2		
1	8.000	1	0	0	1	1	1	3	3	3	3	3	3	2.9	-2		
1	31.480	1	0	0	4	4	4	4	4	4	4	4	4	2.9	-16		
1	4.728	1	0	0	4	4	4	4	4	4	4	4	4	2.9	-16		
1	18.117	1	0	0	4	4	4	4	4	4	4	4	4	2.9	-16		
1	5.483	1	0	0	1	1	1	3	3	3	3	3	3	3.0	80		
1	5.977	1	0	0	1	1	1	3	3	3	3	3	3	3.0	80		
1	4.255	1	0	0	1	1	1	3	3	3	3	3	3	3.0	80		
0	0.000	1	0	0	1	0	0	1	3	3	3	3	3	3.0	80		
1	2.087	0	0	0	1	0	0	1	3	3	3	3	3	3.0	80		
1	4.800	1	0	0	1	1	1	3	3	3	3	3	3	2.8	-8		
0	0.000	1	0	0	1	1	1	3	3	3	3	3	3	3.0	0		
1	10.440	1	0	0	1	1	1	3	3	3	3	3	3	2.9	-27		
1	7.607	2	0	0	1	1	1	3	3	3	3	3	3	3.1	2		
1	37.005	2	0	0	1	1	1	3	3	3	3	3	3	3.1	2		
1	12.112	0	0	0	1	1	1	3	3	3	3	3	3	2.8	-23		
1	6.518	1	0	0	1	1	1	3	3	3	3	3	3	2.9	-27		
1	10.235	0	0	0	1	1	1	3	3	3	3	3	3	3.0	3		
0	12.990	0	0	0	1	0	0	1	3	3	3	3	3	3.1	3		
1	7.467	1	0	0	1	1	1	3	3	3	3	3	3	3.1	3		
1	6.132	1	0	0	1	1	1	3	3	3	3	3	3	3.1	3		
1	31.200	1	0	0	1	1	1	3	3	3	3	3	3	3.0	4		
1	3.117	1	0	0	1	1	1	3	3	3	3	3	3	3.1	3		
1	7.882	0	0	0	1	1	1	3	3	3	3	3	3	3.1	3		
1	3.127	1	0	0	1	1	1	3	3	3	3	3	3	3.1	3		
1	16.553	0	0	0	1	1	1	3	3	3	3	3	3	2.9	-2		
1	2.485	1	0	0	1	1	1	3	3	3	3	3	3	2.9	-2		
1	3.348	1	0	0	1	1	1	3	3	3	3	3	3	2.9	-2		
1	7.077	1	0	0	1	1	1	3	3	3	3	3	3	2.9	-2		
1	23.772	0	0	0	1	1	1	3	3	3	3	3	3	2.9	-2		
0	0.000	1	0	0	1	1	1	3	3	3	3	3	3	2.9	-2		
1	2.500	2	1	0	1	0	0	1	3	3	3	3	3	2.9	-27		
1	15.995	0	0	0	1	0	0	1	3	3	3	3	3	2.9	-27		
0	0.000	0	0	0	1	0	0	1	3	3	3	3	3	2.9	-27		
1	3.000	0	0	0	1	0	0	1	3	3	3	3	3	2.9	-27		
1	7.335	0	0	0	1	0	0	1	3	3	3	3	3	2.9	-27		
1	4.688	1	0	0	1	1	1	3	3	3	3	3	3	3.1	2		
0	0.000	0	0	0	1	0	0	1	3	3	3	3	3	3.1	2		
1	3.077	1	0	0	1	1	1	3	3	3	3	3	3	2.9	-27		
1	6.888	0	0	0	1	1	1	3	3	3	3	3	3	2.9	-27		
1	4.038	1	0	0	1	1	1	3	3	3	3	3	3	2.9	-27		
0	0.000	0	0	0	1	0	0	1	3	3	3	3	3	2.9	-27		
1	4.790	3	0	0	1	1	1	3	3	3	3	3	3	2.9	-27		
1	30.245	0	0	0	1	0	0	1	3	3	3	3	3	2.9	-27		
0	0.000	0	0	0	1	0	0	1	3	3	3	3	3	2.9	-27		
1	2.665	0	0	0	1	1	1	3	3	3	3	3	3	2.9	-27		
1	5.555	5	1	0	1	1	1	3	3	3	3	3	3	2.9	-27		
0	0.000	4	0	0	1	0	0	1	3	3	3	3	3	2.9	-27		
1	8.888	4	1	0	1	1	1	3	3	3	3	3	3	2.9	-27		
1	8.888	4	1	0	1	1	1	3	3	3	3	3	3	2.9	-27		
1	8.888	4	1	0	1	1	1	3	3	3	3	3	3	2.9	-27		
1	8.888	4</															

Appendix G. Quick preview of questionnaire responses

id	Completed	Age... []	Gender.. []	Current_program.. []	Current_year	Number_of_e-le	Number_of_e	Number_of	Number_of	Number_of	Number_of	Last_know	Last_know	Last_know	Last_know	
1	Y		Female	BHsc - comprehensive	4	No	Yes	No	No	Yes	No	No	No	No	No	Yes
2	Y	20-24 year	Female	health sciences - com	4	No	Yes	No	No	Yes	No	No	No	No	No	Yes
3	Y	25-29 year	Female	Health Sciences-Healt	3	No	Yes	No	No	No	Yes	No	No	No	Yes	No
4	Y	20-24 year	Female	Health Sciences	3	No	Yes	No	No	Yes	Yes	No	No	No	Yes	No
5	Y	20-24 year	Female	Health Sciences HIM	3	No	Yes	No	No	Yes	No	No	No	Yes	No	No
6	Y	17-19 year	Female	Health Science	2	Yes	No	No	No	Yes	No	No	No	No	Yes	No
7	Y	20-24 year	Female	Health Information Ma	4	No	Yes	No	No	Yes	No	No	No	No	Yes	No
8	N	20-24 year	Male	Health Sciences	3	No	Yes	No	No	Yes	No	No	No	Yes	No	No
9	Y	20-24 year	Female	Health Sciences	4	No	Yes	No	No	No	Yes	No	No	No	Yes	No
10	Y	20-24 year	Female	Health Science	3	No	Yes	No	No	Yes	No	No	No	No	Yes	No
11	Y	20-24 year	Male	Health Science Compr	2	Yes	Yes	No	No	Yes	No	No	No	No	Yes	No
12	N	20-24 year	Female	Health Science	2	No	Yes	No	No	Yes	No	No	Yes	No	No	No
13	Y	20-24 year	Female	Health Sciences Comp	3	No	Yes	No	No	No	Yes	No	No	No	Yes	No
14	N	20-24 year	Female	Health Science	2	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No
15	N	20-24 year	Female	Health Information Mar	1	Yes	No	No	No	No	Yes	No	No	No	Yes	No
16	N	20-24 year	Female	Health Science Compr	2	Yes	No	No	No	Yes	No	No	No	Yes	No	No
17	Y	25-29 year	Female	BHs - Health Informati	3	No	Yes	No	No	Yes	No	No	No	No	Yes	No
18	Y	20-24 year	Female	Health Sciences	3	Yes	No	No	No	Yes	No	No	No	No	Yes	No
19	Y	20-24 year	Female	Health Science	3	No	Yes	No	No	Yes	No	No	No	No	Yes	No
20	Y	25-29 year	Male	Health Science	4	No	No	Yes	No	No	Yes	No	No	No	Yes	No
21	Y	25-29 year	Female	health sciences	4	No	No	Yes	No	No	Yes	No	No	Yes	Yes	No
22	Y		Female	Health Science	3	Yes	No	No	No	No	Yes	No	No	No	Yes	No
23	N		N/A			No	No	No	No	No	No	No	No	No	No	No
24	Y	20-24 year	Female	Health Sciences (Com	4	No	Yes	No	No	No	Yes	No	No	Yes	No	No
25	Y	20-24 year	Female	BScN	3	No	Yes	No	No	Yes	No	No	No	No	Yes	No
26	Y	17-19 year	Female	BScN	2	No	Yes	No	No	No	Yes	No	No	No	Yes	No
27	N	20-24 year	Female	Nursing	3	No	Yes	No	No	Yes	No	No	No	No	Yes	No
28	Y	17-19 year	Female	BScN	2	No	No	Yes	No	No	Yes	No	No	No	Yes	No
29	N	20-24 year	Female	Bachelor of Science in	2	No	No	No	No	No	Yes	No	No	Yes	No	No
30	Y	20-24 year	Female	Nursing	4	No	Yes	No	No	Yes	No	No	No	Yes	No	No
31	Y	20-24 year	Female	BScN	4	No	Yes	Yes	No	No	Yes	No	No	No	Yes	No
32	Y	17-19 year	Female	Collaborative Nursing (2	No	No	Yes	No	No	Yes	No	No	No	Yes	No
33	Y	30-34 year	Female	Post PN-BScN	2	No	Yes	No	No	No	Yes	No	No	No	No	Yes
34	Y	17-19 year	Female	Nursing	1	No	No	Yes	No	No	Yes	No	No	No	Yes	No
35	Y	20-24 year	Female	nursing	3	No	Yes	No	No	Yes	No	No	No	No	Yes	No
36	Y	45-49 year	Female	RPN-BScN Program	2	No	Yes	No	No	Yes	No	No	No	No	Yes	No
37	Y	20-24 year	Female	BScN Nursing	3	No	Yes	No	No	Yes	No	No	No	No	Yes	No
38	Y	17-19 year	Female	Collaborative Nursing	1	No	Yes	No	No	Yes	No	No	No	No	Yes	Yes
39	Y	20-24 year	Female	Health Sciences - Hea	2	No	Yes	No	No	Yes	No	No	No	Yes	No	No
40	Y	20-24 year	Female	BscN	4	No	No	Yes	No	Yes	No	No	No	Yes	No	No
41	Y	17-19 year	Female	BScN	2	No	No	Yes	No	No	Yes	No	No	No	Yes	No
42	Y	20-24 year	Female	BScN	4	No	No	Yes	No	Yes	No	No	No	No	Yes	No
43	N	17-19 year	Male	Health Sciences	2	Yes	No	No	No	Yes	No	No	No	No	No	Yes
44	Y	20-24 year	Female	BScN	3	Yes	No	No	No	Yes	No	No	No	No	Yes	No
45	Y	20-24 year	Female	BScN Nursing	3	No	No	Yes	No	No	Yes	No	No	No	No	Yes
46	Y	20-24 year	Female	BScN	4	No	Yes	Yes	No	No	Yes	No	No	No	Yes	No
47	Y	17-19 year	Female	BScN	2	No	No	Yes	No	No	Yes	No	No	Yes	No	No
48	Y	17-19 year	Female	Bachelor of Science in	1	No	Yes	No	Yes	No	No	No	No	No	Yes	No
49	Y	17-19 year	N/A	BScN- Nursing Progra	2	No	No	Yes	No	No	Yes	No	No	No	Yes	No
50	Y	25-29 year	Male	BScN - Nursing	3	No	Yes	No	No	Yes	No	No	No	Yes	No	No

Appendix H. Summary of study key steps with timelines

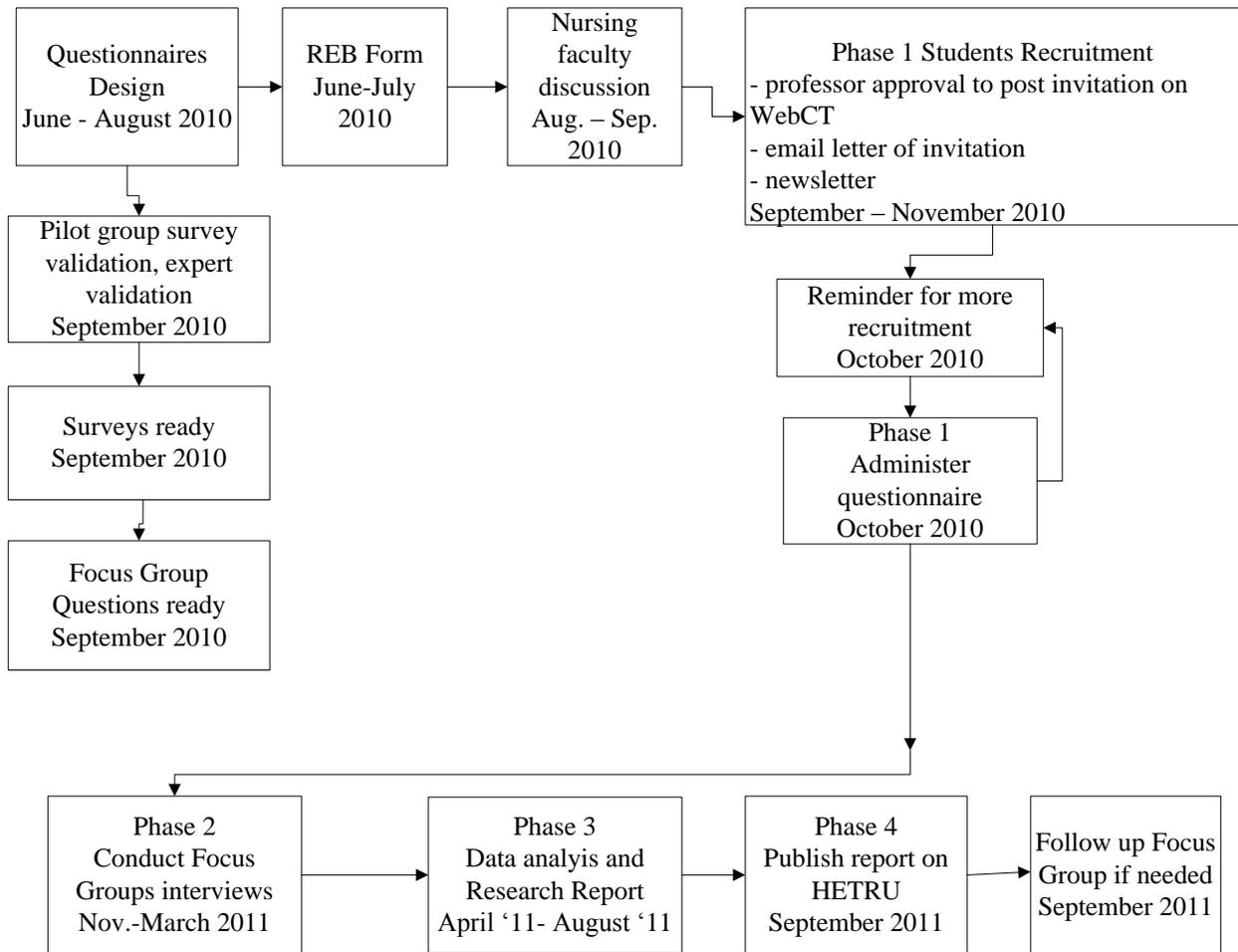


Figure 7.

Appendix I. Letter of Invitation to Questionnaire

I am writing to request your participation in a confidential survey of your experiences as an undergraduate health sciences student at UOIT. This survey is being conducted at Faculty of Health Sciences UOIT, and aims to determine effectiveness of e-learning for undergraduate health sciences students.

E-learning experience can be either through 100% online (virtual classroom) courses or blended learning where course has both face-to-face and online instruction.

The survey will help us learn more about our undergraduate health sciences students and their expectations of, and reactions to, e-learning at Faculty of Health Sciences UOIT. Survey results will provide insight into improving the e-learning experience for you, as well as for future undergraduate health sciences students.

Your participation in completing the questionnaire is voluntary. If you are not comfortable answering specific questions, please skip over them. If you wish to withdraw at any time, you may do so. However, we do hope that you will participate and provide as much information as possible to help create a representative sampling of opinion and reactions from our undergraduate health sciences students. The online web survey service at hir.uoit.ca/limesurvey/ will aid in ensuring the safe storage of the data and the confidentiality of the research. Furthermore each participant will be assigned a numeric code that will be used on the survey. No names will be attached to the number. Principal investigator is planning to keep raw data and aggregate data, with identifiers until September 2011, for duration of the project. After that date, participant's information and survey results will be deleted from the secure storage serve.

If you agree to participate, the questionnaire will take about 20 minutes to complete. You do not

need to complete the entire survey in one sitting. Here is the information you will need to participate:

The survey is on the web at: [http:// hir.uoit.ca/limesurvey/](http://hir.uoit.ca/limesurvey/)

Your access code for the survey is: _____

If you would like further information about the survey, or if you encounter any problems, please contact Carmina Vica at carmina.vica@uoit.ca.

Thank you in advance for providing this important feedback.

Sincerely,

Carmina Vica

Graduate student in Health Informatics at UOIT

Appendix J. Questionnaire Consent Letter

CONSENT TO PARTICIPATE IN RESEARCH STUDY AT UOIT

Evaluating nursing student satisfaction using an e-learning system: a case study

You are asked to participate in a research study conducted by *Carmina Vica*, from the Master of Health Informatics at the Health Sciences, UOIT. Result will be contributing to my master's thesis dissertation.

If you have any questions or concerns about the research, please feel free to contact me **Carmina Vica**, principal investigator, at carmina.vica@uoit.ca or *dr. Jennifer Percival*, Faculty Supervisor at jennifer.percival@uoit.ca.

PURPOSE OF THE STUDY *The objectives of this study are to determine any combination among factors that influence health sciences student's satisfaction in an e-learning system and determine the gain in student satisfaction by considering three variables of interest: student's experience in use of e-learning system, overall satisfaction level and GPA scores.*

PROCEDURES If you volunteer to participate in this study, we would ask you to do the following things: Participants are required to complete an online questionnaire. The research results will be published in on Health Education Technology Research Unit (HETRU) website on Fall 2011 and a summary of research findings in the Fall Health Sciences newsletter.

POTENTIAL RISKS AND DISCOMFORTS *There are no physical, psychological or social risks associated with participation in any phases of this study. No deception is involved during the study and there is no potential that participants will feel coerced into contributing to this research. Overall there are minimum risks for the participants to be involved in this study.*

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY *An increased demand for e-learning in nursing education is emerging because it complements face to face education. Advances in computers and technology require new research instruments. Measures of the experience and attitudes of healthcare students to the increased use of e-learning contribute to the improvements of the e-learning curriculum.*

PAYMENT FOR PARTICIPATION Survey participants will be provided a ballot for a draw for participation prizes of one iPhone and five \$20 gift cards.

CONFIDENTIALITY Every effort will be made to ensure confidentiality of any identifying information that is obtained in connection with this study. The online web survey service at hir.uoit.ca/limesurvey/ will aid in ensuring the safe storage of the data and the confidentiality of the research. Principal investigator is planning to keep raw data and aggregate data, with identifiers until September 2011, for duration of the project.

PARTICIPATION AND WITHDRAWAL You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise that warrant doing so.

RIGHTS OF RESEARCH PARTICIPANTS You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. This study has been reviewed and received ethics clearance through the UOIT Research Ethics Board. If you have any concerns regarding your rights as a participant, please contact the Ethics and Compliance Office at compliance@uoit.ca or telephone 905 721 8668 ext 3693.