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# Design, Implementation, and Evaluation of an Online Systemic Human Anatomy Course with Laboratory

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A thesis submitted in partial fulfillment of the requirements for the degree in Doctor of Philosophy
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DESIGN, IMPLEMENTATION, AND EVALUATION OF AN ONLINE SYSTEMIC
HUMAN ANATOMY COURSE WITH LABORATORY

(Thesis format: Integrated Article)


by


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# Abstract

Systemic Human Anatomy is a full credit, upper year undergraduate course with a prosection laboratory demonstration at Western University Canada. To meet enrolment demands beyond the physical space of the laboratory facility, a fully online section was developed to run concurrently with the traditional face-to-face (F2F) course in 2012-13. Lectures for F2F students were broadcast in live and archived format to online students using Blackboard Collaborate virtual classroom. Online laboratories were delivered in the virtual classroom by teaching assistants (TAs) with three dimensional (3D) anatomical models (Netter's 3D Interactive Anatomy).

Student performance outcomes and student and instructor perceptions of the experience were studied over a two year period to determine the strengths and weaknesses of the new format. Data comparing the online and F2F student grades suggest that previous academic achievement, and not delivery format, predicts performance in anatomy. Students valued pace control, schedule and location flexibility of learning from archived materials. In the online laboratory, they had difficulty using the 3D models and preferred the unique and hands-on experiences of cadaveric specimens. The F2F environment was conducive to learning in both lecture and lab because students felt more engaged by instructors in person and were less distracted by their surroundings.

The course was modified in its second year with the addition of virtual breakout laboratory rooms, which allowed students to learn in smaller groups and interact with 3 TAs per lesson. The new laboratory format encouraged the majority of online students to use the 3D models. Virtual breakout rooms engaged online students in learning and the students were satisfied with their interactions with TAs and peers, though online laboratories did not adequately replace the F2F learning environment for all students. The biggest concern of the instructors was their inability to see coverbal student behaviour and use it to assess class engagement and their teaching effectiveness.

The design and evaluation of the course will guide anatomy educators in accommodating large student populations when faced with limited laboratory facilities and/or cadaveric specimens.  The instructional methods will also be of interest to science, engineering, and mathematics educators who teach 3D concepts.

## Keywords

# Co-Authorship Statement

The written material in this thesis is the original work of the author. Stefanie Attardi participated in all aspects of the work contained within this thesis including online course design and implementation, conception of the research questions, study design, data collection, data analysis, and preparation of the manuscripts. The roles of the co-authors are detailed below.

Chapter 3: Development and Implementation of an Online Systemic Human Anatomy Course with Laboratory.

Delivery of the online course was designed by Stefanie Attardi and Kem Rogers. Commercial anatomy software were reviewed by Stefanie Attardi and Kem Rogers. Photographs for the Self Directed Neuroanatomy Website were captured by David Arromba, Stefanie Attardi, and Michael Wu, and the website was designed and launched by David Arromba, Tyler Benning, Shawn Foster, Merran Neville, and Adam Pypstra with input from Stefanie Attardi. Funding for the Netter's 3D Interactive Anatomy licenses was provided by the Western Science Student Donation. Preparation of this manuscript was performed by Stefanie Attardi with input from Kem Rogers. This manuscript has been published: Attardi and Rogers. 2015. Design and implementation of an online systemic human anatomy course with laboratory. Anatomical Sciences Education 8:53-61.

Chapter 4: Mixed Methods Student Evaluation

The concept of this research was created by Stefanie Attardi. The interviews were designed by Stefanie Attardi with input from Kem Rogers and John Barnett. The survey was designed by Stefanie Attardi with input from Kem Rogers and Ken Meadows. Data collection was completed by Stefanie Attardi. The interviews were analyzed by Stefanie Attardi and Suwhan Choi. The survey was analyzed by Stefanie Attardi with input from Kem Rogers. Preparation of this manuscript was performed by Stefanie Attardi with input from Kem Rogers, John Barnett, and

Suwhan Choi.  This manuscript was submitted for publication to Anatomical Sciences Education.

Chapter 5: Pedagogical Modifications for Improving Communication

The concept of this research was created by Stefanie Attardi. Modifications to the online course were determined by Michele Barbeau with input from Stefanie Attardi and Kem Rogers.  The changes were implemented by Michele Barbeau and Stefanie Attardi.  The survey was designed by Stefanie Attardi with input from Kem Rogers.  The data were collected and analyzed by Stefanie Attardi with input from Kem Rogers.  Preparation of this manuscript was performed by Stefanie Attardi with input from Kem Rogers.  This manuscript will be submitted to Anatomical Sciences Education.

Chapter 6: Instructor Perspectives of Teaching Systemic Human Anatomy Online

The concept of this research was created by Stefanie Attardi.  The interviews were designed by Stefanie Attardi with input from Kem Rogers and John Barnett.   The interviews were conducted by Stefanie Attardi and analyzed by Stefanie Attardi and Noah Mintz.  Preparation of this manuscript was performed by Stefanie Attardi with input from Kem Rogers.  This manuscript will be submitted to Anatomical Sciences Education.

# Dedication

Dedicated to my parents, Marcel and Sue Attardi.

*With your love, anything is possible.*

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I want first to thank my supervisor, Dr. Kem Rogers.  I could not have asked for a better mentor.  He went above and beyond to help me develop skills in research and teaching.  Through leading by example, he has taught me to keep current, be innovative, create opportunities, and above all to enjoy the ride.

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# Chapter 1

# 1    Introduction

This chapter outlines the Systemic Human Anatomy curriculum at Western University, enrolment history, factors that drove the creation of the online course, and the importance of evaluating its outcomes.

## 1.1    Systemic Human Anatomy at Western University

### 1.1.1    Curriculum

Anatomy is the study of the structure of organisms. Systemic Human Anatomy (ACB 3319) is a full credit, third year undergraduate course with a prosection laboratory demonstration. It has been offered by the Department of Anatomy and Cell Biology at Western University Canada for the past 30 years. This popular course is a prerequisite for several modules in the Bachelor of Medical Sciences program and is also sought after by allied health science students. The learning objectives for the course are for students to acquire facts and concepts about the structure of the human body and how it relates to function. Students attend biweekly, 50 minute didactic lectures (50 hours total) and a weekly, 1 hour laboratory demonstration (24 hours total). A systems approach is taken to introduce gross and functional anatomy of the central and peripheral nervous systems (20 hours), special senses (2 hours), musculoskeletal (22 hours), cardiovascular (6 hours), respiratory (3 hours), digestive (5 hours), urinary (3 hours), and reproductive systems (5 hours). During the interactive laboratory sessions, a teaching assistant reviews lecture material and describes anatomical structures and relationships in 3 dimensions to small groups of 15 students. The teaching assistant uses human prosections, plastic models, diagrams and videos as teaching aids. While this is not a dissection-based course, students are given the opportunity to directly handle both the plastic models and prosections. Minimal specimen preparation work is required by departmental staff, as the prosections come from cadavers previously dissected by advanced anatomy

students as part of their coursework (i.e., clinical anatomy graduate students, medical, physiotherapy, occupational therapy and kinesiology students).

Students do not have access to the laboratory and laboratory teaching materials outside of the instructor-guided session; however, face-to-face office hours with a teaching assistant were available on a drop-in basis (2 x 3-hour long sessions each week).

## 1.1.2    Assessment of Students

Student comprehension of the lecture material is assessed through quarterly, multiple choice term tests totaling 90% of the final grade.  The students' understanding of the laboratory concepts, in conjunction with the corresponding lecture material, are tested through non-cumulative weekly quizzes (24) totaling 10% of the final grade.  Each quiz is administered at the end of the laboratory session.  Quiz questions (10) are displayed in a projected Power Point presentation and are of mixed format (structure identification on cadaveric images, text book figures, and screen shots of 3D computer models; multiple choice; fill-in-the-blank; and short answer).

## 1.1.3    Enrolment

Undergraduate enrolment at Ontario's public universities has increased steadily over the past decade (COU-CUO, 2014a).  Its effect has been observed in Systemic Human Anatomy, as registration grew from 92 students in 2001-02 to 280 by 2011-12.  Despite physical expansion of the laboratory space to accommodate the growing number of undergraduates, each year students were waitlisted and unable to take the course.  This popular course is also required for several modules in the Bachelor of Medical Sciences Program at Western University and is a prerequisite for select allied health science programs in Ontario.  In 2012, a new online section was added to the course to accommodate wait listed students and to study outcomes of offering the course in an online distance format.  In this thesis, the traditional delivery format of the course will be

referred to as the face-to-face (F2F) format and the new distance delivery format will be called the online format.

## 1.2    Importance of Outcomes Assessment

As of 2012, Ontario's public universities offered 3100 fully online courses in which approximately 195 000 undergraduate and graduate students are enrolled annually (COU-CUO, 2014b) to provide opportunities for the province's increasing number of post-secondary students (COU-CUO, 2014a).  Enrolment in post-secondary institutions has also increased continually on the national level (AUCC, 2011).  It is estimated that 875 000 – 950 000 Canadian students are registered in an online course at any given time (Contact North, 2012). Though online courses expand academic options for this growing student body, it is important to evaluate their impact on student learning to ensure that the quality of higher education is maintained.  The Ontario provincial government has committed to the investment of $43-million (CAD) in online post-secondary education, beginning in 2015, through the launch of the Ontario Online Initiative (OMF, 2014). As part of this initiative, a central hub will be created for instructors to share best practices and research on optimizing online education (OMTCU, 2014).  Few North American Institutions have published their approach to teaching anatomy online and the associated outcomes (Boudinot and Martin, 2001; Limpach et al., 2008; Attardi and Rogers, 2015).  Outcomes assessment of Systemic Human Anatomy online, modification of the course, and reassessment will help guide anatomy educators in accommodating large student populations when faced with limited laboratory space and/or cadaveric specimens.  The instructional methods will also be of interest to educators of science, technology, engineering, and mathematics who use interactive environments to teach 3D concepts.

## 1.3     Purpose of the Thesis

This thesis serves to provide a rationale for the design of a novel online anatomy course, describe its implementation, determine outcomes in terms of student academic achievement, assess student perceptions of learning anatomy in the online versus F2F format, assess instructor perspectives of teaching anatomy in an online distance format, generate theory on the strengths and weaknesses of the online format, and make recommendations for the future of online anatomy education.

## 1.4     Literature Cited

Attardi SM, Rogers KA.  2015. Design and Implementation of an Online Systemic Human Anatomy Course with Laboratory.  Anat Sci Educ 8: 53-62.

AUCC. 2011. Association of Universities and Colleges of Canada . Trends in higher education. Volume 1: Enrolment. Ottawa, ON.  URL: http://www.aucc.ca/wp-content/uploads/2011/05/trends-2011-vol1-enrolment-e.pdf. [Accessed 7 March 2015]

Boudinot SG, Martin BC. 2001. Online anatomy lab (OAL): A self-regulated approach to the instruction of human anatomy. Interact Multimedia Electron J Comput Enhanc Learn 3:1.

COU-CUO, Council of Ontario Universities – Conseil des Universities de L'Ontario.  2014a.  Facts and Figures: Applications Enrolment.  Toronto, Canada. URL:  http://cou.on.ca/applications-enrolment  [accessed 17 Feb 2015]

COU-CUO, Council of Ontario Universities – Conseil des Universities de L'Ontario.  2014b. Policy issues: Online learning. Toronto, Canada. URL: http://www.cou.on.ca/policy-advocacy/online  [accessed 17 Feb 2015]

Contact North. 2012. Online learning in Canada: At a tipping point; A Cross-Country Check-up 2012. Thunder Bay, ON. URL: http://contactnorth.ca/sites/default/files/contactNorth/files/pdf/publications/online_learning_in_canada_at_a_tipping_point_-_a_cross_country_check_up_2012_-_july_18_2012_final.pdf.  [accessed 7 March 2015].

Limpach AL, Bazrafshan P, Turner PD, Monaghan MS. 2008. Effectiveness of human anatomy education for pharmacy students via the Internet. Am J Pharm Educ 72:145.

OMF. Ontario Ministry of Finance. 2014. Budget: Ontario's new vision for education. Toronto, Canada. URL: http://www.fin.gov.on.ca/en/budget/ontariobudgets/2014/ch1a.html#s1-10 [accessed 18 March 2015]

OMTCU, Ontario Ministry of Training, Colleges, and Universities. 2014. News release: Province improving online learning.  Toronto, Canada. URL: http://news.ontario.ca/tcu/en/2014/01/province-improving-online-learning.html?utm_source=ondemand&utm_medium=email&utm_campaign=m [accessed 17 Feb 2014]

# Chapter 2

## 2    Literature Review

### 2.1    Definition of Learning

Mayer (2010) defines learning as "a change in the learner's knowledge attributable to experience".   The term "knowledge" encompasses facts and concepts, skills (procedures and strategies), and attitudes (beliefs) (Mayer, 2010). The learning objective for Systemic Human Anatomy is for students to acquire facts and concepts about human morphology and how they relate to function; therefore, in this thesis, "learning" refers to a change in the student's understanding of anatomical facts and concepts.

### 2.2    Distance Education

#### 2.2.1    Evolving Definitions

Distance education describes a method of education where students do not have F2F contact with their teacher and can study at a time and place of their choice (Bates, 2005).   It is not possible to trace its exact origins temporally because the variations in scholars' exact definition of distance education influence how they discuss its historical context (Larreamendy-Joerns and Leinhardt, 2006).   Since this thesis is concerned with distance education enabled by technology, only its recent history is outlined.

Kaufman (1998) and Sumner (2000) describe three generations of distance education in terms of how students accessed learning materials and instructors, and the role that technological advancement played in the evolution of the generations.  The first generation of distance education, referred to at the time as correspondence education, involved the use of a single technology from which students learned.  Common forms were educational radio or television programs or printed materials.  There was no direct communication between students and

the instructor or peers.  Student assignments and feedback from the instructor were sent through the postal service.  In the second generation of distance courses, students used multimedia.   Multimedia learning refers to learning from words combined with pictures (Mayer and Moreno, 2003).  The words can be printed or spoken, and the pictures can be static or animated.  The multimedia learning resources were designed specifically for the purpose of distance education, but rarely by the instructor for the course. In the (present day) third generation, distance education is based on two-way communication between the teacher and the student.  Communication can occur between the instructor and groups of students, in contrast to previous generations where the instructor communicated with each student on an individual basis. Two way communications can also be facilitated between students.  As the generations have progressed, the dialogue between participants has increased, thus the learner has become more involved in the process (Kaufman, 1989).

The definition of distance education continues to evolve as new communication technologies become available.  Simonson et al. (2011) redefined the distance education method as a format where individuals in the learning group are separated from each other, but interactive telecommunication systems are used to connect students and instructors with each other and with the learning resources.

### 2.2.2    Definition of Online Distance Education

Online courses are forms of distance courses.  In a fully online course, students are required to have access to a computer with internet connectivity, and they can participate in its entirety without having to attend any F2F sessions (Bates, 2005).  This term is not to be confused with e-learning or computer assisted learning (CAL), which only require the use of a computer or telecommunication system for learning and may or may not involve internet connectivity (Harasim, 2000; Bates, 2005).

## 2.2.3    Moore's Transactional Distance

Transactional distance is a pedagogical concept defined as a psychological space between the teacher and the learner in which there is a potential for misunderstanding (Moore, 1993).  Transactional distance cannot be directly measured, as it is a relative and not an absolute term.  Instead, educational methods can be described in terms of their effect on transactional distance.  The concept of transactional distance can be applied to F2F learning systems, though it is most commonly discussed in terms of the distance education format since participants are separated physically from each other.

Moore (1993) defines two variables of which transactional distance is a function: the instructional dialogue and programme structure.  The term "dialogue" refers to purposeful interactions of positive quality between teachers and students.  The communication method directly impacts the quality of dialogue, and thus the transactional distance.  For example, a lesson during which communication is unidirectional from the teacher to the student (e.g. via audiotape) will lack dialogue because the media does not allow the learner to communicate back to the teacher.  Through careful selection of communication methods that increase dialogue, the transactional distance is reduced.   Moore identified other factors that affect dialogue such as the physical environment in which the participants are located, frequency and opportunity of communication, and the emotional status and personality of the participants.

The programme structure refers to the way that educational experience is designed for delivery through communication media.  Highly structured programs are those which employ inflexible instructional media and the way that students use the media is predetermined.  There is no opportunity for deviation from the lesson to suit the needs of a particular learner.  For example, in a pre-recorded educational video, the words and activity of the instructor and time on task are fixed.  There is no opportunity for the learner to influence the course of the lesson.  Conversely, programs with a relatively open structure in which

personalized interactions can take place allow the learner to determine the course of the lesson. Transactional distance decreases as the program become less structured.

## 2.2.4    Moore's Types of Interaction

Moore (1989) defined the different types of interactions that occur in a distance education course. Learner-content interaction refers to the process of interacting intellectually with the content, which results in changes of the learner's understanding of the material. The learning resources are intended to facilitate the learner's interaction with the content. Learner-instructor interaction refers to acts through which the expert motivates the student to learn and stimulates the student's interest. The interaction is not limited to the conventional conversation. The instructor may present information, demonstrate a skill, or model a specific attitude or value. These three acts complement Mayer's (2010) definition of knowledge (facts and concepts, skills, and attitudes or beliefs) that students acquire during learning. A teacher's influence on student learning is greater when there are learner-instructor interactions compared to student-content interactions alone. The final type, learner-learner interaction, occurs between students. Though its importance is often overlooked, this interaction can be a valuable resource for learning.

Moore (1989) advised that when designing a distance course format, it is crucial that educators plan methods through which all three types of interactions can occur. In a meta-analysis of 74 studies on distance courses in higher education, Bernard et al., (2009) conceded with this notion as it was found that increasing all types of interactions in general promoted better student academic achievement.

## 2.2.5    Comparison of Traditional to Distance Courses

There is enormous variation in approaches to delivering distance courses (Moore, 1993; Bernard et al., 2004). There are countless tools for facilitating the delivery of distance courses.  The various combinations of these tools in a particular course, coupled with the way they are used, makes each distance course unique.  Bernard et al. (2004) conducted a large meta-analysis of 232 studies comparing distance formats to their traditional formats in higher education. Their findings on the effects of course format on student achievement were inconclusive.  Due to the high variability of course delivery methods, in some cases the distance format was extremely effective compared to the traditional format and in others it was extremely ineffective.

## 2.2.6    Temporal Formats

A way in which all distance courses can be categorized is through the timing of learner-instructor and learner-learner interactions.  Synchronous communication in the realm of online education refers to communication between participants without time delay (Moore and Kearsley, 2012).  It requires participants to be actively learning at the same time.  In contrast, asynchronous communication is time lagged such that participants will respond at a time different from the original correspondence (Moore and Kearsley, 2012). In a smaller meta-analysis of 103 studies, Lou et al. (2006) concluded that academic performance is identical between student groups when instructors teach simultaneously and synchronously from a traditional classroom to remote sites using audio and/or videoconferencing technology.  Furthermore, Bernard et al. (2009) demonstrated that there are no differences in student achievement when comparing synchronous to asynchronous distance formats.

## 2.3     Anatomy Teaching Materials

### 2.3.1     Historical Context

Human gross anatomy is "the examination of structures of the human that can be seen without a microscope" (Moore et al., 2014).  The discipline has been one of the most significant components of medical curricula (McLachlan and Patten, 2006). Learning from cadavers (deceased human bodies) dates back to the Renaissance (14th – 17th century) (Persaud, 1984).  Dissection is the disassembly of cadavers with the purpose of studying their structure.  Despite changes to the field of medicine since the commencement of dissection, this learning experience has persisted into current health professional education and dissection is believed to be "a universally recognizable step in becoming a doctor" (Dyer and Thorndike, 2000).  Presently, the most common medical education practice is to deliver didactic lectures to introduce students to structure and function, followed by additional experiences (such as dissection) to complement the learning process (Sugand et al., 2010).

The advantages and disadvantages of studying from human cadavers have been discussed thoroughly in the literature.  It is widely accepted by anatomy education scholars that hands-on cadaveric dissection experience facilitates understanding of anatomical structures in three dimensions (Marks, 2000; Aziz et al., 2002; Heylings, 2002; McLachlan and Patten, 2006; Azer and Eizenberg, 2007; Collins, 2008; Sugand et al., 2010).  Dissection requires students to put the scientific method into practice as students must problem solve during the process (Aziz et al., 2002).  Since the task of dissecting the whole body is shared by a group of students, it hones team work skills (Aziz et al., 2002).  The use of cadavers has also been recognized for introducing students to concepts related to death or dying (Aziz et al., 2002; Shaffer, 2004; Tam et al., 2009), which will be prevalent in health care professions. Finally, since each cadaver is unique, working with them teaches students about human anatomical variability (Aziz et al., 2002; Shaffer, 2004).

Major factors that restrict the use of cadavers are the great financial expense (e.g. for preservation chemicals, embalming, facilities) and the availability of body donors (Aziz et al., 2002; McLachlan et al., 2004). The act of dissection is also time consuming (Aziz et al., 2002). Prosected material refers to a cadaveric specimen that has been expertly dissected in advance for the purpose of teaching others. Studying from prosections allows the learner to understand anatomical relationships from a real specimen without the time consuming work of dissection (Collins, 2008). Prosections also maximize the use of cadavers when the number of body donors may be insufficient (Collins, 2008). Use of prosected materials, however, has not overshadowed all of the issues surrounding a dissection program. The specialized expertise required to teach cadaveric anatomy may be unavailable due to a decline in the number of anatomy graduate programs (Trelease, 2002), resulting in a shortage of trained anatomists (Aziz et al., 2002; Collins, 2008). Other disadvantages of teaching with cadaveric materials in general include potential unsafe exposure to preserving chemicals (Aziz et al., 2002; McLachlan et al., 2004; Wright, 2012) and psychosocial ramifications in some students (e.g. evoking fear and anxiety)(Aziz et al., 2002; McLachlan et al., 2004). Finally, it has been argued that the anatomy of deceased humans does not accurately reflect the living state (Aziz et al., 2002; Gunderman and Wilson, 2005).

Advancements in computer technology, commencing in the 1980s, provided new anatomy learning resources (Aziz et al., 2002; Trelease, 2002). Following this revolution, around the turn of the millennium, rapid changes from the traditional dissection model of pedagogy were observed in medical education (McLachlan et al., 2004). The necessity to rely solely on cadavers was reduced (Aziz et al., 2002). Novel alternatives included diagnostic imaging (Aziz et al., 2002; Trelease, 2002; McLachlan et al., 2004; Gunderman and Wilson, 2005; Collins, 2008), digital images (Trelease, 2002), medical simulators (Trelease, 2002; McLachlan et al., 2004; Sugand et al., 2010), anatomical data sets (Spitzer et al.,

1996); virtual reality (Trelease, 2002), and 3D anatomical computer models (Trelease, 2002, Sugand et al., 2010).

## 2.3.2    Computer Assisted Learning in Anatomy

Computer-aided instruction and online learning tools have also been used as supplementary resources in face-to-face anatomy courses at health professional schools (Boyce, 2012; Sugand et al., 2010; Trelease, 2015) and veterinary schools (Gaitskell-Phillips et al., 2012).  Online discussion forums (Choudhury and Gouldsborough, 2012; Durham, et al., 2009; Green and Hughes 2013; Green et al., 2014), which are usually an inherent feature of a learning management system (specialized course website software) and chat (instant messaging) rooms (Choudhury and Gouldsborough, 2012) have been used to facilitate communication among anatomy students.  More specific to the anatomical sciences has been the development of anatomy e-learning modules, where students use a website to progress through descriptive text and pictures (Green et al., 2006; Raynor and Iggulden, 2008), anatomical illustrations (Durham et al., 2009), or interactive photographs (O'Byrne et al., 2008; Doubleday et al., 2011).

There are a number of commercially developed anatomy education software programs that include interactive 3-dimensional (3D) computer models of the body's structures (Sugand et al., 2010). Three dimensional modelling is the process of acquiring measurements from a real object in three dimensions (i.e. length, width, and height) and using that data to produce a computer graphic of the object.  A true 3D virtual model exhibits interactivity such that the user can manipulate the model to change his or her vantage point of the model (Redmondino and El-Hakim, 2006).  3D anatomical computer models can be used in both online learning environments (Boyce, 2012; Brenton et al., 2007; Durham et al., 2009) or in F2F environments (Wright, 2012).  It has been suggested that 3D models used in conjunction with a dissection experience can increase learning of anatomy (Petersson et al., 2009), but it is unknown if the

exclusive use of 3D computer models will enhance learning in a fully online course.

## 2.4     Online Anatomy Courses

There are a number of fully online undergraduate courses in anatomy that can be found on the websites of other institutions (CVU-UVC, 2014; Education Portal, 2014); however, very few have documented their approach to online teaching in the literature.  Boudinot and Martin (2001) describe an online gross anatomy laboratory course for undergraduate pharmacy students at the University of Georgia.  Online slideshows were provided to the students using ADAM Interactive software where students could advance through anatomical illustrations accompanied by text.  Students could interact with the images by adding or removing labels for each structure.  Limpach et al. (2008) also used a slideshow approach for online anatomy students in a doctor of pharmacy program at Creighton University.  Power Point files were provided to students on the course website with accompanying audio recording of the instructor giving the same lecture to F2F students.  Data analysis over a 3 year period revealed no significant differences between final grades of the online and face-to-face students.

## 2.5     Evaluation of Computer Assisted Learning in Anatomy

Numerous short term studies have shown that computer assisted learning (CAL) has been beneficial to anatomy students; however, there is a need for research assessing CAL over longer time periods (Tam et al., 2009).  More recent research describes outcomes from F2F anatomy courses that incorporated online CAL in the form of discussion forums (Durham, et al., 2009; Choudhury and Gouldsborough, 2012; Green and Hughes 2013; Green et al., 2014), chat (instant messaging) rooms (Choudhury and Gouldsborough, 2012), anatomy e-

learning modules (Green et al., 2006; Raynor and Igguldent, 2008), anatomical illustrations (Durham et al., 2009), interactive photographs (O'Byrne et al., 2008; Doubleday et al., 2011), and 3D computer models (Durham et al., 2009; Wright, 2012).

Many of these studies, as well as studies on fully online anatomy courses (Boudinot and Martin, 2001; Limpach et al., 2008) have explored the relationship between online CAL and test scores.  The effect of CAL use on grades has been studied between groups that used the same resource but at different frequencies (Boudinot and Martin, 2001; Green and Hughes, 2013; Green et al., 2014), between  groups that used different CAL resources (Doubleday et al., 2011), between groups that participated in CAL and those that did not (Limpach et al., 2006; O'Byrne et al., 2008), and by assessing performance of an entire user group after the implementation of CAL (Green et al., 2006; Wright, 2012).

Student perceptions of the learning experience have been assessed in studies using surveys.  Methods for collecting student feedback included students' responses to statements on Likert-type scales for agreement (Boudinot and Martin, 2001; Green at al., 2006; Limpach et al., 2008; O'Byrne et al., 2008; Durham et al., 2009; Choudhury and Gouldsborough, 2012; Wright, 2012), on nominal scales for given criteria (Doubleday et al., 2011) and open ended questions (O'Byrne et al., 2008; Wright, 2012).  A less common method for data collection was the analysis of student interview transcripts for recurring themes (Durham et al., 2009).

## 2.6　　Literature Cited

AUCC. 2011. Association of Universities and Colleges of Canada. Trends in Higher Education: Volume1 – Enrolment.  Ottawa, ON: The Association of Universities and Colleges of Canada. 70 p.

Azer SA, Eizenberg N. 2007. Do we need dissection in an integrated problem-based learning medical course? Perceptions of first- and second-year students. Surg. Radiol. Anat. 29: 173-180.

Aziz MA, Mckenzie JC, Wilson JS, Cowie RJ, Ayeni SA, Dunn BK. 2002. The human cadaver in the age of biomedical informatics. The Anat Rec (New Anat.) 269: 20-32.

Bernard RM, Abrami PC, Lou Y, Borokhovski E, Wade A, Wozney L, Wallet PA, Fiset M, Huang B. 2004. How does distance education compare with classroom instruction?  A meta-analysis of the empirical literature. Rev. of Educ.Res. 74:379-439.

Bernard RM, Abrami PC, Borokhovski E, Wade CA, Tamim RM, Surkes MA, Bethel EC. 2009. A meta-analysis of three types of interaction treatments in distance education. Rev. of Educ. Res. 79:1243-1289.

Boudinot SG, Martin BC. 2001. Online anatomy lab (OAL): A self-regulated approach to the instruction of human anatomy. Interact Multimedia Electron J Comput Enhanc Learn 3:1.

Boyce N. 2012. A new dimension for medical education. Lancet 380:1547.

Bates AW.  2005. Technology, e-learning and distance education. 2nd Edition. New York, NY: Routledge. 246p.

Brenton H, Hernandez J, Bello F, Strutton P, Purkayastha S, Firth T, Darzi A. 2007. Using multimedia and Web3D to enhance anatomy teaching. Comput Educ 49:32–53.

Collins J. 2008. Modern approaches to teaching and learning anatomy. Brit. Med. J. 337:665-667.

Choudhury B, Gouldsborough I. 2012. The use of electronic media to develop transferable skills in science students studying anatomy. Anat Sci Educ 5:125–131.

Durham JA, Brettell S, Summerside C, McHanwell S. 2009. Evaluation of a virtual anatomy course for clinical undergraduates. Eur J Dent Educ 13:100–109.

Doubleday EG, O'Loughlin VD, Doubleday AF. 2011. The virtual anatomy laboratory: usability testing to improve an online learning resource for anatomy education. Anat Sci Educ 4:318–326.

Drake RL, McBride JM, Lachman N, Pawlina W. 2009. Medical education in the anatomical sciences: The winds of change continue to blow. Anat. Sci. Educ. 2:253-259.

Dyer GSM, Thorndike MEL. 2000. Quidne mortui vivos docent? The evolving purpose of human dissection in medical education. Acad. Med. 74: 969-979.

Education Portal. 2014. Online anatomy course overviews with school options. Remilon, LLC, Mountain View, CA. URL: http://education-portal.com/online_anatomy_course.html [accessed 07 March 2015].

Gaitskell-Phillips G, Short N, Stanikova B. 2012. Taking veterinary anatomy online. Altern Lab Anim 40:P24–P25.

Green RA, Farchione D, Hughes DL, Chan SP. 2014. Participation in asynchronous online discussion forums does improve student learning of gross anatomy. Anat Sci Educ 7:71–76.

Green RA, Hughes DL. 2013. Student outcomes associated with use of asynchronous online discussion forums in gross anatomy teaching. Anat Sci Educ 6:101–106.

Green SM, Weaver M, Voegeli D, Fitzsimmons D, Knowles J, Harrison M, Shephard K. 2006. The development and evaluation of the use of a virtual learning environment (Blackboard 5) to support the learning of pre-qualifying nursing students undertaking a human anatomy and physiology module. Nurse Educ Today 26:388–395.

Gunderman RB, Wilson PK. 2005. Exploring the human interior: The roles of cadaver dissection and radiologic imaging in teaching anatomy. Acad. Med. 80: 745-749.

Harasim L. 2000. Shift happens. Online education as a new paradigm in learning. Internet and Higher Ed. 3: 41-61.

Heylings DJA. 2002. Anatomy 1999-2000: The curriculum, who teaches it, and how? Med. Educ. 36: 702-710.

Kaufman DM. 1989. Third generation course design in distance education. In Sweet R (Editor). Post-secondary distance education in Canada. Policies, practices, and priorities. Athabasca, AB: Athabasca University, p. 65 – 82.

Larreamendy-Joerns J, Leinhardt G. 2006. Going the distance with online education. Rev. of Educ. Res. 76:567-605.

Limpach AL, Bazrafshan P, Turner PD, Monaghan MS. 2008. Effectiveness of human anatomy education for pharmacy students via the Internet. Am J Pharm Educ 72:145.

Lou Y, Bernard RM, Abrami PC. Media and pedagogy in undergraduate distance education: a theory-based meta-analysis of empirical literature. Educ. Tech. Res. & Dev. 54:141-176.

Marks SC. 2000. The role of three-dimensional information in health care and medical education: the implications for anatomy and dissection. Clin. Anat. 13:448-452.

Mayer RE. 2010. Applying the science of learning to medical education. Med. Educ. 44:543-549.

Mayer R, Moreno R. 2003. Nine ways to reduce cognitive load in multimedia leanring. Educ. Psych. 38: 43-52.

McLachlan JC, Bligh J, Bradley P, Searle J. 2004. Teaching anatomy without cadavers. Med. Educ. 38: 418-424.

McLachlan JC, Patten D. 2006. Anatomy teaching: ghosts of the past, present, and future. Med. Educ. 40:243-253.

Moore KL, Dalley AF, Agur AMR. 2014. Clinically Oriented Anatomy. 7th Edition. Baltimore, MD: Lippincott Williams & Wilkins. 1134p.

Moore MG. 1989. Three types of interactions. Am. J. of Dist. Educ. 3: 1-7.

Moore MG. 1993. Theory of transactional distance. In: Keegan D (Editor). Theoretical principles of distance education. New York, NY: Routledge. p. 22-38.

Moore MG, Kearsley G. 2012. Distance education: A systems view of online learning. 3rd Edition. Belmont, CA: Wadsworth, Cengage Learning. 384 p.

O'Byrne PJ, Patry A, Carnegie JA. 2008. The development of interactive online learning tools for the study of anatomy. Med Teach 30:e260–e271.

Persaud TVN. 1984. The early history of anatomy: From antiquity to the beginning of the modern era. Springfield IL: Thomas Books. 357p.

Petersson H, Sinkvist D, Wang C, Smedby O. 2009. Web-based interactive 3D visualization as a tool for improved anatomy learning. Anat Sci Educ 2:61–68.

Raynor M, Iggulden H. 2008. Online anatomy and physiology: Piloting the use of an anatomy and physiology e-book-VLE hybrid in pre-registration and post-qualifying nursing programmes at the University of Salford. Health Info Libr J 25:98–105.

Redmondino F, El-Hakim S. 2006. Image-based 3D modelling: A review. Photogramm Rec 21:269–291.

Shaffer K. 2004. Teaching anatomy in the digital world. NEJM 351:1279-1281.

Simonson M., Schlosser C, Orellana A. 2011. Distance education research: A review of the literature. J Comput Higher Educ 23:124–142.

Spitzer V, Ackerman MJ, Scherzinger AL, Whitlock D. 1996. The visible human male: A technical report. J Am Med Inform Assoc 3:118–130.

Sugand K, Abramams P, Khurana A. 2010. The anatomy of anatom: A review for its modernization. Anat. Sci. Educ. 3:83-93.

Sumner J. 2000. Serving the system: a critical history of distance education.

Tam MDBS, Hart AR, Williams S, Heylings D, Leinster S. 2009.  Is learning anatomy facilitated by computer-aided learning? A review of the literature. Med Teach 31: e393-e396.

Trelease RB. 2002. Anatomical informatics: Millennial perspectives on a newer frontier. The Anat. Rec. 269: 224-235.

Trelease RB. 2015. Essential e-learning and m-learning methods for teaching anatomy. . In: Chan KL, Pawlina W (Eds). Teaching Anatomy. A practical guide. Cham, Switzerland: Springer International Publishing, p. 247 – 258.

Wright SJ. 2012. Student perceptions of an upper level undergraduate human anatomy laboratory course without cadavers. Anat. Sci. Educ. 5: 146-157

## Chapter 3

## 3  Design and Implementation of an Online Systemic Human Anatomy Course with Laboratory

This chapter describes the rationale behind the development of the online course, its design and implementation, preliminary student grade outcomes, and challenges during the inaugural year.

### 3.1  Rationale for the Development of an Interactive Online Course

Due to the high level of detail taught during Systemic Human Anatomy lectures and the interactive nature of the laboratory sessions, offering a quality online version of the course that optimized Moore's (1989) three types of interactivity could only be accomplished using collaborative teaching software and 3D anatomical computer models.  Collaborative teaching software (specialized videoconferencing software) is an internet-based application that combines live screen casting with videoconferencing for synchronous or asynchronous meetings.  The software can simultaneously transmit three channels from a F2F classroom: audio, video, and a display of visual teaching materials (e.g. Power Point slides, white board, a user's computer desktop, web pages) with the teacher's annotations to these materials.  Individuals logged into the software are able to communicate with other participants using voice or text chatting, which can increase student-instructor and student-student interactions.

There is a risk of 3D models themselves being of little educational value if they are not used in an optimal educational environment (Brenton et al., 2007).  Since each online student would have his/her own set of 3D computer models and it was assumed that many students would be working alone, it was crucial that the laboratory instructor facilitate student-content interactions.  By using collaborating teaching software to deliver live laboratory demonstrations, the laboratory

instructor could show students how to manipulate the 3D models and how to identify structures pertaining to that week's laboratory.

None of the online anatomy courses reported in the literature and found on university websites describe combining collaborative software with virtual 3D anatomical models to offer anatomy lectures and laboratories. Here we report on the development of a fully online undergraduate systemic human anatomy course with a live, interactive laboratory utilizing selected 3D anatomical software suitable for such a course.

## 3.2   Delivery of Online Lectures

Lectures for F2F students were transmitted to online students using Blackboard Collaborate 12 (Blackboard Inc., Washington, DC), which was supported by the Instructional Technology Resource Centre (ITRC) at Western University. The audio/video equipment required for simultaneous delivery of the F2F lectures to online students using collaborative software has been described by Barbeau et al. (2013). The voice of the instructor, a video of the instructor's movements, the instructor's Power Point slides, and the instructor's annotations to the slides were broadcast from the F2F classroom to the online students (Figure 1).   A teaching assistant in the F2F audience integrated the online students into the F2F classroom using Blackboard Collaborate's instant messenger. The teaching assistant answered their questions directly using the text feature or passed their live questions to the instructor as needed. To accommodate students with scheduling conflicts, archives of the lectures in Blackboard Collaborate format were made available exclusively to the online students through the course website (Sakai Collaboration and Learning Environment 2.9, The Sakai Foundation, http://www.sakaiproject.org). Students who viewed the lectures asynchronously communicated primarily with their teaching assistant via email and the forum on the course website. The online students were able to attend the face-to-face teaching assistant office hours.
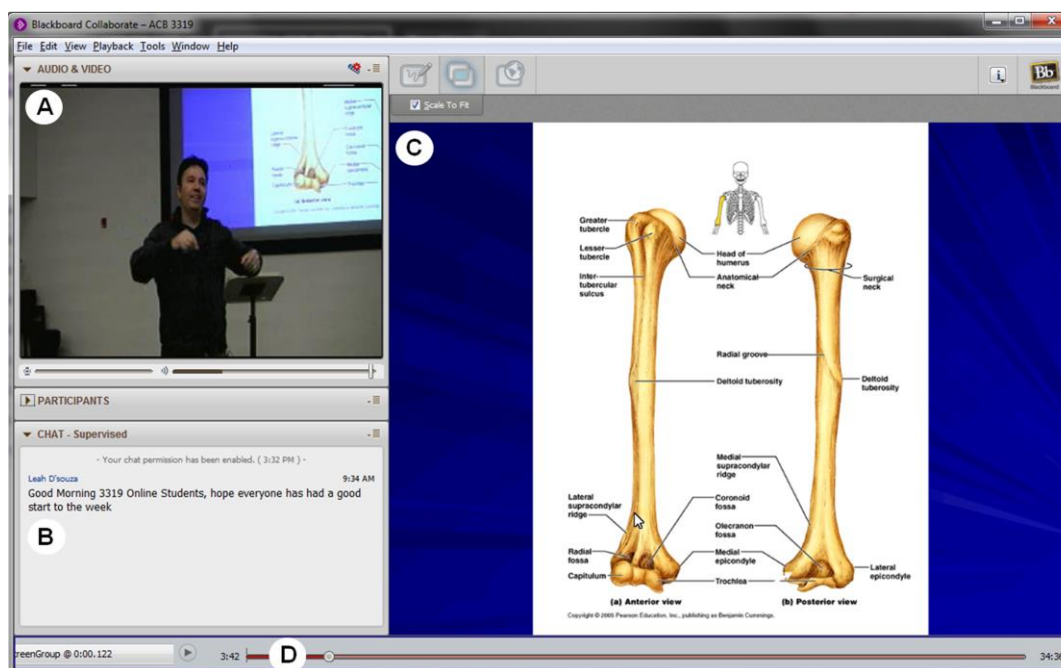
Figure 1. A screen capture of an online lecture archived in Blackboard Collaborate. The video panel (A) shows a real time video feed of the instructor. The chat panel (B) shows text exchanges between participants that occurred during the live session.   The content area (C) displays the instructor's Power Point presentation and the instructor's annotations on the slides.  The navigation bar (D) is used to fast forward, rewind, or pause the recording.  Sample textbook image from Marieb, Elaine N., Mallatt, Jon B., Wilhem, Patricia B.; Human Anatomy, 4th Edition, VC 2005, p.181. Reprinted by permission of Pearson Education, Inc., Upper Saddle River, NJ; (Marieb et al., 2005).

## 3.3 Development of Online Laboratories

### 3.3.1 Delivery of Online Laboratories

Blackboard Collaborate (BBC) was also used to facilitate online laboratory demonstrations. Teaching assistants used electronic versions of diagrams and videos from the F2F laboratory to present in BBC. To accommodate the portion of the laboratory where specimens are used, a teaching assistant manipulated commercially available 3D virtual anatomical models via application sharing within BBC (Figure 2). Each online student had access to the same 3D virtual models, which allowed them to manipulate (rotate, pan, zoom, label, remove structures) these images on their own computers, in addition to viewing the teaching assistant's screen. The teaching assistant remained online in Blackboard Collaborate for the remainder of the session to engage in live chat and application sharing with the students at their request. The total duration of the sessions is 1.5 hours. While the F2F students' laboratory sessions are 1 hour long, the duration of the online sessions was increased to allow for extra time to use Blackboard Collaborate (i.e., setting up application sharing, text chat, voice chat). Live attendance at laboratory was not mandatory and unlimited access to the archived demonstrations in BBC was made available through the Sakai course website. Face-to-face students were not given access to archived laboratory material or the 3D virtual models.
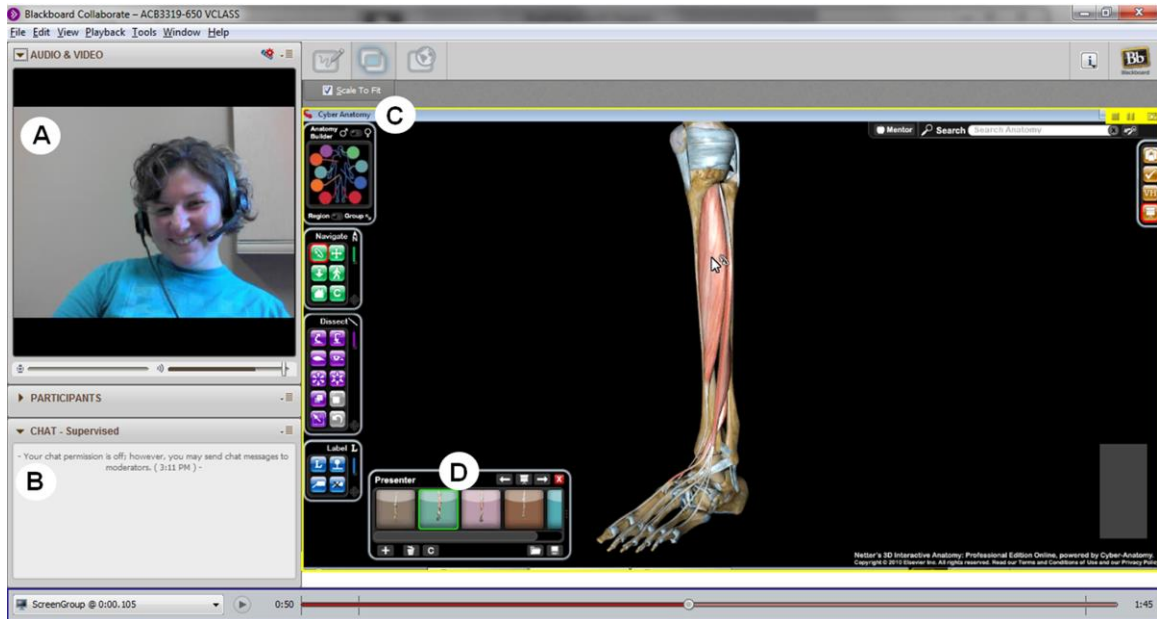
**Figure 2. A screen capture of an online laboratory demonstration archived in Blackboard Collaborate.  The video panel (A) shows a real time video feed of the instructor.  The chat panel (B) shows text chatting between participants that occurred during the live session.  The content area (C) was used as an application share.  The live manipulation of a 3D model in Netter's 3D Interactive Anatomy (outlined in yellow) was broadcast from the instructor's desktop to the participants' computers.  (D) Prepared dissections used during the lesson.**

Blackboard Collaborate and the 3D virtual models were made available to students in an on-campus computer laboratory (36 desktop PC computers) in the event that they did not own a computer that met the system requirements (Windows XP or higher; Mac OS 10.5 or higher) and/or have their own access to the internet.  Online students did not have access to the prosections and models used in the F2F laboratory at any time; however, they were allowed to attend the F2F office hours with a teaching assistant.

## 3.3.2    Commercial Anatomy Software Evaluation

Virtual (computer) models of the body's structures were required for online teaching assistants and students to manipulate during laboratory sessions.  A commercial anatomical software package was sought that would allow teaching assistants and students to use the virtual specimens in a manner similar to the F2F laboratory.  In the same way that prosections are prepared to teach in the F2F laboratory, laboratory instructors needed the ability to customize the virtual models in advance to show structures pertinent to a specific laboratory topic.  It was crucial that the software allowed for saving and distributing the instructor's customized models through the internet to allow each online student to interact with the same virtual models on their own computers.  The software needed to grant the user control of his or her vantage point by rotating the specimen around an unrestricted number of axes.  The structures needed to be anatomically accurate and comprehensive enough to cover topics of the course.   Recognizing that some online students may need to complete laboratory activities outside of the live time without the teaching assistant, the program needed to have an optional, detailed labelling function to guide the user in identifying structures. The program's menu needed to be presented in a simple manner so that users could easily search for, manipulate, and modify structures as desired.   Since a system's approach is taken to teach the course, the program needed to allow users to display structures by system in addition to body region.

Ten commercial anatomy educational software programs were trialed and compared by the authors over an eight month period using a Lenovo Thinkpad T520 laptop (Windows 7 64-bit, Intel Core i5 processor, 4 GB RAM, Intel 3000 graphics engine). The suitability of each software program for use in the online systemic human anatomy course was assessed on the basis of 5 categories (Table 1).  The programs were rated out of 2 for each category and a total score was calculated by adding each categorical score (Table 2).

**Table 1. Evaluation criteria used to assess the suitability of commercial anatomy software.**

| Category | Evaluated Criteria |
| --- | --- |
| 1. Quality of virtual models | Resolution and visual clarity of the models<br>Comprehensiveness of anatomical structures and labels<br>Inclusion of cross sectional anatomy |
| 2. Volumetric data | Data used to create models (Visible Human Project, cadaver, other) |
| 3. Manipulation of virtual models | Ability to virtually dissect (remove specific structures)<br>Ability to rotate the models<br>Number or rotational axes<br>Ability to view the specimen from different vantage points<br>Number of vantage points<br>Rendering speed during manipulation of the model |
| 4. Program functionality | Ease of use of the menu and tools<br>Ability to create, save, and share dissections<br>Search function/querying for structures<br>Ability to sort structures by system and/or body region |
| 5. Cost | Licensing/user fee (*yes or no*) |

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**Table 2. Assessment of commercial anatomy software packages.**

| Software/ Publisher | Quality of Models (/2) | Volumetric Data (/2) | Manipulation of Models (/2) | Program Functionality (/2) | Total Score (/8) | Cost |
|---|---|---|---|---|---|---|
| Netter's 3D Interactive Anatomy (Elsevier Inc.) | 1 | 2 | 2 | 2 | 7 | $ |
| BioTK (Numerica Ltda.) | 1 | 1 | 2 | 2 | 6 | $ |
| Cyber Anatomy (Cyber Anatomy Corp.) | 1 | 2 | 2 | 1 | 6 | |
| Visible Body (Argosy Publishing Inc.) | 1 | 2 | 2 | 1 | 6 | $ |
| Acland's Anatomy (Wolters Kluwer Health) | 0 | 2 | 0 | 0 | 2 | $ |
| Anatomy & Physiology Revealed (McGraw-Hill Education) | 1 | 2 | 1 | 1 | 5 | $ |
| Anatomy.TV (Primal Pictures Ltd.) | 1 | 2 | 1 | 1 | 5 | Free |
| VH Dissector Pro (Touch of Life Technologies) | 1 | 1 | 2 | 0 | 4 | $ |
| Zygote Body (Zygote Media Group, Inc.) | 1 | 1 | 2 | 0 | 4 | Free |
| A.D.A.M. Interactive Anatomy (Ebix, Inc.) | 1 | 0 | 1 | 0 | 2 | $ |

Scale: 0 = program did not meet criteria in the category and was not suitable for use in the course; 1 = program met many criteria in the category but was not ideal for use; 2 = program met most or all of the criteria in the category and was suitable for use. $ = associated fee; Free = no cost to the department.

Netter's 3D Interactive Anatomy (Netter, 2012) received the highest total score (7) and was chosen for use in the online laboratories for several reasons.  The tools (for navigating, dissecting, building and labelling the models) were found to be well organized in the menu and their use was intuitive.  The models had a high enough resolution to allow structures to remain clear when magnified to fill the size of a 17" computer monitor. The models had unlimited axes of rotation, allowing the user to view a structure from any vantage point.  After a given model was loaded, the rendering speed was such that there was a smooth transition when the user rotated or modified the model with the dissection tools. The complete model of the whole body included over 7000 structures and anatomical landmarks.  The ability to create customized models and share them with other users was possible when using the local downloaded instructor version of Netter's 3D Interactive Anatomy (Microsoft Windows 2000 OS or later required). The models could be customized (e.g. through dissection, magnification, rotation, addition of labels) and saved in a specialized file format (*.cap).  The *.cap file could be opened and the customized models could be recovered by any other user with the instructor version of the software.  A teaching assistant spent approximately 0.5-1 hour per laboratory to prepare *.cap files (virtual prosections) to use during the demonstration.  The instructor version of Netter's 3D did not run with McIntosh operating systems or support the use of *.cap files; however, a web-based student version of the software could be accessed by McIntosh users (Mac OS 10.3.9 – 10.7 required).

Each online student was given a personal login to the instructor version of the program that could be used to access the web-based version of the software or download a desktop application to their own Windows based computer.

The display area in Netter's 3D Interactive Anatomy for the models is a plain black background and can be cleared of the software's other tools. This optimizes the speed of application sharing in BBC as there are less visual details that need to be transmitted from the instructor's desktop to the central server and

on to the students.  The models for Netter's 3D Interactive Anatomy were developed by Cyber Anatomy Corp.  Their own product, Cyber Anatomy (Cyber-Anatomy, 2009), which was almost identical to Netter's 3D Interactive Anatomy had a slightly different color palette used to shade the models and a graded background which significantly slowed the speed of application sharing in BBC.

BioTK (VirtualbioTK, 2010) and VH Dissector Pro (VH Dissector Pro, 2012) also allowed the user to create, save, and share custom dissections.  Virtual models were created for these programs using volumetric data from the visible human project (Spitzer et al., 1996).  However, the cadaver for the visible human project was not preserved in the anatomical position. The arms were internally rotated, the elbows were flexed, and the forearms in a mid-pronated position.  It was anticipated that this would cause our students difficulty in studying the upper limb from these models.  In addition, the models contained structures and labels that exceeded the scope of the course.  These software packages are better suited for use in clinically oriented anatomy courses.  Anatomy.TV (AnatomyTV, 2006) was also developed using visible human data, though the user cannot create customized models and export them from the program.  Visible Body's (Visible Body, 2012) menu, tools, and search function met our needs for the course; however, the user did not have the ability to save and share customized dissections.  Acland's Anatomy (Acland RD, 2013), Anatomy & Physiology Revealed (APR, 2012), and A.D.A.M. Interactive Anatomy (ADAM, 2012) contained little or no 3D computer models.  Acland's Anatomy and Anatomy & Physiology Revealed both featured expertly dissected cadavers with comprehensive and clear explanations of cadaveric anatomy.  Though these products did not meet our teaching needs, their tutorials may be helpful to students in dissection-based courses as a pre or post-lab activity.  Zygote Body (Zygote, 2012) did not meet the level of detail taught in our course and was likely developed for high school level courses.  This product contained several anatomical inaccuracies and labelling errors.

None of the programs, including Netter's 3D Interactive Anatomy, was found to have sufficient anatomical detail and visual clarity for the brainstem and internal structures of the cerebrum, brainstem, and cerebellum. Therefore, it was necessary to develop additional teaching materials for the central nervous system (CNS) in house.

### 3.3.3 Development of the Self-Directed Neuroanatomy Laboratory Website

Supplementary online materials for the central nervous system were developed for use in conjunction with Netter's 3D Interactive Anatomy (Netter, 2012). In the F2F laboratories for the CNS, students handle plastinated specimens of the brain and spinal cord. Interactive images of these specimens, fully rotatable through 360° were created working with Western University's Instructional Technology Resource Centre. Photographs of the plastinates were taken using a Canon EOS 7D camera (Canon U.S.A Inc., Lake Success, NY) with a Canon EF 70-200mm f2.8/L IS II USM telephoto lens (Canon U.S.A Inc., Lake Success, NY) set at 100mm and F16 to maximize the depth of focus. To secure each specimen in the desired position for photography, customized stands were created from wooden pegs rooted in perforated hardboard. To blend the stand with a black photography background, black, flat velvet was used to cover the hardboard and the pegs were spray-painted black. The specimen and its stand were fixed on a graded turntable which was rotated such that the specimen was photographed at each 5° increment, resulting in 72 photographs per specimen. The time per specimen to create a custom stand and take photographs was approximately 2 hours. Ajax Zoom (Custom Web Solutions, Inh., Essen, Germany) was used to stitch together each series of photographs allowing the user to rotate the specimen 360°, pan, and zoom up to 100% of the original photograph size. Images were originally photographed at 17 megapixels, and reduced to 6 megapixels for the purpose of integration into Ajax Zoom using Adobe Photoshop CS1 (Adobe Systems Inc., San Jose, CA). An open website, the Self Directed Neuroanatomy Laboratory (SDNL, 2012) through which

students can access the specimens contains thumbnail links to the 360° images
(Figure 3A).  Each thumbnail is accompanied by a description of the initial
anatomical view and plane of cut.  When a specimen is opened in Ajax Zoom,
the user can rotate the image about a vertical axis through a full 360°, pan, and
zoom up to 100% of the original photo size (Figure 3B).
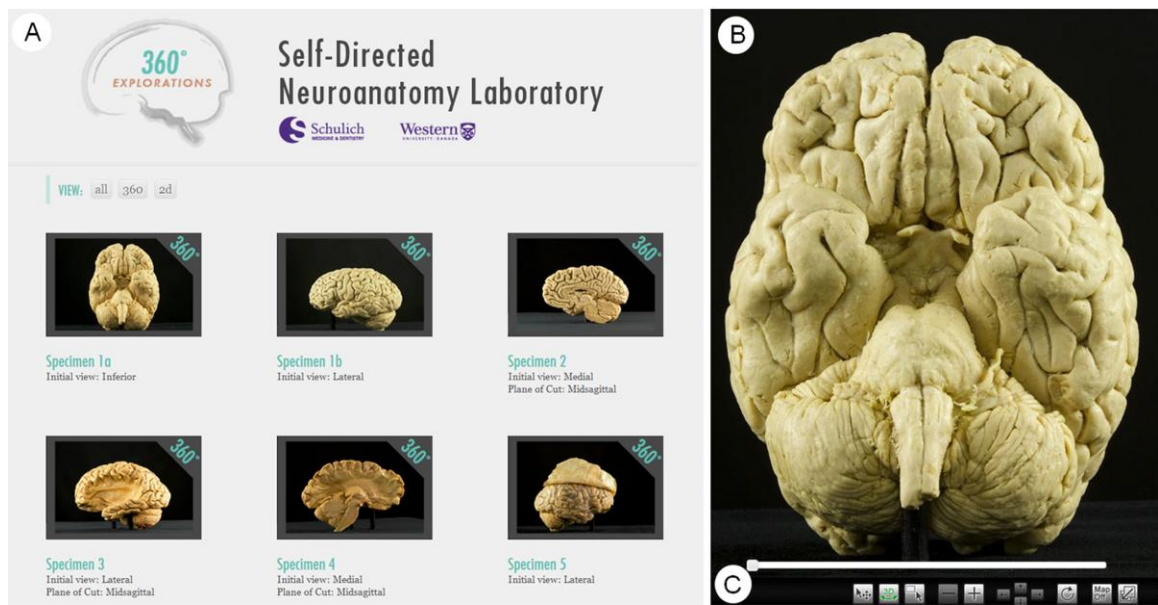
**Figure 3. Screen captures of the Self Directed Neuroanatomy Laboratory website. (A) The homepage displays thumbnail links to the rotatable images. (B) Specimen 1a is shown in the Ajax Zoom interface. (C) Controls for magnification and rotation.**

### 3.3.4　Assessment of Online Students

Online students write their quarterly term tests in person at a supervised examination centre while laboratory based quizzes were completed online in the Sakai course website.  The quizzes became available at the end of the laboratory session and students were required to complete them by the following morning.  This time period accommodated students who were unable to attend the laboratory demonstration live.  To decrease the likelihood of students sharing quiz questions and plausible answers, different versions of each quiz were developed.  For each of the 10 questions, 2-5 alternative questions were created of the same question type, level of difficulty, and topic.  The Sakai course website generated a unique quiz for each student by drawing randomly 1 question from each question pool.

### 3.3.5　Preliminary Outcomes

Analysis of student grades was approved by the Office of Research Ethics at Western University Canada (REB# 102631) (Appendix 1)

Students self-selected either the F2F or online section of the course.  Of the 365 F2F students, 282 (77%) were registered in the third year of their degree program and 83 (23%) were in their fourth year.  Of the 40 online students, 16 (40%) were registered in the third year of their degree program and 24 (60%) were in their fourth year.

Incoming grade averages for each student were calculated using previous grades in 6 second year level required courses (cell biology, biochemistry, genetics, organic chemistry, scientific methods, and statistics) for the Bachelor of Medical Sciences program.  The mean incoming grade average for the online students was 81.9% (SD = 7.5%), which was significantly higher (independent samples T-test, $p = 0.02$) than the F2F students at 78.5% (SD = 8.9%).

Assessments of student performance were compared between the sections for the 2012-2013 cohort (Table 3).   One statistically significant difference was found between the sections on Test 3 (Mann-Whitney U test, $p = 0.024$) with a mean of 86.4% (SD = 12.6%) for F2F students and 82.9% (SD = 13.0) for online students; however, there was no difference in final grades between the sections. There was a strong, positive correlation (Pearson) between incoming grade average and final anatomy grade in both sections of the course (Figure 4), with students performing at a level that could be accurately predicted from their prior academic performance.

**Table 3. Comparison of 2012-13 student performance measures between the sections.**

| Performance measure | Face-to-face (N = 365) Mean grade (%) ± SD | Online (N = 40) Mean grade (%) ± SD | p-value |
|---|---|---|---|
| Test 1 | 80.03 ± 9.60 | 82.91 ± 8.56 | 0.052 |
| Test 2 | 82.03 ± 12.27 | 81.71 ± 13.41 | 0.863 |
| Test 3 | 86.43 ± 12.62 | 82.91 ± 13.00 | 0.024[a] |
| Test 4 | 82.89 ± 11.58 | 83.50 ± 9.53 | 0.914 |
| Lab Quizzes (24) | 79.43 ± 14.01 | 78.88 ± 10.52 | 0.167 |
| Final Grade | 82.70 ± 9.71 | 82.33 ± 9.75 | 0.689 |

**[a]The face-to-face students scored significantly higher (Mann-Whitney U test) on Test 3 compared to the online students.**
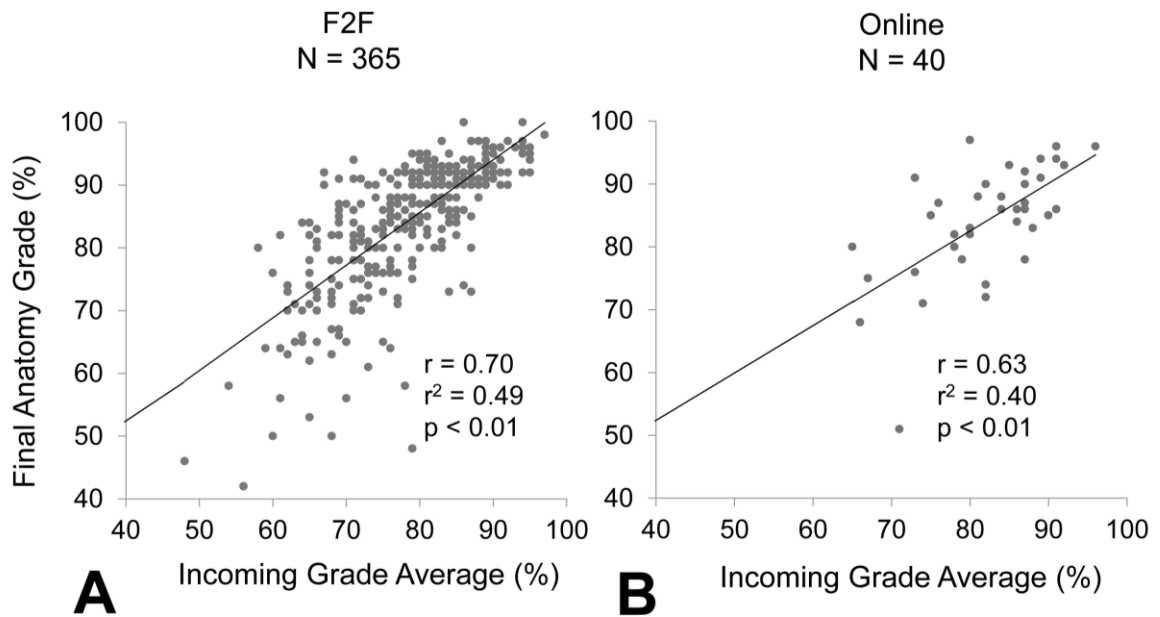
**Figure 4. Correlation between incoming grade average and final anatomy grades for 2012-13. There were strong, positive correlations (Pearson) between incoming grade and final course grade in both the F2F (A) and online (B) sections.**

### 3.3.6    Cost

The one time start-up cost for Systemic Human Anatomy online was $2048 CAD. This included the laptop computer and HD camera and with their accessories ($1747 CAD) for capturing F2F lectures and a standard Ajax Zoom license ($301 CAD) for creating the rotatable brain images in the 360anatomy website. Licensing fees for Blackboard Collaborate ($3 CAD/student) and Netter's 3D Interactive Anatomy ($80 CAD/student) are determined on an institutional basis and paid annually.

## 3.4    Discussion

### 3.4.1    Implementation Challenges

In this paper we describe the first implementation of a fully online undergraduate anatomy course with a laboratory using collaborative teaching software and 3D anatomical computer models.  Pedagogical and technical challenges arose in the inaugural year of the course but were easily resolved.  The live broadcasting of lectures to online students failed on only four occasions due to an inability to stay connected to BBC.  At these times, issues with internet connectivity were experienced campus wide and beyond the control of the researchers.  The lectures to F2F students continued and the professor re-recorded the lesson for online students from his/her office using the course laptop and BBC.

While the ability to annotate slides was considered an asset of using BBC for teaching, during lectures it required the professor to remain stationary at the laptop to use the mouse.  Some of the professors preferred to walk around the lecture theatre and wanted to be able to advance slides and point to structures on the slides from any location.  It was not possible for them to use a conventional laser pointer because the laser's movement on the slides could not be broadcasted to online students.  An Air Mouse GO Plus, GYM1100NA

(Gyration, Camarillo, CA), which is wireless and can be controlled without resting on a surface, was purchased ($99 USD) at the midpoint of the course. Some lecturers used this tool to advance slides and point to structures using the mouse cursor, which could be seen by online students. Use of the air mouse required Power Point to be opened directly on the computer (as opposed to loaded into BBC) and the desktop shared with online students (as an "application share" in BBC).

Blackboard Collaborate uses Java (Oracle Corporation, Redwood City, CA) programming language. Blackboard Inc. needed time to adjust BBC as each Java update was released. Students who ran Java updates before BBC had been updated reported an inability to launch BBC. They were able to resolve the issue by reinstalling the previous version of Java; however, in some cases this meant that Java was not compatible with other software programs on their computers.

## 3.4.2 Student Performance Outcomes

It has been shown that computer assisted instruction in the health sciences can be as effective as its traditional counterparts (Cook et al., 2008). Our data support this view, as overall student performance in anatomy was not dependent on course delivery format. Instead, final anatomy grades were predicted by previous academic performance. While real student performance outcomes have been reported in other studies of online courses and learning tools (Boudinot and Martin, 2001; Green and Hughes, 2013; Green et al., 2014; Limpach et al., 2008; O'Byrne et al., 2008) correlations with incoming grades were not explored. It is therefore unknown if this predictor of success as seen in our course would be applicable when implementing other instructional interventions. When comparing individual measures of assessment, only one significant difference was found, with the F2F students scoring higher on the third quarterly test (covering the musculoskeletal and cardiovascular systems). This test may have required more study preparation than the other three tests as

students needed to recall origins, insertions, and actions of the muscular system. Alternatively, knowing that they had unlimited access to lecture archives and having become comfortable with the online format of the course, the online students may have delayed watching the recordings and had less time to study. Despite the difference in Test 3 scores between the sections, this did not translate into a difference in final course grades.

### 3.4.3    Use of Archived Material

Access to lecture and laboratory recordings was requested frequently of the course coordinator by students registered in the F2F course.  Most of these students wished to attend their regular F2F lectures and laboratories and have access to archives as supplementary resources, however, access to the recordings was not granted in order to segregate the sections for this study. However, in extenuating circumstances it was convenient to be able to give access to individual F2F students requiring an academic accommodation (i.e., prolonged illness).  Some of the teaching assistants reported that F2F students often studied with their peers in the online section to watch recorded material together.  It is unknown how frequently this occurred.  The popularity of archived lessons is likely due to convenience factors noted in other studies, such as the ability to access a lesson from any  location, at any time of day, and as many times as desired (Nieder and Borges, 2012).  Although new lectures and laboratories will be recorded in future years of the course, in the event that a lecture or laboratory must be cancelled, these initial archives can be released to F2F and online students as a backup (i.e., in  the event of instructor illness or BBC failure to capture the lecture).

### 3.4.4    Teaching Anatomy without Cadaveric Specimens

The fully online anatomy courses described in the literature (Boudinot and Martin, 2001; Limpach et al., 2008) were developed based on traditional courses that did not have a cadaveric laboratory component.  In our traditional face-to-face course from which the online course was developed, students handled prosected

materials during the laboratory demonstration.  Hands-on learning experiences facilitate a student's ability to visualize the body's structures in three dimensions (Heylings 2002).  Furthermore, working with cadaveric specimens exposes the students to anatomical variability and anatomic pathologies. The prosection laboratory experience was replaced in our online laboratories with 3D computer models.  Although this did not give students a hands-on experience, using 3D computer models is of pedagogical value.  Each online student was given a personal license for the 3D models allowing them to explore the anatomy for as long as desired from any location and at any time. This is in contrast to the F2F students who were limited to 1 hour per week with the specimens.  In addition, the computer models allowed students to view spatial relationships from an unlimited number vantage points (Brenton et al., 2007).

As the majority of students registered in the course are in the Bachelor of Medical Sciences program, they will continue on into medicine, dentistry, and the allied health sciences, where they will complete cadaveric anatomy laboratories. The Systemic Human Anatomy laboratory demonstration, whether it be the F2F or online format, will provide our students with a solid foundation for the next level of anatomical studies.

### 3.4.5    Future Directions

Anatomy grades between the online and F2F students will be compared over a 2 year period.  Future qualitative studies will reveal student perceptions regarding their learning experience in both of the course delivery formats.

## 3.5   Conclusion

A fully online section was added to an existing undergraduate laboratory course in systemic human anatomy.  Lectures for face-to-face students were broadcasted to online students using Blackboard Collaborate.  For the laboratory component of the course, teaching assistants and students manipulated

commercially available virtual anatomical models (from Netter's 3D Interactive Anatomy) within Blackboard Collaborate.  This is the first description of a fully online undergraduate anatomy course with an interactive laboratory component where students and instructors manipulate computer models in a virtual classroom.

## 3.6     Literature Cited

Acland RD. 2013. Acland's Video Atlas of Human Anatomy. Wolters Kluwer Health/ Lippincott, William & Wilkins, Baltimore, MD. URL: www.aclandanatomy.com [accessed 24 March 2014].

ADAM. 2012. A.D.A.M. Interactive Anatomy. 2012. Ebix Inc., Atlanta, GA. URL: www.adameducation.com [accessed 24 March 2014].

AnatomyTV. 2006. Interactive Anatomy. Primal Pictures Ltd., London, UK. URL: www.anatomy.tv/  [accessed 24 March 2014].

APR. 2012. Anatomy & Physiology Revealed® 2.0.  McGraw-Hill Education, New York, NY. URL: www.mhhe.com/biosci2/anatomyrevealed/ [accessed 24 March 2014].

Barbeau ML, Johnson M, Gibson C, Rogers, KA. 2013. The development and assessment of an online microscopic anatomy laboratory course. Anat Sci Educ 6:246–256.

Boudinot SG, Martin BC. 2001. Online anatomy lab (OAL): A self-regulated approach to the instruction of human anatomy. Interact Multimedia Electron J Comput Enhanc Learn 3:1.

Brenton H, Hernandez J, Bello F, Strutton P, Purkayastha S, Firth T, Darzi A. 2007. Using multimedia and Web3D to enhance anatomy teaching. Comput Educ 49:32–53.

Cook DA, Levinson AJ, Garside S, Dupras DM, Erwin P, Montori VM. 2008. Internet-based learning in the health professions. A meta-analysis. J. of Am. Med. Assoc. 300: 1181-1196.

Cyber-Anatomy. 2009. Cyber-Anatomy Med™ system.  Cyber Anatomy Inc., Iowa City, IA: URL: www.cyber-anatomy.com [accessed 3 February 2014].

Doubleday EG, O'Loughlin VD, Doubleday AF. 2011. The virtual anatomy laboratory: usability

Green RA, Farchione D, Hughes DL, Chan SP. 2014. Participation in asynchronous online discussion forums does improve student learning of gross anatomy. Anat Sci Educ 7:71–76.

Green RA, Hughes DL. 2013. Student outcomes associated with use of asynchronous online discussion forums in gross anatomy teaching. Anat Sci Educ 6:101–106.

Heylings DJ. 2002. Anatomy 1999-2000: The curriculum, who teaches it and how? Med Educ 36:702–710.

Limpach AL, Bazrafshan P, Turner PD, Monaghan MS. 2008. Effectiveness of human anatomy education for pharmacy students via the Internet. Am J Pharm Educ 72:145.

Marieb EN, Wilhelm PB, Mallatt JB. 2005. Human Anatomy. 5th Ed. San Francisco, CA: Benjamin Cummings. 880 p.

Moore MG. 1989. Three types of interaction. Am J Distance Educ 3:1–6.

Nieder GL, Borges NJ. 2012. An eight-year study of online lecture use in a medical gross anatomy and embryology course. Anat Sci Educ 5:311–320.

Netter FH. 2012. Netter's 3D Interactive Anatomy. Elsevier Inc., Philadelphia, PA. URL: www.interactelsevier.com/netter [accessed 24 March 2014].

O'Byrne PJ, Patry A, Carnegie JA. 2008. The development of interactive online learning tools for the study of anatomy. Med Teach 30:e260–e271.

Primal Pictures. 2007. 3D Human Anatomy Software. Primal Pictures Limited, London, UK. URL: www.primalpictures.com/ [accessed 24 March 2014].

SDNL. 2012. Self-Directed Neuroanatomy Laboratory. Schulich School of Medicine and Denistry, Western University, London, Canada. URL: www.360anatomy.uwo.ca [accessed 8 May 2014].

Spitzer V, Ackerman MJ, Scherzinger AL, Whitlock D. 1996. The visible human male: A technical report. J Am Med Inform Assoc 3:118–130.

VH Dissector Pro. 2012. VH Dissector for Medical Education: Anatomy for Your Career. Touch of Life Technologies, Aurora, CO. URL: www.toltech.net/products/vh_dissector/ [accessed 24 March 2014].

VirtualbioTK. 2010.  VirtualbioTK® Fully interactive and Realistic 3D Anatomy Atlas. VirtualbioTK - Numérica Ltda, Bucaramanga, Colombia. URL: www.biotecavirtual. [accessed 24 March 2014].

Visible Body. 2012.  Human Anatomy Atlas.  Argosy Publishing Inc., Newton, MA. URL: www.visiblebody.com  [accessed 24 March 2014].

Zygote. 2012. Zygote Body. American Fork, UT: Zygote Media Group Inc. URL: http://zygotebody.com/ [accessed 24 March 2014].

# Chapter 4

# 4 Mixed Methods Student Evaluation

This chapter describes the assessment of student perceptions (through interviews and surveys) of learning anatomy in the online and F2F formats, the strengths and weaknesses of the online format during the inaugural year, and recommendations for future offerings of the online course.

## 4.1 Introduction

Student perceptions of online CAL have been collected using surveys (Boudinot and Martin, 2001; Green at al., 2006; Limpach et al., 2008; O'Byrne et al., 2008; Raynor and Igguldent, 2008; Durham et al., 2009; Doubleday et al. 2011; Choudhury, 2012; Wright et al., 2012). Student satisfaction studies are biased in that they are often designed to support the prejudices of the investigator, especially if the investigator is the teacher. It is essential to attempt to identify measurable outcomes, employing both qualitative and quantitative approaches and to have some means of comparison between different methods of instruction (McLachlan and Patten, 2006). Established survey items from these studies may not prove useful in accurately revealing student perceptions of online CAL at Western University because to our knowledge, this was the first online anatomy course where live/archived lectures and laboratories were facilitated using collaborative software and 3D computer models.

### 4.1.1 Mixed Methodology

Prior to developing their questionnaire about online anatomy tutorials, Durham et al. (2009) conducted interviews with a smaller sample of students. Recurrent themes that emerged from interview data were used to develop a Likert-style questionnaire which was distributed to a larger number of participants. This type of study design, where qualitative data collection and analysis preceded and informed the design of the quantitative methods, allowed them to ask questions

via survey that were most pertinent to their educational intervention. This form of exploratory sequential mixed methods research (Creswell, 2011) suited our needs in evaluating our novel online curriculum.

Johnson et al. (2007) defined mixed methods research as "the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches…for the broad purposes of breadth and depth of understanding and corroboration". More recent notions of mixed methods research specify that, in addition to the collection and analysis of quantitative and qualitative data, there must be integration between the approaches (Teddlie and Tashakkori, 2009). A strand is a component of the study (qualitative or quantitative) that encompasses the basic research process: stating a question, data collection, data analysis, and interpretation (Teddlie and Tashakkori, 2009). This study follows an exploratory sequential mixed methods design (Creswell, 2011), where the qualitative strand occurs first and is followed by the quantitative strand to build on the initial exploratory results. Student interviews (qualitative strand) were used to inform the design of student surveys (quantitative strand).

## 4.1.2    Objectives

This study was designed to:
  (1) Reveal student preferences for learning anatomy in the online or F2F format and identify factors driving the decision (qualitative).
  (2) Determine the most important deciding factors for student preference for the online and F2F formats when learning anatomy (quantitative).
  (3) Generate emergent theory on the strengths and weaknesses of the online format

## 4.2    Methods

The research protocol was approved by the Office of Research Ethics at Western University Canada (REB# 103359) (Appendix 2).

Participants were volunteers from the F2F section (308/365; 84.4% participation rate) and online section (22/40; 55% participation rate) of the 2012-13 academic year.  Qualitative data were collected through student interviews (22 online students, 38 F2F students) and quantitative data through surveys (270 F2F) following a cross-over exposing individuals to both course formats (Figure 5). Students participated in 2 lectures, 1 laboratory demonstration, and 1 quiz during their cross over week in place of their regular course activities.  In this study, qualitative data collection and analysis occurred prior to quantitative data collection. The results from the interviews were used as a guide to formulate more specific questions to be asked of the students via survey.
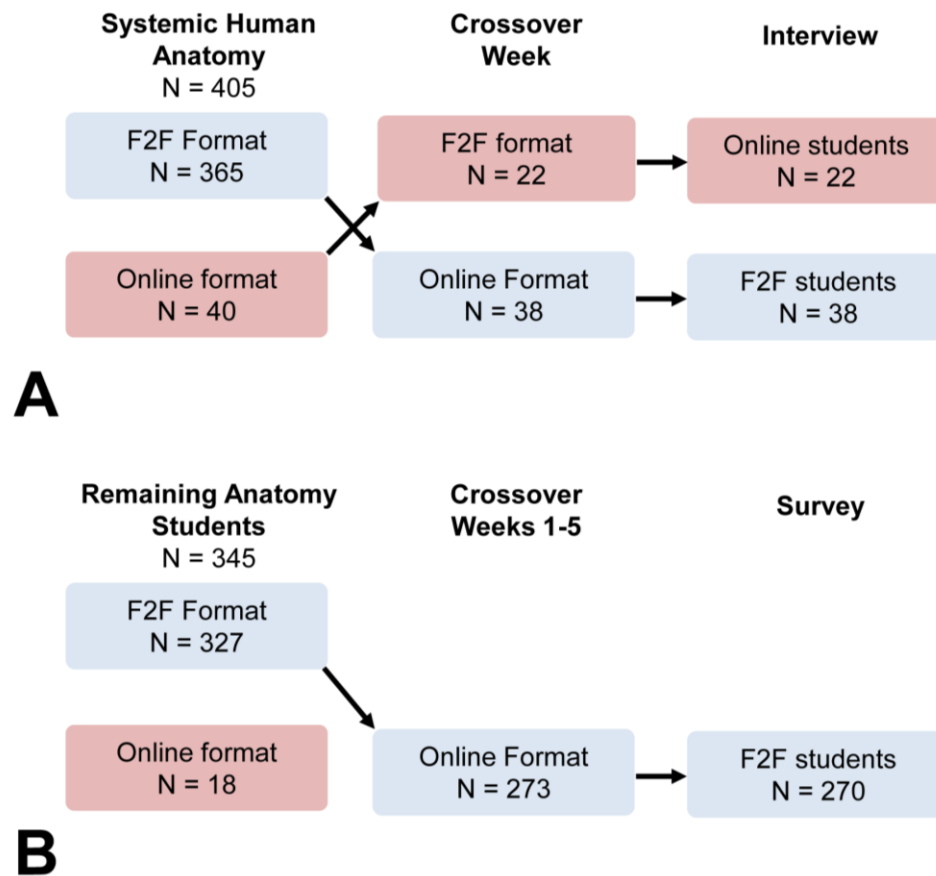
**Figure 5. Crossover study design for 2012-13. (A) Qualitative Strand. Participants from the F2F section and online section were interviewed following the completion of one week's worth of course activities in the alternate delivery format in place of their regular activities.   (B) Quantitative Strand. Remaining participants from the F2F section in groups of 50-60 students took turns participating in a crossover week over a 5 week period.  They were surveyed at the same time after the final crossover week.**

## 4.2.1    Qualitative Strand: Interviews

The cross over week for interview participants took place during the lower limb portion of the muscular system unit.  Students were taught the upper limb during the preceding week.  This allowed the students to compare the F2F and online delivery formats while keeping constant both the body system and the instructor.

Individual student interviews were conducted online and recorded using Blackboard Collaborate. The participants previously used Blackboard Collaborate to attend online lectures and laboratories as part of their regular course activities or to partake in the study, thus they were familiar with the software.  A standardized open-ended interview approach (Patton, 1980) was employed where the exact wording of the questions was predetermined, but the participant could answer the question in whatever way he/she determined to be meaningful. Students were asked which format they preferred for different aspects of the course and to explain reasons for their preferences (Table 4).  The interviewer stated her interpretation of the interviewee's responses and the interviewee could agree or disagree and provide clarification.  To improve response validity, the interviewer (S.A.) had no affiliation with the course.  Students were made aware that their responses could not influence their grades and that the recordings would only be listened to by the interviewer for the purpose of transcription.

**Table 4. 2012-13 student interview questions.**

1. Do you have a preference for attending the face-to-face lecture, attending the lecture online at the same time as the face-to-face class, or watching the lecture after it has been recorded?  Can you please explain why?

2. This question is about the anatomy laboratory, specifically, the part of the lab where the teaching assistant gives a demonstration and the students can study the specimens.  Do you have a preference for attending the face-to-face lab, attending online lab at the same time as the teaching assistant, or watching the lab recording?  Can you please explain why?

3. In terms of writing the weekly laboratory quiz, do you have a preference for the face-to-face quiz or the online testing format?

4. Describe changes, if any, that could be made to the online course that would make the learning experience better for you.

5. Describe changes, if any, that could be made to the face-to-face course that would make the learning experience better for you.

6. Are there any other questions you feel I should have asked you regarding your experiences as an anatomy student and your opinions about face-to-face and/or online formats?

Blackboard Collaborate interview recordings were converted to MP3 format using Elluminate Publish! (Blackboard Inc., Washington, DC).  Visual cues from the interviewees were not part of the study, thus MP3 audio was sufficient to capture the data.  Express Scribe v 5.57 (NCH Software, Greenwood Village, CO) was used to play the MP3 files while they were transcribed into a Word 7 document (Microsoft Corporation, Redmond, WA).   The Word files were loaded as primary documents into Atlas.ti (Scientific Software Development GmbH, Berlin, Germany) for analysis.

To avoid researcher bias in the study's qualitative stage, there were no predetermined hypotheses to test.  Delivery format preferences were quantified and a thematic analysis was undertaken to identify phenomena that impacted these preferences.  A code is a researcher-generated word or short phrase applied to a portion of qualitative data to assign it a particular attribute or meaning (Saldana, 2013). A codebook – a list of codes and their descriptions (Saldana, 2013) – was created by two researchers (S.C. and S.A.) using the constant comparative method (Glaser, 1965).    The initial codebook was developed by analyzing 5 interviews as a team. As many codes as possible were created and applied to the data. As new codes were generated, they were compared with other codes pertaining to the same category, and previously named codes were modified as needed.  The first researcher coded the remaining transcripts using the initial codebook. Modifications were made to the codebook as further codes emerged, resulting in the final codebook.  No new codes emerged from the data at interview 17 for both groups, thus only 40 interviews (20 online, 20 F2F) were analyzed.  The second researcher coded the same 40 interviews using the final codebook.

Kappa statistics measure the degree of agreement between raters when data are rated using the same nominal scale (Fleiss, 1971).  A Fleiss' Kappa value of 0.79 was calculated from the 40 interviews using the Coding Analysis Toolkit (Lu and Shulman, 2008).   A Fleiss' Kappa value of 0.61 – 0.8 suggests substantial

agreement between two raters (Landis and Koch, 1977); therefore, interview analysis using the final codebook was reliable.

A given code was only applied to the appropriate text once per interview so that its code frequency would not increase if an interviewee spoke repeatedly on the same sentiment.

## 4.2.2    Quantitative Strand: Surveys

Survey respondents (270 F2F students), who had not been interviewed, self-selected to participate in one of five cross-over weeks (Figure 5). During the crossover week, participants trialed unfamiliar software including Backboard Collaborate for attending online lectures and laboratories and Netter's 3D Interactive Anatomy for online laboratory activities. To ensure that participants received prompt technical support if needed from the online teaching assistant and researchers, each crossover week was limited to 60 students. A different system was taught during each crossover week:  (1) systemic circulation (2) respiratory system (3) upper gastrointestinal system (oral cavity, pharynx, esophagus, stomach) (4) lower gastrointestinal system (intestines, liver, gall bladder, pancreas) and (5) urinary system.

The survey (Appendix 5) was designed following the interviews.  The interviewees provided a wide range of factors that influenced their delivery format preference.  All of these factors were compiled and converted into self-explanatory statements for the survey respondents to rate.  The survey consisted of three parts:  (1) Demographic information.  (2) Delivery format preferences for lecture, laboratory, and quizzes. (3) Reasons for delivery format preferences. Students rated several possible reasons for their preferences using a 5-point Likert scale (1 = not at all important, 2 = a little important, 3 = somewhat important, 4 = quite important, 5 = very important).   The list of reasons provided was developed based on preliminary interview data.  The Likert scale data were recoded into three categories where "Important" was the sum of percentages for "quite important" and "very important", "Not important" was the sum of

percentages for "not at all important" and "a little important", and "somewhat important" remained the same.

The survey was conducted online using Fluid Surveys (FluidSurveys, Ottawa, ON) after the final crossover week. Online data collection was chosen due to the large number of participants. It allowed the survey to be available for two weeks for students to complete at a convenient time, and minimized human error as results could be directly exported to Excel (Microsoft Corporation, Redmond, WA). Descriptive statistics were calculated using the Statistical Package for Social Sciences (IBM, Armonk, New York).

## 4.3     Results

### 4.3.1     Interviews

*(Please note that interview excerpts have not been edited for grammatical errors. Text within square brackets was added by the authors to clarify the context of the quote for the reader.)*

The completion rate for interviews was 100%, as all 60 students who enrolled in the cross over week participated in the full interview. A total of 137 codes were applied to the data. Ten codes categorized student preferences, 72 described students' deciding factors for delivery format, and 55 described suggestions for improving both formats. The frequency of each code was calculated in Atlas.ti.

Student delivery format preference can be seen in Table 5. The majority (70%) preferred attending lectures online. Of these, most (92.9%) preferred the archived format. In contrast, a large majority (72%) preferred attending the F2F laboratory. Quiz format preference (Table 6) was more dispersed, with 52.5% favouring online, 32.5% F2F, and 15% undecided. Students tended to prefer the quiz format that they were most familiar with in the course.

Descriptive codes (deciding factors and suggestions) with a frequency of 5 students or greater were grouped into common themes and divided into smaller subthemes (Table 7 andTable **8**).

**Table 5. Lecture and laboratory format preferences of online (N = 20) and F2F student (N = 20) interviewees for 2012-13.**

| Format Preference | Lecture | | | Laboratory | | |
|---|---|---|---|---|---|---|
| | Online students N (%) | F2F students N (%) | Total students N (%) | Online students N (%) | F2F students N (%) | Total students N (%) |
| **F2F** | 5 (25) | 6 (30) | 11 (27.5) | 13 (65) | 16 (80) | 29 (72.5) |
| **Online** | 15 (75) | 13 (65) | 28 (70) | 6 (30) | 4 (20) | 10 (25) |
| *Live* | 0 | 2 (15.4[a]) | 2 (7.1[a]) | 5 (83.3[a]) | 1 (25[a]) | 6 (60[a]) |
| *Recorded* | 15 (100[a]) | 11 (84.6[a]) | 26 (92.9[a]) | 1 (16.7[a]) | 3 (75[a]) | 4 (40[a]) |
| *No preference* | 0 | 0 | 0 | 0 (0) | 0 | 0 |
| **Undecided** | 0 | 1 (5) | 1 (2.5) | 1 (5) | 0 | 1 (2.5) |
| **No answer** | 0 | 0 | 0 | 0 (0) | 0 | 0 |

[a]**Percent of students preferring online format.**

**Table 6. Quiz format preferences of online (N = 20) and F2F student (N = 20) interviewees for 2012-13.**

| Quiz Format Preference | Online students N (%) | F2F students N (%) | Total students N (%) |
|---|---|---|---|
| **Face-to-Face** | 2 (10) | 11 (55) | 13 (32.5) |
| **Online** | 16 (80) | 5 (25) | 21 (52.5) |
| **Undecided** | 2 (10) | 4 (20) | 6 (15) |
| **No answer** | 0 | 0 | 0 |

**Table 7. Interview transcript code frequencies for online (N = 20) and F2F students (N = 20). Codes ending with a (+) indicate a positive perception of the represented phenomenon while codes ending with (-) indicate student dissatisfaction.**

| Theme | Subtheme | Code | Online students N (%) | F2F students N (%) | Total students N (%) |
|---|---|---|---|---|---|
| 1. Time Management | Instructional pace | Pace control of lecture recordings (+) | 15 (75) | 7 (35) | 22 (55) |
| | | Online lab longer, less rushed (+) | 6 (30) | 5 (25) | 11 (27.5) |
| | | Request F2F student access to recordings | 7 (35) | 3 (15) | 10 (25) |
| | | Pace control of online quiz questions (+) | 7 (35) | 2 (10) | 9 (22.5) |
| | | Pace control of lab recordings (+) | 4 (20) | 2 (10) | 6 (15) |
| | | Viewing online quiz timer is stressful (-) | 1 (5) | 5 (25) | 6 (15) |
| | | Request slower lecture pace | 2 (10) | 3 (15) | 5 (12.5) |
| | | Strict time limit for online quiz (-) | 2 (10) | 2 (10) | 4 (10) |
| | Scheduling | Online lecture schedule flexibility (+) | 11 (55) | 4 (20) | 15 (37.5) |
| | | More study time for online quiz (+) | 6 (30) | 5 (25) | 11 (27.5) |
| | | Easier to procrastinate with online lecture archives (-) | 1 (5) | 9 (45) | 10 (25) |
| 2. Laboratory Specimens | Cadavers | Touching specimens physically (+) | 5 (25) | 15 (75) | 20 (50) |
| | | Visualization of specimens in 3D space (+) | 7 (35) | 8 (40) | 15 (37.5) |
| | | Request online student access to cadavers | 8 (40) | 5 (25) | 13 (32.5) |
| | | Privilege of learning from cadaveric specimens (+) | 6 (30) | 6 (30) | 12 (30) |
| | Netter's 3D | Difficult to use (-) | 4 (20) | 1 (5) | 5 (12.5) |

**Table 8. Continuation of Table 7. Interview transcript code frequencies for online (N = 20) and F2F students (N = 20). Codes ending with a (+) indicate a positive perception of the represented phenomenon while codes ending with (-) indicate student dissatisfaction.**

| Theme | Subtheme | Code | Online students N (%) | F2F students N (%) | Total students N (%) |
|---|---|---|---|---|---|
| 3. F2F learning space | Lecture hall | Less distractions in F2F lecture hall vs. online (+) | 10 (50) | 2 (10) | 12 (30) |
| | Laboratory | Hard to see quiz questions on projector (-) | 1 (5) | 6 (30) | 7 (17.5) |
| 4. Student-Instructor Communication | Non-verbal | Instructor can point out structures on specimen that student is looking at (+) | 4 (20) | 6 (30) | 10 (25) |
| | | Video stream of professor during online lecture (+) | 1 (5) | 6 (30) | 7 (17.5) |
| | Verbal | Easier to ask questions orally in F2F lab (+) | 1 (5) | 7 (35) | 8 (20) |
| | | May type questions to TA during live online lab (+) | 4 (20) | 1 (5) | 5 (12.5) |
| | | Explanations from F2F TAs easier to understand | 2 (10) | 3 (15) | 5 (12.5) |
| 5. Technology Issues | Netter's 3D | Difficult to install (-) | 2 (10) | 8 (40) | 10 (25) |
| | | Incompatibility with some Mac operating systems (-) | 2 (10) | 4 (20) | 6 (15) |
| | | Slow to load specimens (-) | 5 (25) | 0 (0) | 5 (12.5) |
| | Blackboard Collaborate | Request better sound quality (-) | 3 (15) | 2 (10) | 5 (12.5) |

 Five themes emerged from the data:

## 4.3.1.1    Time Management

The most frequent code, found in 55% of interviews, described the students' ability to control the pace of online lecture recordings. One student's representative comment conveyed the benefit of the play/pause button and navigation bar:  *"Going to class sometimes I don't write everything properly.  I don't get it down in the time that the prof is telling us something. The recorded version helps me get everything and listen to them properly".*  Interviewees suggested that the F2F students should have access to lecture archives to experience the same benefits (25%) and requested that the instructional pace decrease (12.5%).   Archive pace control was a factor in preferring the online laboratory (15%), though it was not perceived to be as important as lecture because the online labs were a longer duration, thus less rushed (27.5%).  Pace control was also an appreciated attribute of the online quiz (22.5%).  Unlike the F2F quiz where the teaching assistant progressed through questions for a group of students, in the online quiz a student could budget his or her time.  As a student described, "*You know you have 10 minutes [total] but you can spend as much time as you want on each question.  When you're done really quickly you can just move on and have [more] time for the next one"*.  A smaller number of students (15%) thought that the online quiz timer counting down on the screen (and could not be hidden) was stressful and could concentrate better when the TA advanced the questions at equal time intervals.  Another consideration for students preferring the F2F quiz format was the strict time limit of the online quiz (10%). The online quiz automatically submits the student's answers after exactly 10 minutes, where in the F2F lab the TAs may permit students to finish documenting responses.

Lecture archives were also perceived as beneficial because they could be viewed at a time convenient for the student (37.5%).  In contrast, some students

(25%) identified archive access as a detriment to personal time management because it was easier to procrastinate learning the material knowing that archives were available.  Schedule flexibility in terms of the online quiz was also valued (27.5%) because it allowed students more time to study the lab material.  As one student described *"You can take the quiz whenever you want as long as you don't go past 9AM the next day.  So I can actually study and make sure I'm prepared for the quiz.  Whereas in the F2F lab they finish the lab demonstration and you get maybe 5 minutes to just look over all your notes".*

## 4.3.1.2    Laboratory Specimens

Half of the interviewees (50%) recognized pedagogical value in touching specimens and models physically in the F2F lab.  Most of these students thought that touching a specimen facilitated their understanding of 3D relationships.  One student recalls, *"They had models out and you could actually touch them.  To me that made it a little better in terms of understanding and being able to point to where things are. Especially for anatomy where you need to know where things are.  It's more location based. Spatially based.  For me sometimes it's still hard to visualize things even with the 3D models.  I feel like touching it.  It helps me grasp the different parts of it better".*  A few students noted that they were more engaged in learning when they could touch a specimen.  For example, "*It feels like you're interacting with something rather than a computer screen […] It just feels more interactive when you're seeing it in person".* In addition to touching specimens in 3D, viewing them in the F2F lab as opposed to on a screen helped some students (37.5%) to better understand anatomical concepts.  For a smaller group of students (30%), the mere presence of the cadavers was considered to be a unique privilege.  As one student expressed, "*It's not something you can find on the internet, you know.  Unless you're registered in this course, you can't go into a lab.  It's not every day that you can like see and touch a cadaver and to be shown in real life what it is".* Interviewees (32.5%) recommended an optional drop-in F2F laboratory time for online students.

A small number of participants (12.5%) were confused by the Netter's 3D Interactive Anatomy interface, making it difficult to use the 3D computer models.

### 4.3.1.3    The F2F Learning Space

Interviewees described how their physical surroundings impacted learning and assessment.  Thirty percent of students expressed that they could better focus on learning during a lecture in the F2F class versus online in another location.  When viewing an online lecture, environmental factors may be present that do not pertain to the learning experience.  One student commented, *"I feel more concentrated and focused when I'm physically there [at F2F lecture].  When I'm doing the online lectures I can get distracted with something else at home".*  Another student exemplified, *"say like right now I'm doing laundry.  If I'm listening to a recorded lecture, if my laundry's done I'll go and do it and I'll come back.  Then the material is more broken up".*  For other students, environmental factors of the F2F classroom were conducive to paying attention.  As one student mentioned *"other people around who are also paying attention, you don't really want to distract other people".*

Student comments focused on their physical surroundings in the laboratory during the quiz, but not during the demonstration.  During the F2F quiz, questions were displayed on a projector.  Some students (17.5%) expressed concern that they were not able to clearly see the questions because they were seated too far away from the screen or other students were obstructing the view.  This was not an issue during the online quiz, as questions were displayed on each student's computer monitor.

### 4.3.1.4    Student-Instructor Communication

It was perceived that communication between instructors and students was easier in the F2F environment, specifically in the lab.  In the online and F2F labs, TAs and students manipulated anatomical structures on cadaveric specimens

and computer models respectively. The F2F TA and students were in the same physical space as the specimen and could take turns manipulating its parts while conversing to better communicate concepts. The online TA broadcast the 3D computer model displayed on his or her screen. Students manipulated a replica of this model on their own computers. If they had a question about their model, they could not show their computer screen to the TA. One student articulated the difficulty in this system, *"I think there would be a bit of a barrier there in terms of her explaining it to me on the program [Netter's 3D Interactive Anatomy] because she wouldn't be looking at my perspective of the model. In the F2F labs I could physically point to something and we could look at the same thing"*.

In addition, 20% of students mentioned it was easier to ask general questions orally in the F2F lab. In the online lab students could type an instant message to the TA and get a spoken response; however, only 12.5% believed it was still an asset to be able to sign into an online lab and ask questions in this manner.

Despite F2F student-instructor communication favouring the laboratory environment, other aspects of the online course design were noted as helpful in facilitating non-verbal communication. The importance of a video stream of the professor, particularly for the study of anatomy, was discussed by 17.5% of students. One student emphasized the importance of the video feed through comparison to another online course lacking this feature: *"In some classes we just have the [Power Point] slides […]it's not really the full experience of the lecture. Especially with something like anatomy where he's showing all the movements and stuff. It's very helpful to see the professor's actual gestures and movements"*.

## 4.3.1.5   Technology Issues

Some interviewees were unable to install Netter's 3D interactive Anatomy on their computers (25%). Most of these students (15%) had the MacIntosh Mountain Lion operating system, OS 10.8 (Apple Inc., Cupertino, CA), which is

incompatible with the required 3D viewer, 3Dvia (Dassault Systems, Waltham, MA). A small number of students (12.5%) who were able to use Netter's 3D Interactive Anatomy expressed that it was slow at loading virtual prosections. Virtual prosections are 3D models that have been custom created by the teaching assistant (e.g. through dissection, magnification, addition of labels) and saved as a special file format (*.cap). A particular virtual prosection can be opened by another user by launching the *.cap file.

Students did not encounter significant issues with Blackboard Collaborate, but suggested that the wireless microphone in the lecture hall be replaced to improve audio quality (12.5%). This was not an issue during the online laboratory during which the TA used a hard wired headset.

## 4.3.2    Surveys

The completion rate for strand 2 participants was 98.9%. Two hundred seventy three students enrolled in the study and participated in the crossover, and 270 fully completed the survey. Participant demographics and the body system studied during each crossover week can be seen in Table 9. The average age of the participants was 20.6 years with more females (59.3%) than males (40.7%). Most students were registered in the Bachelor of Medical Sciences degree (74.4%) and were in their third year of undergraduate studies (83%).

The mean age, proportion of males to females and distribution of degree programs were statistically identical between the crossover weeks. The year of study was not equally distributed ($X^2$ (15, N = 270) = 30.065, p <0.05). Since few participants were not in their third year of study (46/270, 17%) and they were spread across 5 crossover weeks, stratifying the data according to year of study would yield small sample sizes. Therefore, remaining data for all students were analyzed together and not stratified by demographic characteristics.

**Table 9. Demographic profile of F2F survey participants for crossover weeks 1-5.**

| Character-istics | Circulatory (N = 51) Mean ± SD or N (%) | Respiratory (N =60) Mean ± SD or N (%) | Upper GI (N = 53) Mean ± SD or N (%) | Lower GI (N = 54) Mean ± SD or N (%) | Urinary (N = 51) Mean ± SD or N (%) | Total (N = 270) Mean ± SD or N (%) |
|---|---|---|---|---|---|---|
| **Age (years)** | 20.27 ± 0.53 | 20.68 ± 1.08 | 20.60 ± 0.93 | 20.90 ± 1.40 | 20.71 ± 1.02 | 20.6 ± 1.05 |
| **Gender** | | | | | | |
| Male | 20 (39.2) | 25 (41.7) | 23 (43.4) | 22 (40.7) | 19 (37.3) | 110 (40.7) |
| Female | 31 (60.8) | 35 (58.3) | 30 (56.6) | 32 (59.3) | 32 (62.7) | 160 (59.3) |
| **Degree** | | | | | | |
| Bachelor of Medical Sciences | 43 (84.3) | 40 (66.7) | 40 (75.5) | 42 (77.8) | 36 (70.6) | 201 (74.4) |
| Bachelor of Science – Biology | 4 (7.8) | 12 (20) | 5 (9.4) | 10 (18.5) | 7 (13.7) | 38 (14.1) |
| Bachelor of Science – Other | 4 (7.8) | 6 (10) | 7 (13.2) | 2 (3.7) | 5 (9.8) | 25 (9.3) |
| Doctor of Philosophy | 0 | 0 | 1 (1.9) | 0 | 1 (2) | 2 (7) |
| Other | 0 | 1 (1.7) | 0 | 0 | 2 (3.9) | 3 (1.1) |
| No response | 0 | 1 (1.7) | 0 | 0 | 0 | 1 (0.4) |
| **Year of Study** | | | | | | |
| Third year undergraduate | 50 (98.0) | 49 (81.7) | 48 (90.6) | 41 (75.9) | 37 (72.5) | 224 (83) |
| Forth year undergrad-uate | 1 (2.0) | 7 (11.7) | 4 (7.5) | 10 (18.5) | 12 (23.5) | 35 (13) |
| >4th year undergrad-uate | 0 | 4 (6.7) | 0 | 3 (5.6) | 1 (2) | 9 (3.3) |
| 1st year graduate | 0 | 0 | 0 | 0 | 1 | 1 (0.4) |
| 3rd year graduate | 0 | 0 | 1 (1.9) | 0 | 0 | 1 (0.4) |

After a respondent chose a given delivery format, the importance of several possible reasons affecting his/her decisions were rated. Reasons rated "important" by 75% or more of respondents are detailed in this report.

## 4.3.2.1  Lecture Format Preferences

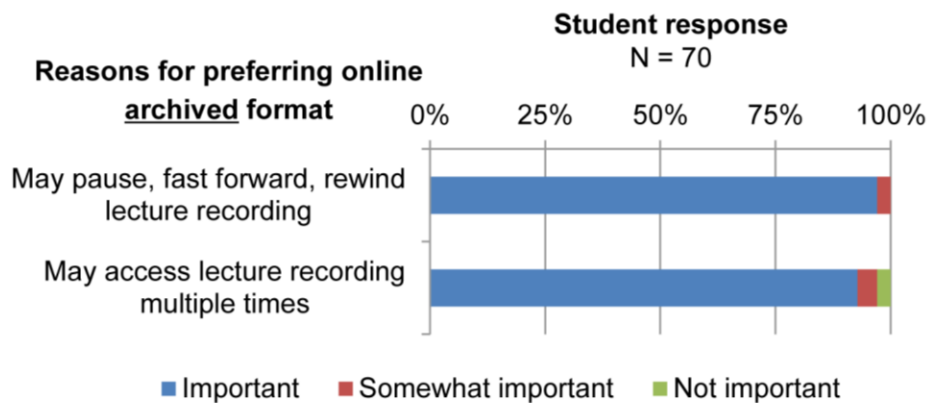The Blackboard Collaborate server failed during live lecture times in crossover weeks 1 (systemic circulation) and 2 (upper GI tract). Since participants during these weeks (N = 105) only had access to the recorded version of online lecture and did not have the option to log in live, their responses regarding lecture format were omitted from the analysis.  Of the remaining respondents (N =165), a bare majority preferred the online lecture format (52.4%) over the F2F format (39.6%) while a small group (7.9%) was undecided (Table 10).

**Table 10 Lecture, laboratory, and quiz format preferences of F2F survey respondents.**

| Format Preference | Lecture (N = 164[a]) N (%) | Laboratory (N = 270) N (%) | Quiz (N = 270) N (%) |
|---|---|---|---|
| **Face-to-Face** | 65 (39.6) | 223 (82.6) | 164 (60.7) |
| **Online** | 86 (52.4) | 31 (11.5) | 80 (29.6) |
| *Live* | 4 (4.7[b]) | 4 (12.9[b]) | NA |
| *Recorded* | 70 (81.4[b]) | 22 (71.0[b]) | NA |
| *No preference* | 12 (14[b]) | 5 (16.1[b]) | NA |
| **Undecided** | 13 (7.9) | 14 (5.2) | 25 (9.3) |
| **No answer** | 0 (0) | 2 (0.7) | 1 (0.4) |

[a]**Responses from 105 participants were omitted due to a Blackboard Collaborate server failure during lecture time in crossover weeks 1 (systemic circulation) and 4 (upper GI tract).**

[b]**Percent of students preferring online format**

**NA: Not applicable**

Within the group who preferred online lectures, 75.6% students believed that the opportunity to attend lecture from any location was an important deciding factor (Figure 6A). A large majority of this group preferred the recorded version (81.4%), over logging in live (4.7%), and a small group did not have a preference between the two (14%) (Table 10). Within the group that preferred the recorded lectures (N = 70), the ability to pause, fast forward, and rewind the lecture recording and access lecture recording multiple times were rated as important by 97.1% and 92.9% respectively (Figure 6B).
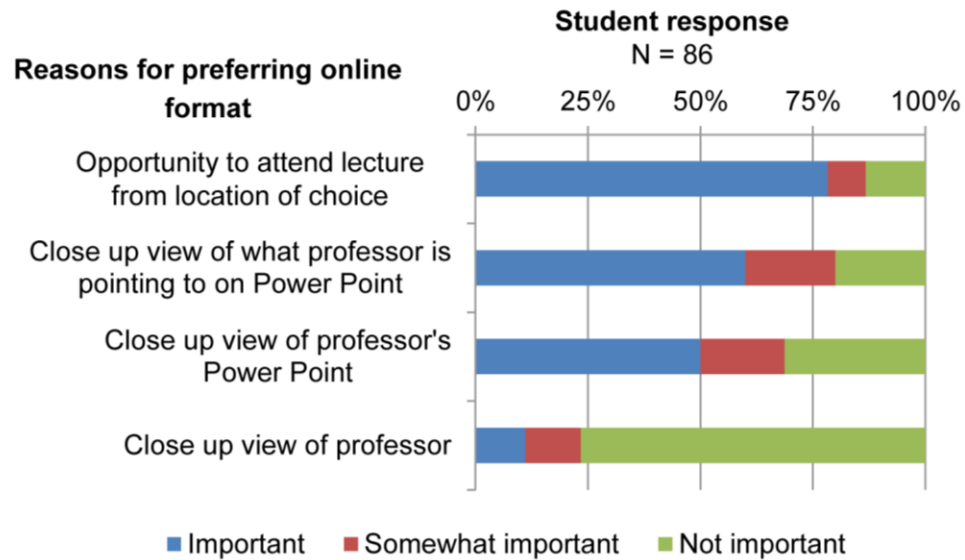
**Figure 6.** Factors influencing the respondents' decisions to prefer (A) the online lecture format in general and (B) specifically the archived online lecture format.

Compared to deciding factors for preferring online lectures, those for F2F lectures were more broadly distributed such that no single item was rated as "important" by more than 75% of respondents.  Within the group who preferred F2F lectures (N = 65), over half perceived that attending F2F lectures facilitated personal time management because it is easier to procrastinate when lecture recordings are available (67.7%) and attending F2F lecture requires students to travel to campus in the morning (64.6%) so they are already at campus for the day.  Being physically located in the classroom was also an important item as students felt more engaged by the professor when in the same room (64.6%) and that there were fewer distractions in the F2F classroom (60%) compared to viewing the lecture from an alternate location (Figure 7).
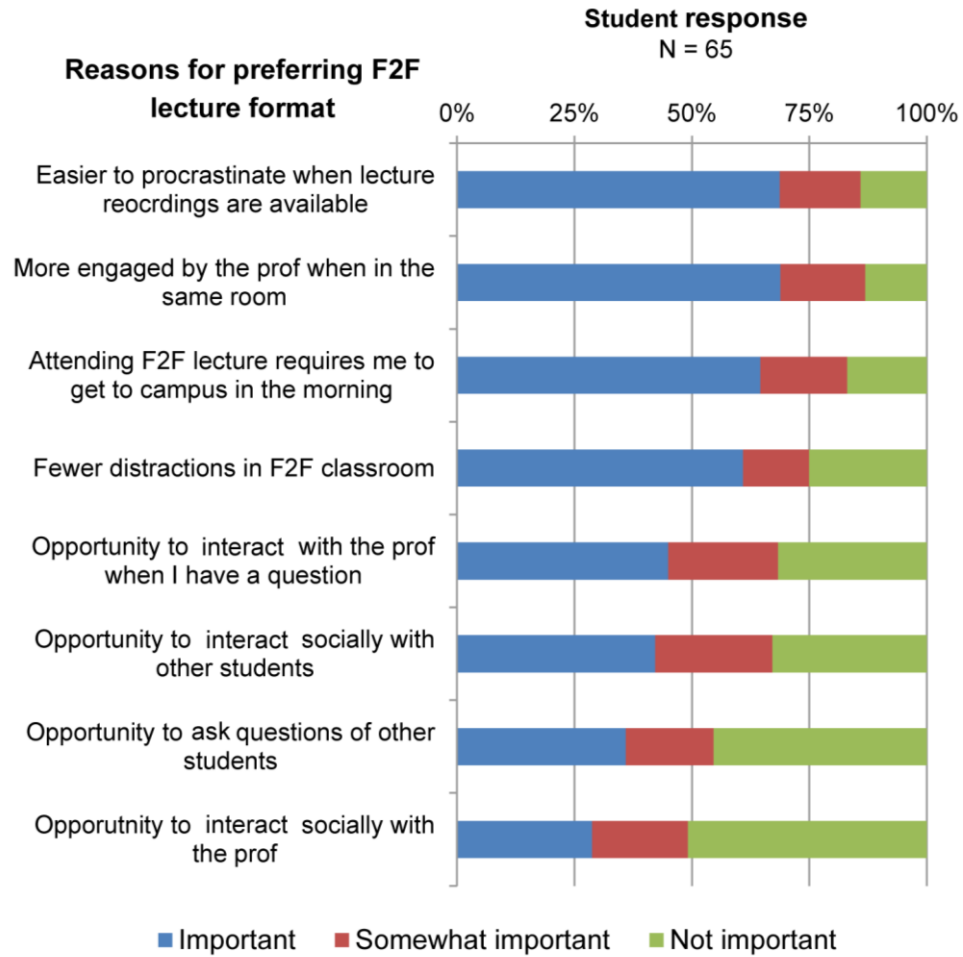
**Figure 7. Factors influencing the respondents' decisions to prefer the F2F lecture format.**

## 4.3.2.2   Laboratory Format Preferences

All responses (N = 270) were included in the remainder of the analysis since the Blackboard Collaborate server failure did not affect the participants' ability to attend the laboratory or write the quiz.  A large majority of respondents preferred the F2F laboratory format (82.6%) over the online format (11.5%), while few students were undecided (5.2%) (Table 10).  Within the group who preferred the F2F laboratory (N = 223), 3 of 4 items pertaining to the teaching assistants were rated as important by most students (Figure 8).  It was important to be able to choose which teaching assistant they wanted to work with (88.3%) as opposed to the online laboratory where there was only one TA per semester.  Once the students chose their TA, being in the same room as him/her was more engaging compared to the virtual lab (88.3%) and it was important to be able to ask the TA questions in person (87.4%).  The opportunity to study cadaveric materials was also rated as an important deciding factor by most students.  Cadavers, as opposed to the 3D computer models, helped the students to see the actual size of body parts (81.2%) and apply course concepts to real life (78.5%).  However, the most important deciding factor related to cadavers was the privilege of learning from real specimens (86.1%).
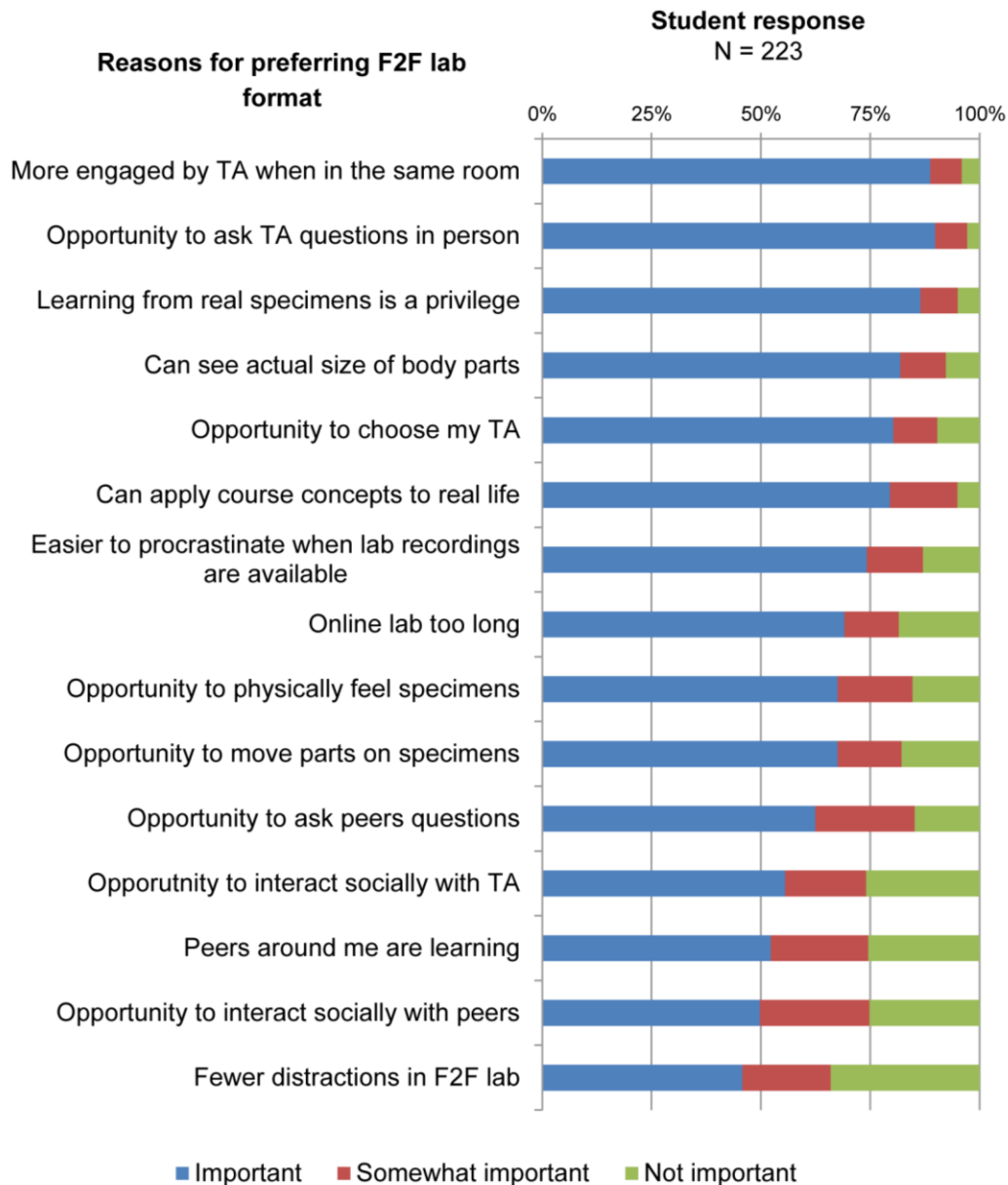
**Figure 8. Factors influencing the respondents' decisions to prefer the F2F laboratory format.**

Of the small group who preferred the online laboratory (N = 31), the most important deciding factors pertained to issues with the F2F laboratory space (Figure 9A).  With approximately 50 students in a given F2F lab section, the noise volume in the room was too loud for some, thus they preferred being able to clearly hear the TA online (83.9%).  The large number of students in the lab also meant that if a TA was referring to a diagram, some students were not able to get close enough to see it clearly.  The ability to see diagrams displayed in BBC close up on their computer monitors was important to some students (74.2%).  In addition, online students could download a Power Point file of the diagrams, which was not offered to F2F students.  Access to the diagrams was an important deciding factor for 77.4% of students.  Like the online lectures, students (74.2%) valued the opportunity to attend the lab from a location of their choice.  Within the group that preferred watching the lab in archived format (N = 22), controlling the pace of the recording and having unlimited access were both rated as important by 72.7% of respondents (Figure 9B).
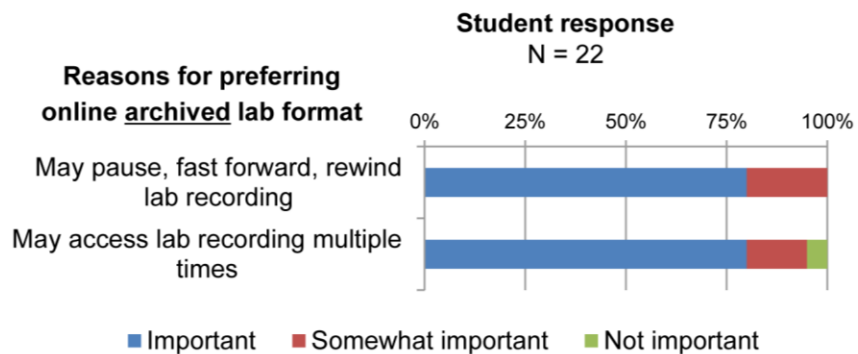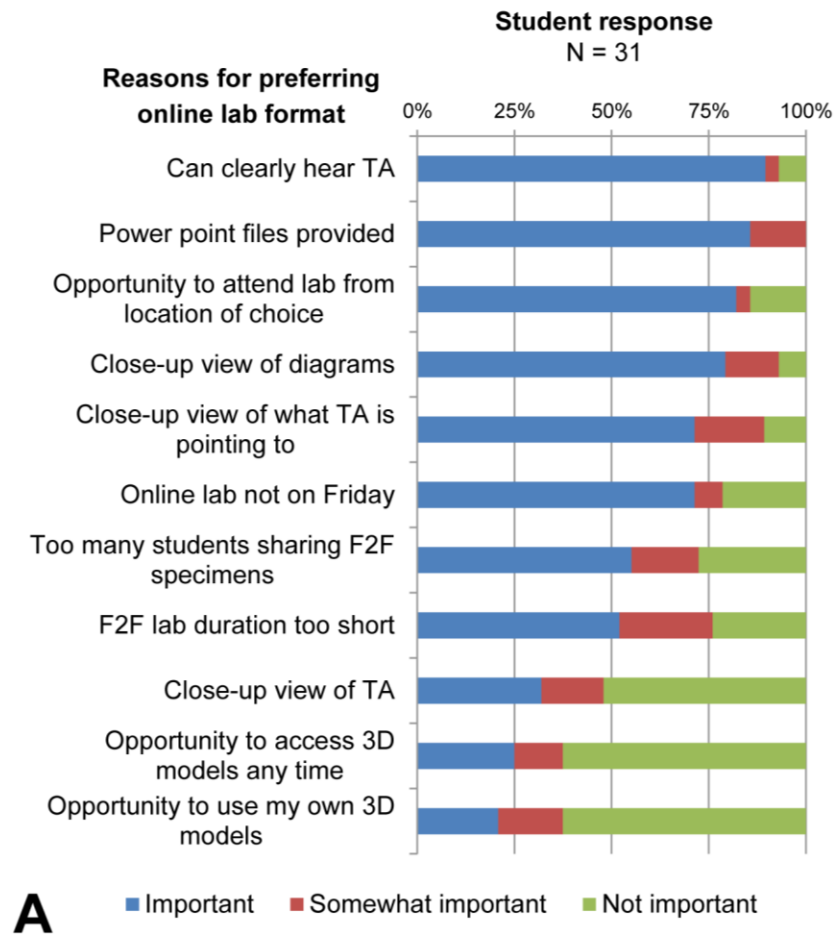
**Figure 9. Factors influencing the respondents' decisions to prefer (A) the online laboratory format in general and (B) specifically the archived online laboratory format.**

## 4.3.2.3    Quiz Format Preferences

The majority of participants preferred the F2F quiz format (60.7%) over the online format (29.6%) (Table 10).  During the online quiz students had to submit an answer to a question before progressing to the next and they were not able to change previous answers.  In the F2F lab, students answered questions on a single sheet of paper so they could change previous answers at any time before the quiz ended.  This was perceived as important by 80.5% of respondents choosing the F2F quiz (Figure 10).
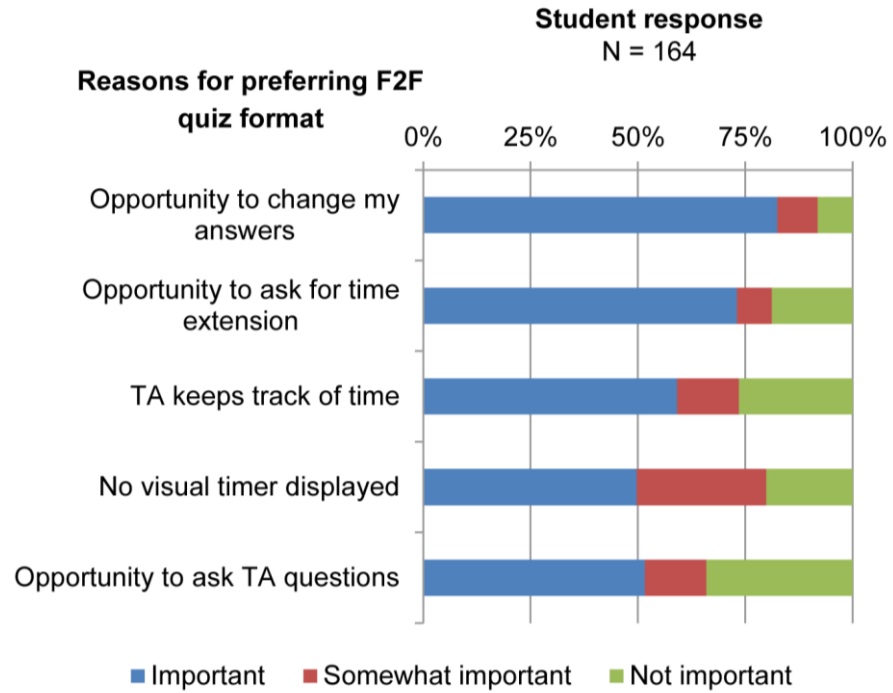
**Figure 10. Factors influencing the respondents' decisions to prefer to F2F quiz format.**

Of the students who preferred the online quiz format (N = 80), 81.1% valued having the opportunity to refer to external resources (e.g. notes, text book), though this did not include assistance from other people (Figure 11).  During the online quiz students could advance through questions at their own pace within a 10 minute time limit, allowing them to spend less time on a question when they knew the answer and thus more time to work on difficult questions.  This was perceived as important by 76.3%.  In order to accommodate students with schedule conflicts during online laboratory, the online quiz was available until 9:30AM in the morning following the laboratory. Students felt it was of benefit to be able to write the quiz at any time during this interval (78.9%), specifically since it granted more time to study (81.3%).
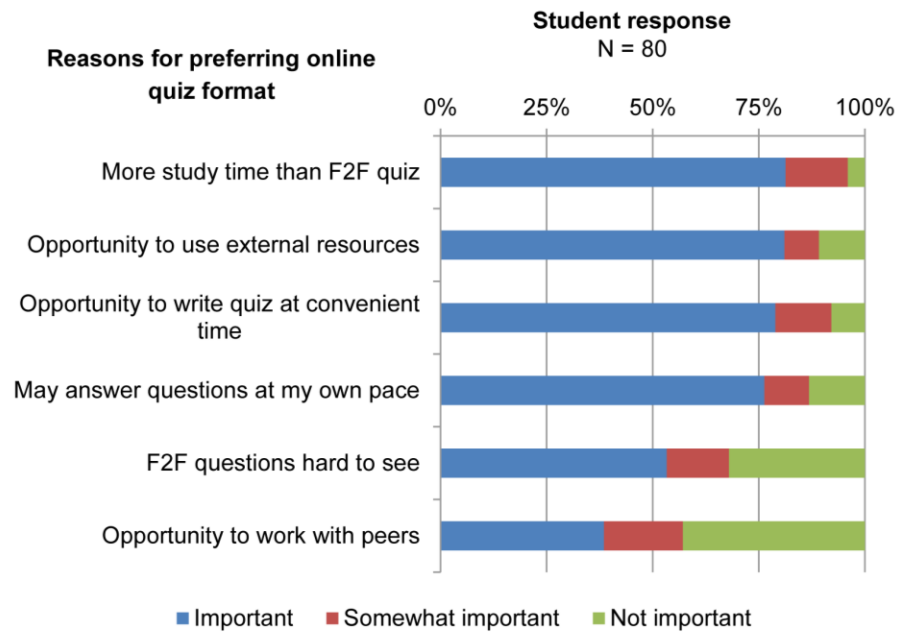
**Figure 11. Factors influencing the respondents' decisions to prefer the online quiz format.**

## 4.3.2.4    Use of Netter's 3D Interactive Anatomy

A large majority of survey participants (70.7%) did not use Netter's 3D Interactive Anatomy during the crossover, while a smaller number did (24.1%) and some chose not to answer (5.2%).  The reasons why most participants (N = 191) did not use the software were dispersed (Table 11).  The most frequent responses by almost half of the participants were that they were able to learn the required content without the software (45%) and perceived its use would not help them perform better on the quiz (44.5%).

Students who used the software (N = 65) did not arrive at a general consensus on how helpful each of the functions were to their learning (Figure 12).  The most helpful (59.3%) feature was being able to add labels to parts on the 3D models.  It was intended that providing students with *.cap* files (prepared dissections) would allow them to easily load a specimen with structure pertinent to the laboratory; however, few students (41.8%) found this feature helpful.  Instead, they found it more helpful loading their own models based on either a body system (55.9%) or region (53.8%).

**Table 11. Reasons why survey participants (191/270; 70.7%) did not use Netter's 3D Interactive Anatomy during the crossover week. Respondents could select all statements that applied.**

| I did not use Netter's 3D Interactive Anatomy because: | N (%) |
|---|---|
| *I learned everything I needed to without it* | 86 (45%) |
| *I didn't think I needed to use it to get questions right on the quiz* | 85 (44.5%) |
| *I didn't have time* | 63 (33%) |
| *It wasn't mandatory to use it* | 54 (28.3%) |
| *I didn't know I had access to it* | 47 (24.6%) |
| *I didn't think it would help me learn* | 43 (22.5%) |
| *I couldn't launch it* | 38 (19.9%) |
| *I didn't care to try it* | 38 (19.9%) |
| *I didn't know how to use it after I launched it* | 37 (19.4%) |
| *My login credentials didn't work* | 7 (3.7%) |
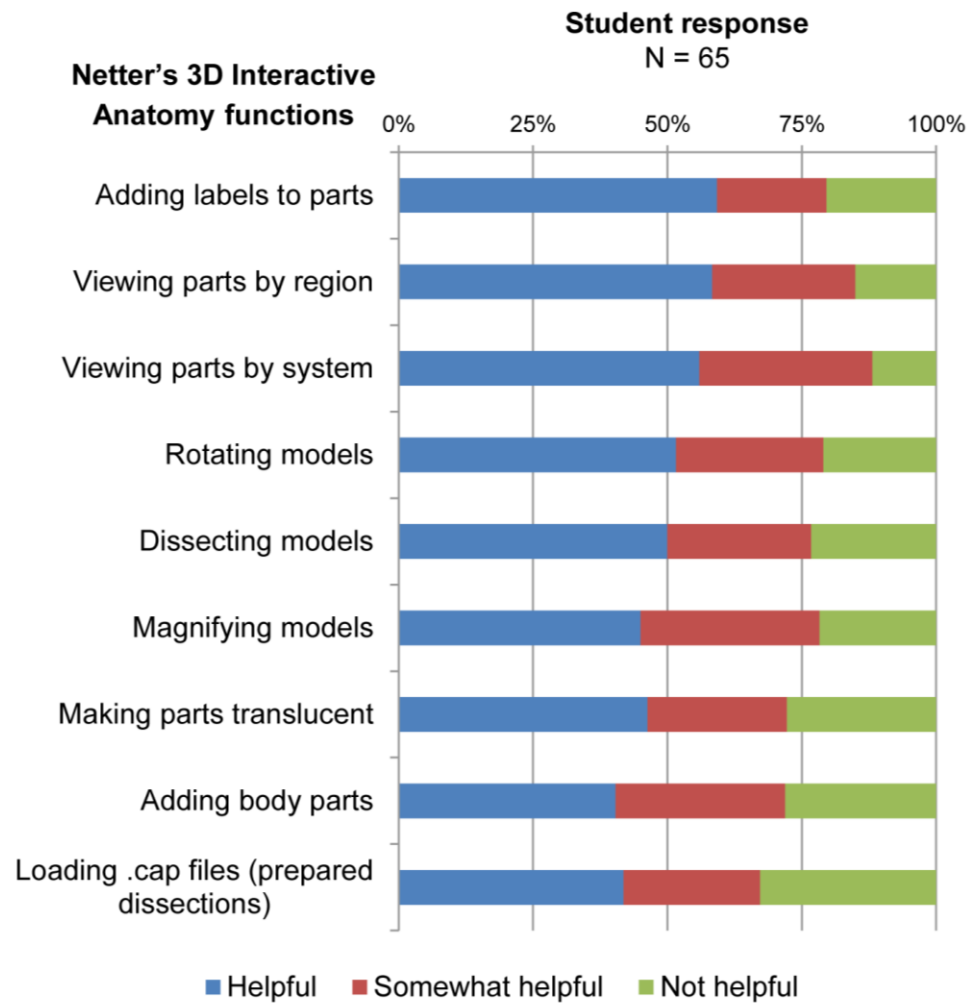
**Figure 12. Helpfulness of Netter's 3D Interactive Anatomy software functions.**

## 4.4　　Discussion

### 4.4.1　Strengths of the Online Format

Students perceived the greatest strength of the online format to be their ability to control the instructional pace of archived lectures, and to a smaller extent, laboratories.  This finding is reflected in literature on medical students' perceptions of learning from pre-recorded lectures (Cardall et al., 2008; Wang et al., 2010; Beale et al., 2014).  However, studies of medical students in their first and second year also found that the primary decision to watch a lecture online versus F2F was driven by reasons related to the specific instructor (Billings-Gagliardi and Mazor, 2007; Wang et al., 2010; Gupta and Saks, 2013).  Students in our study may not have considered the instructor as a factor because they were asked to reflect on only one week of one course.  Pace control was also a factor for a student's preference for assessment format.  Interestingly, some favoured the ability to self-navigate through online quiz questions, while others preferred a teaching assistant to control the question delivery rate in the F2F quiz so they did not have to monitor the time in addition to answering questions.

Students valued the choice to complete online course activities asynchronously at a time of their convenience.  They described personal, rather than pedagogical reasons for watching lecture and laboratory archives outside of live times.  Conversely, the perceived benefit of completing the quiz within a 16 hour time frame was founded on an educational basis.  Both interviewees and survey respondents recognized value in having time between the laboratory and quiz to study, which is not given in the F2F format.  This may be especially important in the study of anatomy, during which students learn a significant number of unfamiliar terms each week.

The choice to attend online lectures and laboratories from any physical location was rated as an important deciding factor by survey respondents, but was not an emergent theme from the interviews.  This question was only asked of

interviewees and survey respondents who preferred online laboratories. Though a small proportion of both experimental groups received the question, there were more survey participants overall from which the observation may have emerged. Students may have preferred not to be on campus during laboratory times (all Friday time slots) if they had weekend travel plans. In some instances, students preferred to attend laboratory from a location of their choice because they perceived issues with the physical F2F learning space. The F2F laboratories were held in one large room containing 60 students. Despite being divided into groups of 15 students per TA, they had difficulty hearing the demonstration. Students struggled to see quiz questions if they were seated farther away from the projector. The online laboratory allowed students to select a quieter location to learn and they could see quiz questions on their own computer screen.

## 4.4.2    Weaknesses of the Online Format

Most participants valued the opportunity to touch specimens in F2F laboratory. Interviewees elaborated on the sense of touch, suggesting that it facilitated a better understanding of the structures in three dimensions. While the online laboratory students could manipulate 3D models with a computer mouse, this interactivity did not act as a substitute for feeling specimens physically. This is supported by the literature on cognitive psychology of manual perception. Information on an environment's spatial properties provided by touch allows for perception of these properties (Hatwell, 2003). In addition, touch validates a lived experience from which students can develop synesthetic maps of human anatomy (Aziz et al., 2004). This may explain why students found palpable objects to be more engaging than their virtual counterparts displayed on a computer screen. It is widely accepted by anatomists that a hands-on cadaveric dissection experience facilitates understanding of anatomical structures in 3D for medical students (Marks, 2000; McLachlan and Patten, 2006; Azer, 2007; Collins, 2008; Sugand et al., 2010). Though this was a study of undergraduate science students in a prosection-based course, the results also demonstrate the importance of offering a hands-on experience. Many students also preferred real

specimens over virtual specimens due to the perceived difficulty of using Netter's 3D Interactive Anatomy.  The variety of tools available for students to interact with the 3D models, coupled with the unfamiliar interface, may have contributed to an excessive cognitive load.  Extraneous cognitive load – the cognitive processing that does not contribute to achievement of the learning objective (Wilson, 2015) – may have been too overwhelming to allow the students to process the learning experience.  Difficulty with the interface overshadowed the positive aspects of 3D model use (e.g. unlimited use).

While archives allow students to choose to participate in the course asynchronously, they may be a detriment for some students lacking self-discipline.  The successful online learner must be skilled in time management (Dabbagh, 2007).  Many students who recognized potential for procrastination with archive use preferred attending the course F2F to maintain their learning schedule.  This concern is not unique to undergraduate students, and has been observed at the professional level.  In a study of Harvard University medical students, most attended lectures F2F versus archives because they lacked the self-motivation to watch recorded lectures (Cardall et al., 2008).  Students may not attend to recorded material unless its content is pertinent to an imminent evaluation.  In quantitative analyses of lecture archive access by medical students, viewing was closely related to examination dates (McNulty et al., 2009; Nieder and Borges, 2012), though it is unknown if this was for review purposes or viewing for the first time.

The online course was designed to facilitate student-teacher communication through live audio/video and instant messaging in the virtual classroom.  A small number of interviewees thought that the live video stream of the professor was helpful, especially during lectures.  It allowed them to see non-verbal cues from the instructor that pertained to the lesson (e.g. muscle actions).  Despite the video stream's role in facilitating communication of concepts, the majority of survey respondents preferred F2F lecture and laboratory because they were

more engaged by the instructor when they were located in the same physical environment. Other survey items suggest factors increased engagement with instructors in the F2F format. There were more environmental distractions when students attended sessions online from remote locations (e.g. household responsibilities, interruptions from people). In addition, it was easier to engage in conversation orally with the instructor in the F2F environment versus instant messaging in the virtual classroom. In a meta-analysis of 74 studies on interactivity in online courses, Bernard et al. (2009) concluded that one method to positively affect the student learning experience is to increase interaction between students and instructors. It is therefore not surprising that a major driving factor in our participants' preferences for delivery format is their perception of the quality of interaction and engagement with their instructor.

## 4.4.3    Study Design Successes and Challenges

Blackboard Collaborate was the ideal software to use to interview participants. Conducting the interviews online did not require participants to travel to a specific location, allowing for a flexible interview schedule. Most students were interviewed between 6:30-10:00PM after their classes. They were able to participate from a location of their preference, most choosing the home. The 100% completion rate of the interviews may be attributed to the convenience of online interviewing. Only 2/60 participants had technical issues with their microphones and needed to borrow departmental hardware to complete the interview. Students appeared to be comfortable answering questions through BBC. Participants had the right to not answer a question or withdraw from the interview entirely, but all students answered the complete question set. This may be due to the anonymity of the process. The students were not seen via webcam during the interview, and were assured that the interview would only be analyzed by others in written format. The only disadvantage of recording interviews in BBC was that the audio quality of the recordings was not high enough to allow for use of automatic transcription software. Most students used their computers' built in microphones or ear buds. Voice-over-internet technology is also

dependent on the internet speed of both parties. The combination of these factors yielded archives that were audible, but contained some feedback and background noise.

The number of online student participants was lower than F2F because enrollment in the online section of the course was limited to 40 compared to 365 in the F2F section. Students from both sections participated in the interview phase, but only F2F students completed the survey as no additional online students were available. The survey was representative of F2F students who were only exposed to the online format of the course for a week and it may not have been enough time for a student to fully experience the online format. If a student encountered technical difficulties, they had to be resolved immediately as there were only two opportunities to attend online lecture and one for laboratory. It is recommended that future crossover studies of this nature be extended to two weeks. Due to time constraints associated with researching an active course, it was not possible during this study to extend the length of each crossover.

Despite the limited time available for the crossovers, this design was crucial to revealing accurate student perceptions. Students were able to experience both environments, and thus make decisions about their learning preferences based on what might be advantageous or detrimental about both formats. Furthermore, since the study took place as part of their active course, including a graded assessment (quiz), their effort during the crossover likely reflected their effort in the remainder of the course.

It was not possible to track live and archived student attendance through Blackboard Collaborate; however, such a feature may not have provided an accurate observation of its use. It would be unknown if a specific student actually participated in a live or archived format because the students did not use web cameras and were not required to communicate with others. Being logged into the virtual classroom may not reflect the student's presence at the computer.

Since students placed a high value on access to lecture archives, it is likely that participants shared their access with students not enrolled in that particular week of the study.

### 4.4.4    Future Directions

The most frequent suggestion by interviewees for improving Systemic Human Anatomy was to share learning materials between the sections.  Participants predicted that face-to-face students would appreciate access to archives and online students would value the opportunity to work with cadaveric specimens on a voluntary basis.  Students did not suggest creating a hybrid course, rather to keep the existing sections but share resources for optional use.

The online laboratories will be modified in future years to increase interaction between students and teachers and students and the 3D models.  The impact of the intervention will be assessed through a comparison of grades and student perceptions of learning anatomy in the online and face-to-face formats.  Future qualitative studies will also reveal professor and teaching professor perceptions of instructing anatomy in both environments.

## 4.5    Conclusion

A fully online section of an undergraduate systemic human anatomy course with a laboratory demonstration was offered in live and archived format using collaborative teaching software and 3D anatomical computer models.  Students valued pace control, schedule and location flexibility of learning from archived materials and being assessed online.  In the online laboratory, they had difficulty using the 3D models and preferred the unique and hands-on experiences of cadaveric specimens.  The F2F environment was conducive to learning in both lecture and laboratory since students felt more engaged by instructors in person and were less distracted by their surroundings.  Increasing the quality of student-

teacher interaction in the future may improve engagement and help them to make better use of the 3D models.

## 4.6     Literature Cited

Azer SA, Eizenberg N. 2007. Do we need dissection in an integrated problem-based learning medical course? Perceptions of first-and second-year students. Surg Radiol Anat 29: 173-180.

Aziz MA, McKenzie JC, Wilson JS, Cowie RJ, Ayeni SA Dunn BK. 2002. The human cadaver in the age of biomedical informatics. Anat Rec (New Anat) 269: 20-32.

Beale EG, Tarwater PM, Lee VH. 2014. A retrospective look at replacing face-to-face embryology instruction with online lectures in a human anatomy course. Anat Sci educ 7:234-241.

Bernard RM, Abrami PC, Borokhovski E, Wade CA, Tamim RA, Surkes MA, Bethel EC. 2009. A meta-analysis of three types of interaction treatments in distance education.  Rev Educ Res 79: 1243 – 1289.

Billings-Gagliardi S, Mazor KM. 2007. Student decisions about lecture attendance: Do electronic course materials matter? Acad Med 82: S73 – S76.

Boudinot SG, Martin BC. 2001. Online anatomy lab (OAL): A self-regulated approach to the instruction of human anatomy. Interact Multimedia Electron J Comput Enhanc Learn 3:1.

Cardall S, Krupat E, Ulrich M. 2008. Live lecture versus video-recorded lecture: are students voting with their feet? Acad Med 83:1174-1178.

Choudhury B, Gouldsborough I. 2012. The use of electronic media to develop transferable skills in science students studying anatomy. Anat Sci Educ 5:125–131.

Collins JP. 2008. Modern approaches to teaching and learning anatomy. BMJ 227: a1310.

Creswell JW. 2011. Designing and conducting mixed methods research. 2nd Edition. Los Angeles, CA: SAGE Publications. 457p.

Dabbagh N. 2007. The online learner: Characteristics and pedagogical implications. Contemporary Issues in Tech and Teacher Ed 7:217 – 226.

Durham JA, Brettell S, Summerside C, McHanwell S. 2009. Evaluation of a virtual anatomy course for clinical undergraduates. Eur J Dent Educ 13:100–109.

Glaser B. 1965. The Constant Comparative Method of Qualitative Analysis. Soc. Probl. 12: 436–445.

Fleiss JL. 1971. Measuring nominal scale agreement among many raters. Psychol Bull 76: 378-382.

Green SM, Weaver M, Voegeli D, Fitzsimmons D, Knowles J, Harrison M, Shephard K. 2006. The development and evaluation of the use of a virtual learning environment (Blackboard 5) to support the learning of pre-qualifying nursing students undertaking a human anatomy and physiology module. Nurse Educ Today 26:388–395.

Gupta A, Saks NS. 2013. Esploring medical student decisions regarding attending live lectures and using recorded lectures. Med Teach 36: 767 – 771.

Hatwell Y. 2003. Introduction: Touch and cognition. In: Hatwell Y, Streri A, Gentaz E (Eds). Touching for knowing: Cognitive psychology of haptic manual perception. Philadelphia, PA: John Benjamins North America, 1-18.

Johnson RB, Onwuegbuzie AJ, Turner LA. 2007. Toward a definition of mixed methods research. J of Mixed Methods Res 1: 112-133.

Landis JR, Koch GG. 1977. The measurement of observer agreement for categorical data. Biometrics, 33: 159-174.

Limpach AL, Bazrafshan P, Turner PD, Monaghan MS. 2008. Effectiveness of human anatomy education for pharmacy students via the Internet. Am J Pharm Educ 72:145.

Lu CJ, Shulman SW. 2008. Rigor and flexibility in computer-based qualitative research: Introducing the Coding Analysis Toolkit. Int J Mult Res Approaches 2: 105-117.

Marks SC. 2000. The role of three-dimensional information in health care and medical education: The implications for anatomy and dissection. Clin Anat 13: 448-452.

McLachlan JC, Patten D. 2006. Anatomy teaching: ghosts of the past, present, and future. Med Ed 40: 243 – 253.

McNulty JA, Hoyt A, Gruener G, Chandrasekhar AEspiritu B, Price R, Naheedy R. 2009. An analysis of lecture video utilization in undergraduate medical education: associations with performance in the courses.

Nieder GL, Borges NJ. 2012.  An eight year study of online lecture use in a medical gross anatomy and embryology course. Anat Sci Educ 5:311 – 320.

Netter FH. 2012. Netter's 3D Interactive Anatomy.  Elsevier Inc., Philadelphia, PA. URL: www.interactelsevier.com/netter [accessed 6 Jan 2014]

O'Byrne PJ, Patry A, Carnegie JA. 2008. The development of interactive online learning tools for the study of anatomy. Med Teach 30:e260–e271.

Patton MQ. 1980. Qualitative evaluation methods. Beverly Hills, CA: Sage. 381p.

Saldana J. 2013. The coding manual for qualitative researchers. 2nd Ed. Thousand Oaks, CA: Sage. 303p.

Sugand K, Abrahams P, Khurana A. 2010. The anatomy of anatomy: A review for its modernization. Anat Sci Educ 3: 83-93.

Raynor M, Igguldent H. 2008. Online anatomy and physiology: Piloting the use of an anatomy and physiology e-book-VLE hybrid in pre-registration and post-qualifying nursing programmes at the University of Salford. Health Info Libr J 25:98–105.

Teddlie C, Tashakkori A. 2009. Foundations of mixed methods research: Integrating quantitative and qualitative techniques in the social and behaviour sciences.  Thousand Oaks, CA: Sage.

Wang R, Mattick K, Dunne E. 2010. Medical students' perceptions of video-linked lectures and video streaming. Res in Learn Tech 18: 19-27.

Wilson TW. 2015. Role of image and cognitive load in anatomical multimedia. In: Chan KL, Pawlina W (Eds). Teaching Anatomy. A practical guide. Cham, Switzerland: Springer International Publishing, 237-245.

Wright SJ. 2012. Student perceptions of an upper-level, undergraduate human anatomy laboratory course without cadavers.  Anat Sci Educ 5: 146-157.

Chapter 5

# 5 Pedagogical Modifications for Improving Communication

This chapter describes pedagogical modifications to the online course in its second offering to improve communication, and the re-assessment of student performance outcomes and perceptions (through surveys) of the online and F2F learning experience.

## 5.1 Introduction

### 5.1.1 Successes and Challenges from the Inaugural Year

The new online section of Systemic Human Anatomy was offered for the first time in 2012-13. Preliminary data comparing formats suggested that prior academic performance, not delivery format, predicted performance in anatomy (Attardi and Rogers, 2015). Student perceptions of learning anatomy in both formats were assessed to determine strengths and weaknesses of the online course (p. 45). While students preferred attending lectures online in archived format, the F2F lab format was favoured. Recorded lectures gave students the benefit of control over the instructional pace, and time and location of the instruction (p. 82). Students valued the privilege of working with cadaveric specimens in the F2F lab and their understanding of 3D structures was facilitated by the hands-on experience (p. 83). It was suggested that access to archived material be provided to F2F students (p. 82) and optional F2F lab time be made available to online students (p. 83). Students were more engaged by the instructor in a F2F setting in both lecture and laboratory (p. 83). These data suggested a need for increasing the engagement of students by TAs during the online lab, as well as promoting and facilitating the students' understanding of how to effectively use Netter's 3D Interactive Anatomy for independent study.

The TAs provided informal feedback on the utility of the virtual classroom's application share function during the online laboratories. The speed of image transmission of the constantly changing desktop was dependent on the internet connection speed of the TA and the receiving students. The students' connections were not fast enough to receive real time updates of the TAs screen, resulting in images that failed to load and were out of synch with the audio/video of the TA. An alternate method for demonstrating anatomical structures on 3D models was requested by the TAs.

Delivery methods for the online course, particularly the laboratory, were modified for the subsequent year based on student data (p. 45) and informal feedback from the professors and teaching assistants.

## 5.1.2    Pedagogical Modifications

When the Systemic Human Anatomy course was offered in the 2013-2014 academic year  students self-selected in either the F2F (353) or online section (138). Lectures were delivered as they had been in the past, however, the delivery of the lab demonstration was further developed to potentially enhance student instructor interactions.

Modifications were made to the online laboratory to increase interaction between students and TAs with the goals of improving communication between them and better facilitating student use of Netter's 3D Interactive Anatomy as per Moore's (1989) interactions (p. 9).  Each lab was presented online by three TAs. Content for a given lab was divided into two smaller lessons (15 minutes each) which ran simultaneously in two virtual classrooms with a TA facilitating each (Figure 13). Students were divided into two groups and rotated through the breakout rooms. The third TA was logged into both breakout rooms to help participants address technical issues unrelated to course content. For an additional hour the students were gathered into the same virtual room for further optional discussion with one of the TAs.  This format allowed the students to learn in smaller groups and gave

them the opportunity to interact with three TAs in a lab session.  The use of the third TA granted students prompt technical support during the lab without interruption of the lesson. Extra technical support was offered at the beginning of the course.  One week prior to commencement of the labs, online students were trained on how to communicate in the virtual classroom, and how to use Netter's 3D Interactive Anatomy and 360anatomy to study the 3D models.
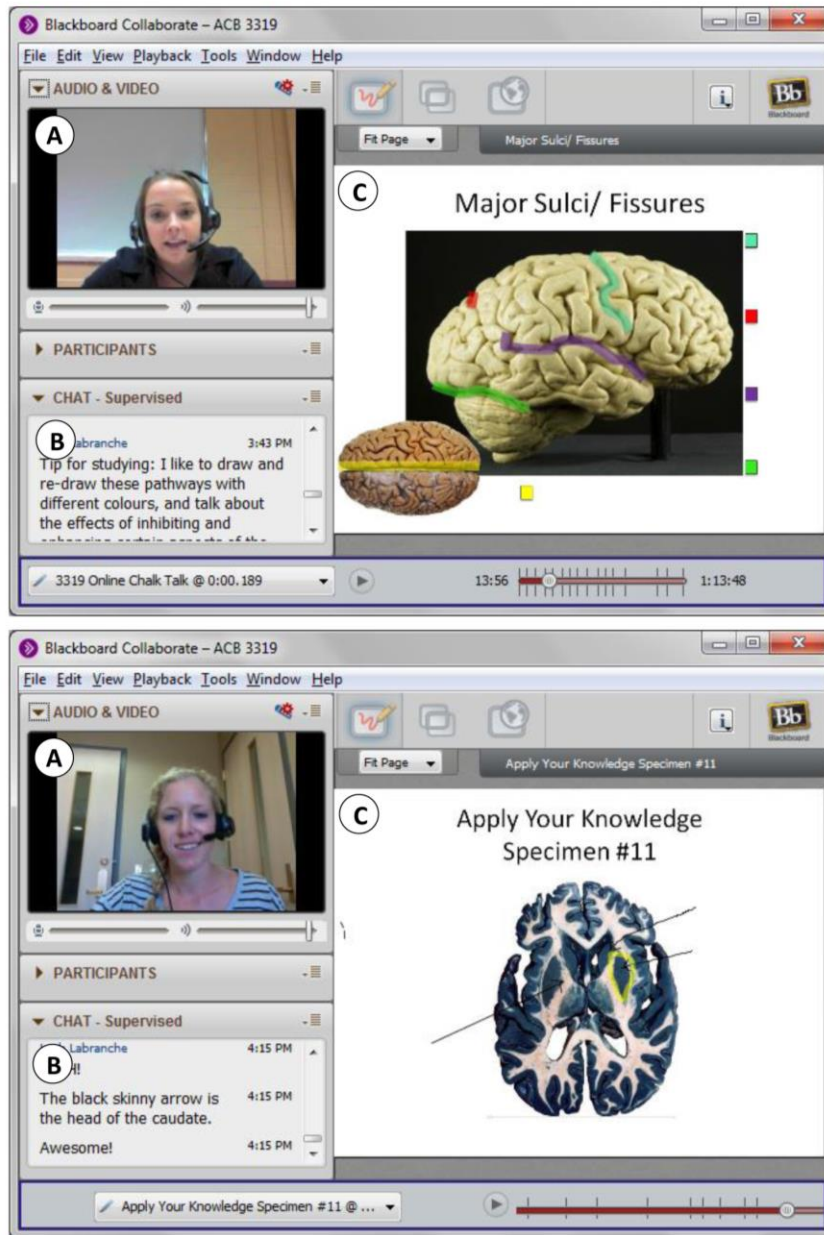
**Figure 13. Virtual laboratory breakout rooms.  The content for each lab was divided into two smaller stations which ran simultaneously in two virtual classrooms with a TA facilitating each.  Students could see and hear the TA (A) and communicate via instant messaging (B).  A third TA was logged in to both rooms to help participants, via instant messaging.  The content area (C) displayed teaching aids with TA and student annotations added. Sample neuroanatomy images from 360anatomy.uwo.ca (SDNL, 2012).**

Live manipulation of 3D models was replaced by Power Point slides. The TAs prepared slides of screen shots from key views of the 3D models. The slides were not intended to replace 3D model use, rather to function as a teaching aid for orienting students to what they should focus on when using the models independently to study. Using Power Point slides allowed the TAs and students to add markings to the slides using free form drawing tools as part of the lesson.

Voluntary F2F lab time (1 hour/week) was offered to online students as per the suggestions from former students (p. 83) course coordinators, and teaching assistants. Online students could use cadaveric prosections and plastic models for independent study. The course coordinator and a former undergraduate anatomy student were present at these drop-in sessions to supervise and answer questions, but did not provide formal instruction. In addition, the week before each set of tests, open F2F lab sessions (2 hours) were available to all online and F2F students.

Student comprehension of lecture material continued to be evaluated by 4 quarterly multiple choice tests, although their total contribution to the final grade decreased from 90% to 80%. Weekly laboratory quizzes were replaced by quarterly fill-in-the-blank lab tests totaling 20% of the final grade. Lab test questions (30) were photographs and illustrations projected on a screen and students were required to identify structures or state functions. Each term test and corresponding lab test were administered F2F in a proctored setting for all students.

## 5.1.3  Objectives

This study was designed to:
   (1) Determine the influence of virtual breakout rooms on student-teacher communication, student-student communication,  and student engagement

(2) Reveal means of online student-student communication outside of
designated lesson times

(3) Assess the impact of the Netter's 3D Interactive Anatomy on learning

(4) Reassess whether prior academic performance and/or the modified
course delivery format predict performance in anatomy.

## 5.2    Methods

Research protocols for analysis of student grades (REB#102631) and student
perceptions (REB#103359) were approved by The Office of Research Ethics at
Western University (Appendix 1 Appendix 3).

Perceptions of learning anatomy in the online and F2F formats were collected
through a quantitative survey (Appendix 6Appendix 7) of both online and F2F
students.  The survey was administered online through Fluid Surveys
(FluidSurveys, Ottawa, Ontario) for a two week period between the students' last
anatomy class and final set of tests.  The survey consisted of 4 parts: (1)
Demographic information (2) Perceptions of student-teacher communication for
academic and social purposes.  While other purposes for communication may
exist, this study focused on the social and pedagogical forms since their
importance was emphasized by the previous year's students (Attardi and Rogers,
2015).  Students rated their agreement to various statements using a 5-point
Likert scale (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree,
4 = agree, 5 = strongly agree).  The Likert scale data were recoded into three
categories where "disagree" was the sum of percentages for "strongly disagree"
and "disagree", "agree" was the sum of responses of percentages for "strongly
agree" and "agree", and "neither agree nor disagree" remained the same. (3)
Perceptions and methods of student-student communication for academic and
social purposes.  Perceptions of communication were assessed using the same
Likert scale as the previous section of the survey.  Students rated the frequency

of different methods of peer communication using a 5-point Likert scale (1 = never, 2 = rarely, 3 = occasionally, 4 = a moderate amount, 5 = a great deal). The Likert scale data were recoded into three categories where "rarely" and "never" were combined, "a moderate amount" and "a great deal" were combined, and "occasionally" remained the same. Students also selected from a list of methods through which online course resources were shared. (4) Usage and assessment of Netter's 3D Interactive Anatomy. Students who used the software rated the helpfulness of its different functions using a 5-point Likert scale (1 = not at all helpful, 2 = a little helpful, 3 = somewhat helpful, 4 = quote helpful, 5 = very helpful). The Likert scale data were recoded into three categories where "not helpful" was the sum of percentages for "not at all helpful" and "a little helpful", "helpful" was the sum of percentages for "quite helpful" and "very helpful" and "somewhat helpful" remained the same. Students who did not use Netter's selected from a list of reasons to indicate why.

Anonymous student grades were provided by the course coordinator and the Bachelor of Medical Sciences Administrative Office. Assessments of student performance were compared between the sections using a Mann-Whitney U test. Incoming grade averages were calculated for each student from six second year required sciences courses (cell biology, biochemistry, genetics, organic chemistry, scientific methods, and statistics). A Pearson correlation test determined whether incoming grade averages and final anatomy grades were correlative.

Descriptive and inferential statistics for survey responses and student grades were calculated using the Statistical Package for Social Sciences (IBM, Armonk, NY).

## 5.3    Results

### 5.3.1    Demographics

Survey respondents were volunteers from the online (101/138; 73.2% participation rate) and F2F section (273/354; 77.1% participation rate). Participant demographics can be seen in Table 12.  The average age of the participants was 20.85 years (SD = 1.18).  There were approximately the same number of males (48.1%) compared to females (51.6%). Most students (68.6%) were in the Bachelor of Medical Sciences program.  The mean age, proportion of males to females and distribution of degree programs were statistically identical between the groups, indicating homogeneity between the sections.   Thus, remaining data for all students were analyzed together and not stratified by demographics.

**Table 12. Survey respondent demographics for 2013-14.**

| Characteristic | Online (N = 138) Mean ± SD or N (%) | Face-to-face (N = 354) Mean ± SD or N (%) | Total (N = 374) Mean ± SD or N (%) |
|---|---|---|---|
| **Age (years)** | 20.99 ± 1.29 | 20.79 ± 0.80 | 20.85 ± 1.18 |
| **Gender** | | | |
| Male | 53 (52.5) | 127 (46.5) | 180 (48.1) |
| Female | 48 (47.5) | 145 (53.1) | 193 (51.6) |
| **No response** | 0 (0) | 1 (0.4) | 1 (0.3) |
| Degree | | | |
| Bachelor of Medical Sciences | 67 (66.3) | 189 (69.5) | 256 (68.6) |
| Bachelor of Science - Biology | 19 (18.8) | 52 (19.1) | 71 (19) |
| Bachelor of Science - other | 14 (13.9) | 30 (11.0) | 44 (11.8) |
| No response | 1 (1) | 1 (0.4) | 2 (0.5) |

## 5.3.2    Student-Teacher Communication

The online students' self-reported attendance behaviour can be seen in Table 13. A large majority of online students reported that they attended lectures in archived format (81.2%), few logged in during live times (2%), and a small group attended some lectures live and some recorded (11.9%).  Some of the online students in the group that did not select any of the provided attendance options (5%) commented that they attended the F2F lectures.  Student reports of their laboratory attendance were similar to lecture attendance.  A large majority of online students watched the archived version of the demonstrations (80.2%), a small group attended some labs during live time and watched some as recordings (10.9%), and few attended during live time (3%).  The group who did not select any of the provided attendance formats (5.9%) commented that they did not attend online labs in any format.  Students preferred the archived over live format because they valued the ability to control instructional pace (92%) and access to the lecture at any time (90.1%).

**Table 13. 2013-14 Online students' self-reported attendance behaviour.**

| Reported Online Attendance Format | Lectures (N = 101) N (%) | Laboratory (N = 101) N (%) |
| --- | --- | --- |
| Live | 2 (2) | 3 (3) |
| Recorded | 82 (81.2) | 81 (80.2) |
| Mix of live and recorded | 12 (11.9) | 11 (10.9) |
| Other | 5 (5) | 6 (5.9) |

The majority of students in both the online (72.7%) and F2F (84.3%) sections agreed that they were able to ask their professors questions pertaining to lecture if they chose to (Figure 14A).  Less thought that they were able to interact with the professor socially, though the majority still agreed (54.1% online; 71.5% F2F).  A significantly greater number of F2F students agreed with these statements compared to online; however, the effect sizes were small ($r < 0.3$), indicating a weak relationship between attendance format and the perception of student-professor interactions. Most of the online students (74.3%) perceived that the live video feed of the professor from the lecture room was important (distribution not shown).  Only a minority of students in both groups felt engaged by the professors when they attended lecture (43% online; 49% F2F).

A large majority of online (75.2%) and F2F (93.8%) students agreed that they were able to ask their teaching assistant questions pertaining to the laboratory and that could interact socially with the TAs (71.3% online; 91.2% F2F) (Fig. 2A). A smaller majority (60.4% online; 81.7% F2F) agreed that overall they were engaged by the teaching assistants during the laboratory.  For each of these comparisons, the proportion of F2F students in agreement with the statement was significantly greater than the proportion of online students; however, small effect sizes ($r < 0.3$) were observed.  Furthermore, most online students (65.7%) agreed that it was easy to contact their TA with technical problems and have them resolved (distribution graph not shown).

Student-teacher communication was compared between the lecture (with the professor) and the laboratory (with the TA) within the same groups (online and F2F) (Figure 14B).  A significantly greater number of students in both groups agreed that they could interact socially with teachers in the laboratory setting versus lecture.  Overall engagement by the teacher in each group was significantly greater in the laboratory compared to lecture.
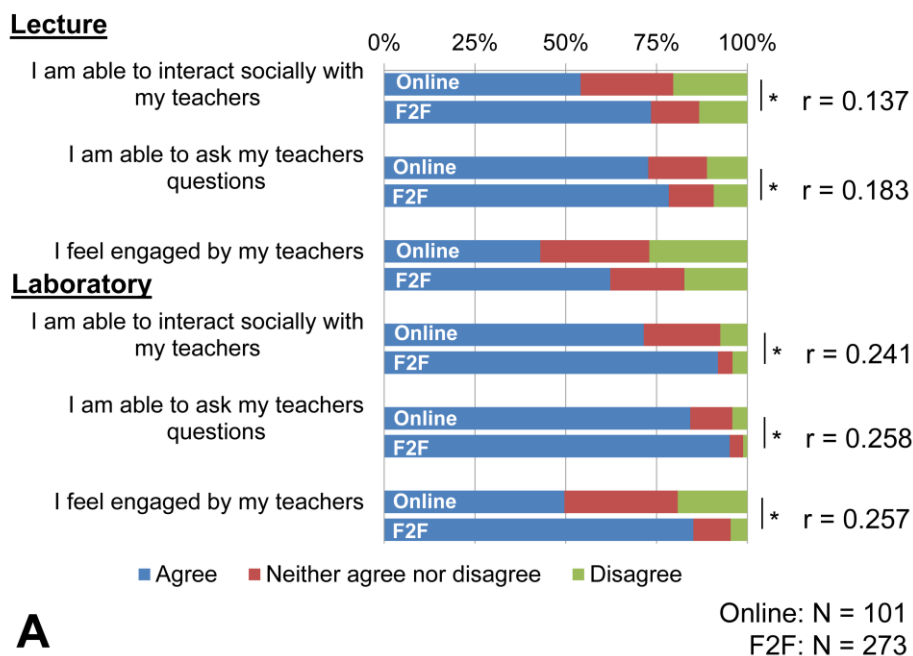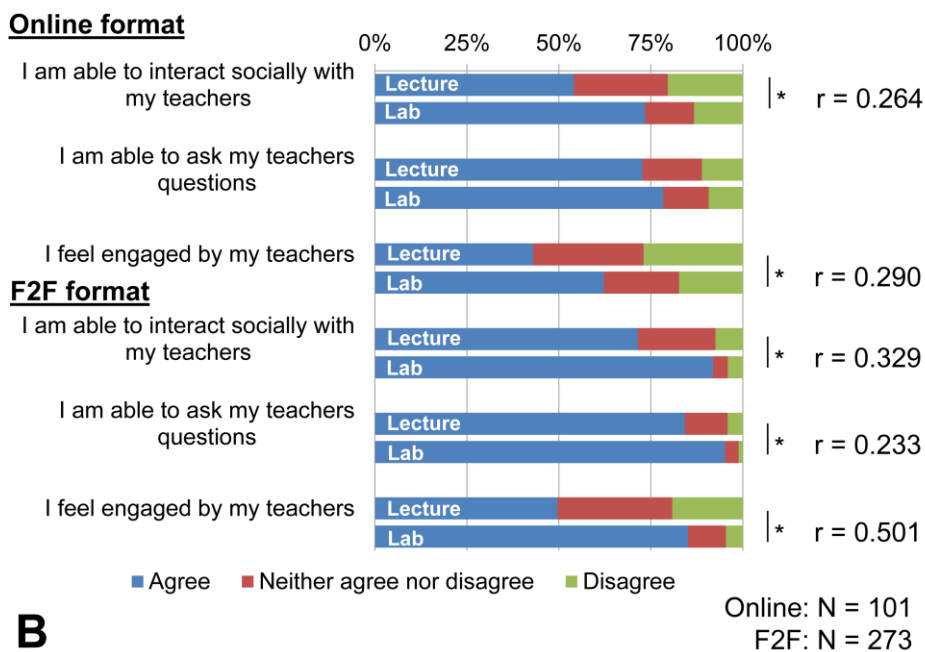
**Figure 14. Perceptions of student-teacher communication. (A) The online versus F2F format. *p < 0.01 Mann-Whitney U independent samples (B) The lecture versus laboratory. *p<0.01 Wilcoxon related samples.**

### 5.3.3    Student-Student Communication

Approximately half of online students (53.6%) agreed that they were able interact with their peers socially during lecture, while a larger majority of F2F students (74.1%) agreed (Figure 15A).  A majority of students in both sections agreed that they were able to ask their peers questions during lectures (67.7% online; 85.1% F2F).  In their respective lab demonstrations, the majority of online (59.2%) and F2F (82.3%) students agreed that they could interact socially with their peers. Most students (57.6% online; 84.6% F2F) also agreed that they were able to ask their peers questions during laboratory if they chose to.  Though each difference between the sections was statistically significant, small effect sizes ($r < 0.3$) were observed.

Student-student communication was compared between the lecture and the laboratory within the same groups (online and F2F) (Figure 15B).  Significantly fewer online students agreed that they were able to ask their peers questions during the lab demonstration compared to lecture.  A significantly greater number of F2F students agreed that they were able to interact socially with their peers in a laboratory setting compared to the lecture. The effect sizes for both of these differences were small ($r < 0.3$).  Social interaction between online students and the ability for F2F students to ask their peers questions were unaffected by the type of instruction.
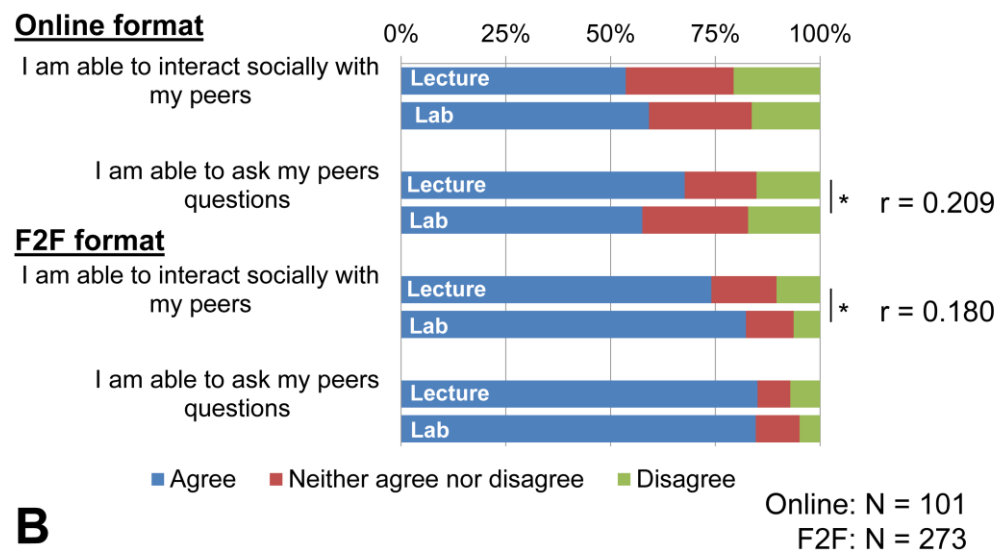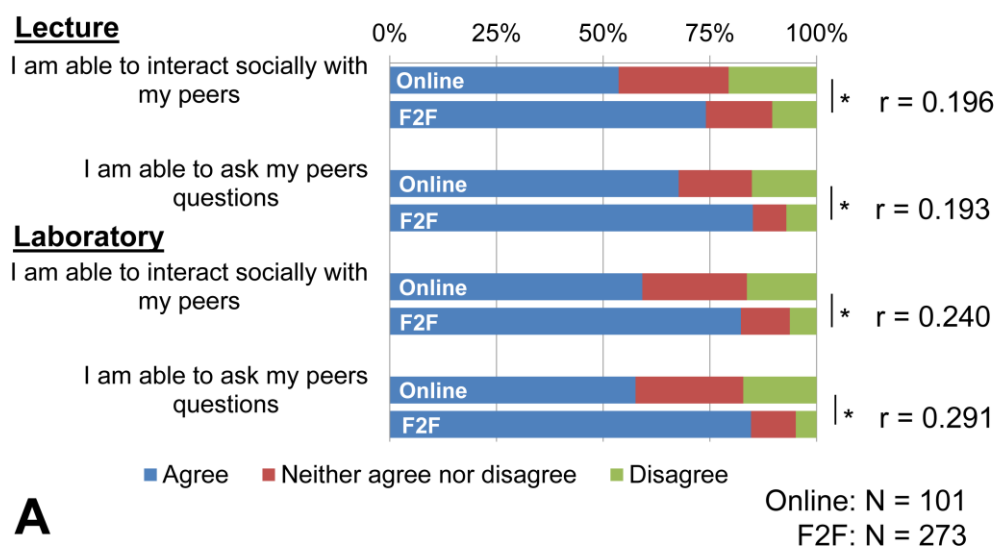
**Figure 15. Perceptions of student-student communication. (A) The online versus F2F format.  *p < 0.01 Mann-Whitney U independent samples (B) The lecture versus laboratory. *p<0.01 Wilcoxon related samples.**

The methods of student-student communication (pertaining to the study of anatomy) that students reported to use the most frequently were texting from a mobile device (34.7% online; 54.9% F2F), Facebook (34.3% online; 63% F2F) and meeting face-to-face (33.7% online; 50.5% F2F) (Figure 16).   The proportion of F2F students who reported using these tools a "moderate amount – a great deal" was significantly higher than the online students; however, effect sizes were small ($r < 0.3$).  A large majority of respondents (83.8% online; 77.8% F2F) reported that they rarely or never used the forum on the course website (Sakai Collaboration and Learning Environment 2.9, The Sakai Foundation).
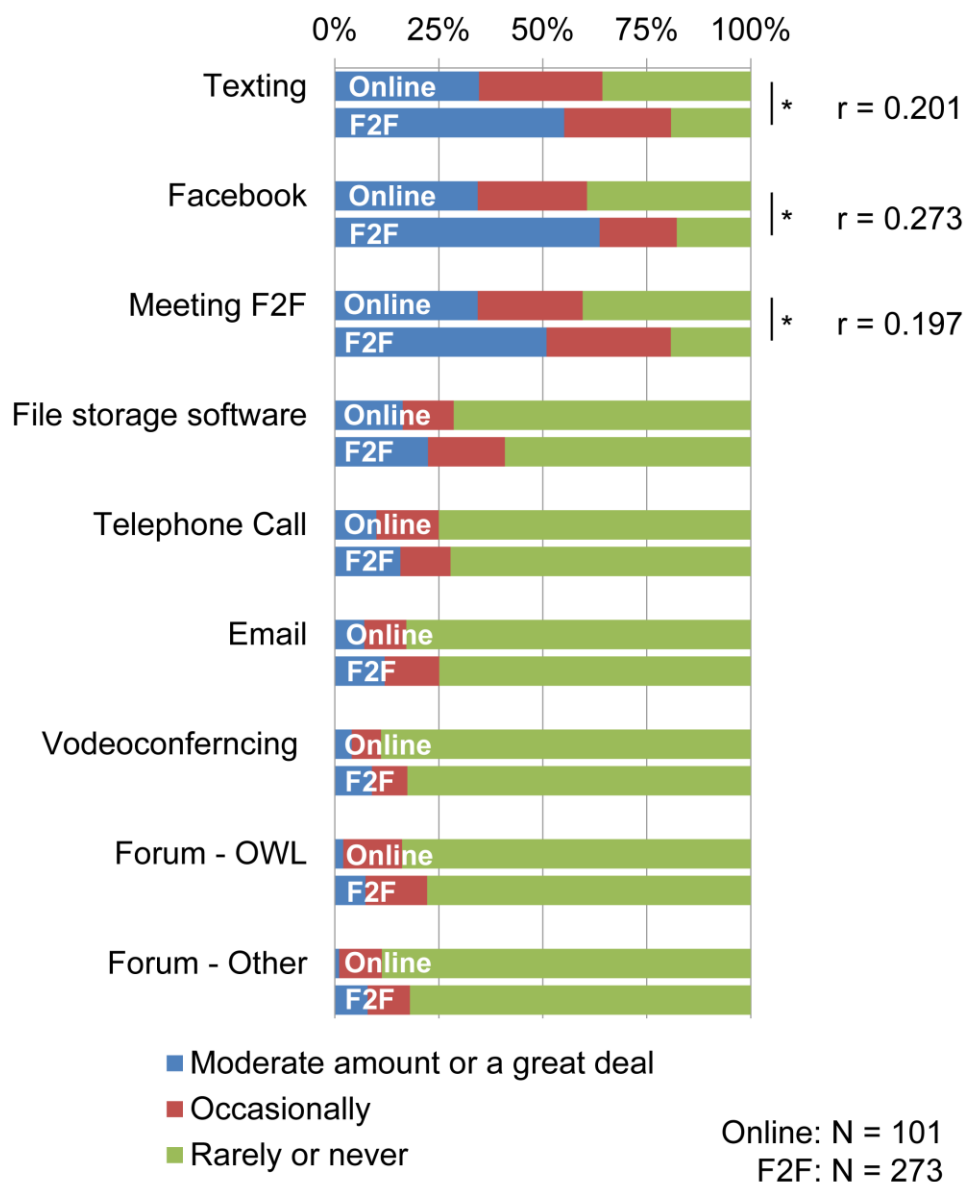
**Figure 16. Methods of student-student communication pertaining to the study of anatomy. *p<0.01 Mann – Whitney U independent samples.**

A substantial number of online students (25; 24.8%) reported that they shared their access to lecture and/or laboratory recordings with classmates in the F2F section.  Within this group of students, the most common means of giving access to archives were sharing login credentials for Blackboard Collaborate (60%) and watching archives together (24%) (Table 14).  Consequently, F2F students (75; 27.5%) reported having access to archives, with most using a classmate's Blackboard Collaborate login credentials (52%) or watching archives with peers (32%).   Very few online students (5; 5%) reported sharing access to Netter's 3D Interactive Anatomy with a F2F classmate.  Of these students, 3 provided their login credentials and 2 used the software with their colleagues.  Only 15 (5.5%) of F2F students used the 3D models, all of whom did not reveal how they accessed the software.

**Table 14. Sharing of resources from online to F2F students.  Respondents could select all sharing methods that applied.**

| Method of resource sharing (online) or receiving (F2F) | Lecture/Lab Archives | | Netter's 3D Interactive Anatomy | |
| --- | --- | --- | --- | --- |
| | Online (N = 25) N (%) | F2F (N = 75) N (%) | Online (N = 5) N (%) | F2F (N = 15) N (%) |
| Login credentials | 15 (60%) | 39 (52%) | 3 (60%) | 0 (0%) |
| Used together | 6 (24%) | 24 (32%) | 2 (40%) | 0 (0%) |
| Shared direct URL | 1 (4%) | 16 (21.3%) | Not applicable | Not applicable |
| Other | 2 (8%) | 3 (4%) | 0 (0%) | 1 (6.7%) |
| Prefer not to answer | 3 (12%) | 1 (1.3%) | 0 (0%) | 15 (100%) |

### 5.3.4    Use and Assessment of Netter's 3D Interactive Anatomy

Approximately half of the online students (56%) used Netter's 3D Interactive Anatomy independent of the TAs.  The software's features that were rated the most helpful for student learning where the ability to dissect 3D models (remove selected body parts) (73.2%), load only models that pertained to a given system (74.1%) and add labels to body parts (70.9%) (Figure 17).  Use of virtual prosections, unique combinations of structures created by the TA and saved as a *.cap file, were rated as helpful by only 50.9% of students.  Of the 9 learning tools provided to the students for rating, use of the *.cap files was ordered second last in terms of helpfulness.

Of the students who did not use Netter's (43%), the most frequent explanations were that they did not have time to use the software (53.5%) and that it wasn't necessary to use it to learn what they perceived they needed to learn (51.2%) (Table 15).
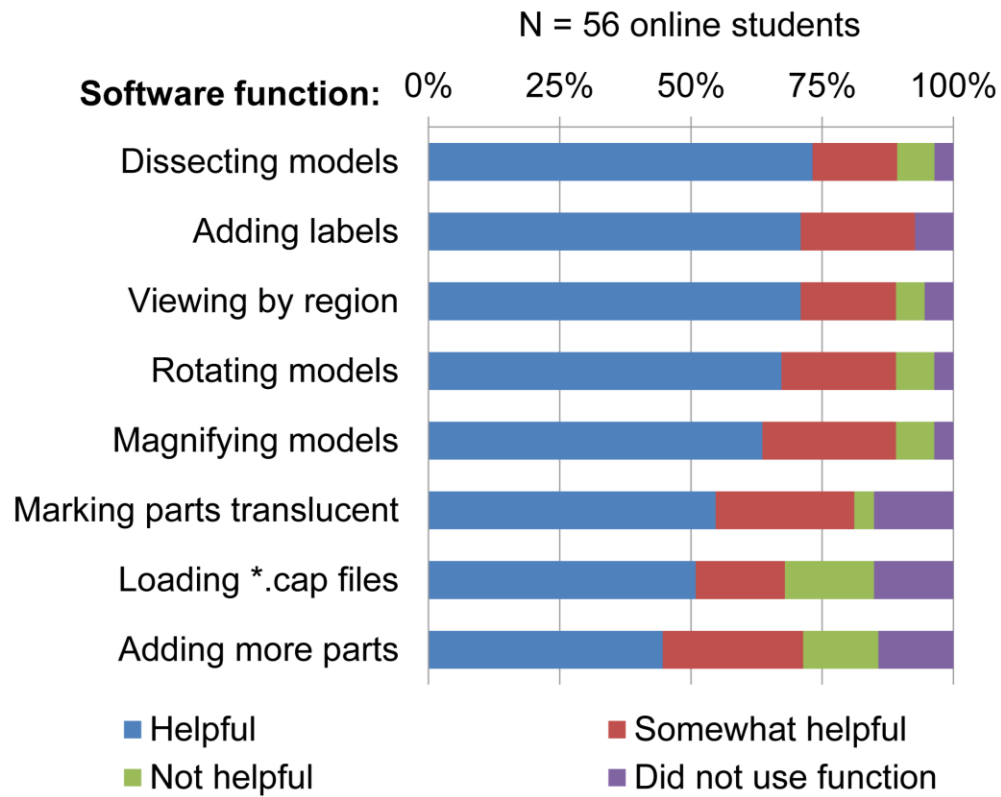
**Figure 17. Helpfulness of Netter's 3D Interactive Anatomy software functions for 2013-14 online students.**

**Table 15. Reasons why 2013-14 online student survey participants (43/101; 42.6%) did not use Netter's 3D Interactive Anatomy.  Respondents could select all statements that applied.**

| I did not use Netter's 3D Interactive Anatomy because: | N (%) |
|---|---|
| *I did not have time* | 23 (53.5) |
| *I learned everything I needed to without it* | 22 (51.2) |
| *I did not think it would help me learn* | 15 (34.9) |
| *It was not mandatory* | 14 (32.6) |
| *I couldn't launch it* | 14 (32.6) |
| *I did not think it would help me prepare for exams* | 11 (25.6) |
| *I did not care to try it* | 7 (16.3) |
| *I did not know I had access* | 6 (14) |
| *My login credentials did not work* | 5 (11.6) |
| *I did not know how to use it* | 5 (11.6) |

## 5.3.5    Academic Performance

The incoming grade average of the online students (79.09%, SD = 9.15%) was significantly higher (Mann-Whitney U Test, p = 0.01) than the F2F students (76.75%, SD = 9.181).  On the first lab test, the online students' average (72.77%, SD = 11.87) was significantly higher (Mann-Whitney U Test, p < 0.001) than the F2F students' (67.67%, SD = 13.29). The effect size was 0.118, suggesting that the relationship between delivery format and performance on lab test 1 was weak and the discrepancy did not translate into a difference in final anatomy grades (Table 16).   There were no significant differences in groups means on the remaining assessments. There was a strong, positive correlation (Pearson) between incoming grade average and final anatomy grade in both the online (r = 0.70, p < 0.01) and F2F (r = 0.71, p < 0.01) sections (Figure 18).

**Table 16. Comparison of student performance measures between the sections for 2013-14.**

| Assessment Measure | Online (N = 138) Mean grade (%) ± SD | Face-to-face (N = 354) Mean grade (%) ± SD | p - value |
|---|---|---|---|
| Test 1 | 80.82 ± 10.66 | 78.87 ± 11.59 | 0.116 |
| Lab Test 1 | 72.77 ± 11.87 | 67.67 ± 13.29 | <0.001[a] |
| Test 2 | 78.85 ± 13.86 | 77.25 ± 13.19 | 0.284 |
| Lab Test 2 | 79.79 ± 15.94 | 78.17 ± 17.42 | 0.469 |
| Test 3 | 82.36 ± 14.02 | 81.48 ± 14.92 | 0.692 |
| Lab Test 3 | 63.52 ± 18.98 | 63.85 ± 20.42 | 0.666 |
| Test 4 | 79.65 ± 12.25 | 78.17 ± 13.64 | 0.365 |
| Lab Test 4 | 85.32 ± 10.93 | 83.97 ± 13.49 | 0.683 |
| Final grade | 78.33 ± 18.81 | 77.04 ± 18.00 | 0.316 |

[a]**The online students scored significantly higher (Mann-Whitney U test) on Lab Test 1 compared to F2F students**
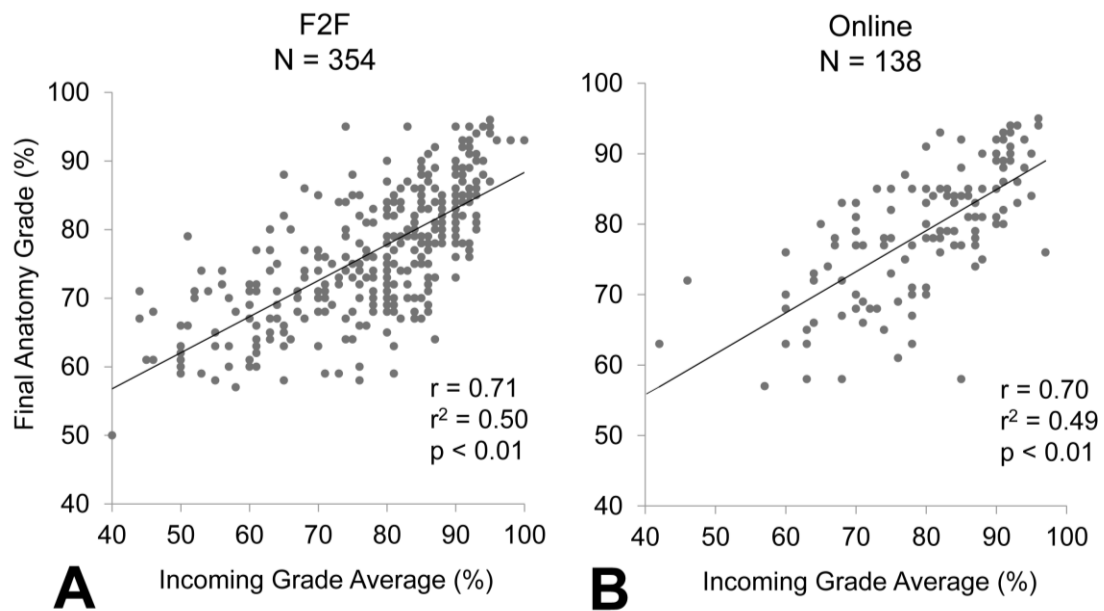
**Figure 18. Correlation between incoming grade average and 2013-14 anatomy grade. There were strong, positive correlations (Pearson) between incoming grade average and final Anatomy grade in both the F2F (A) and online (B) sections.**

## 5.4    Discussion

### 5.4.1    Student-Teacher Communication

The majority of online students agreed that they were able to ask their teachers questions and could interact socially with them in both the lecture and laboratory settings.  Students were able to instant message their teachers for any reason (academic, social) if they attended lecture and laboratories live.  Interestingly, the archived versions of lectures and labs were favoured over live attendance.  Respondents favoured this format because they valued the ability to control instructional pace.  The importance of control over instructional pace has been reported in the previous year of the course (p. 82) and in studies on medical students' perceptions of learning from recorded lessons (Cardall et al., 2008; Wang et al., 2010; Beale et al., 2014).  Students may have perceived the benefit of pace control to be greater than the opportunity to interact live with their professors and TAs.  They also might have felt that asynchronous means of communication with their teachers was sufficient.

It is unknown how students communicated socially or regarding academic matters with their instructors outside of live lecture and lab times. It is plausible that these communications were limited to F2F office hours, email, and the forum on the course website since the instructors did not permit students to contact them by text message or through social media (the primary means of student-student communication).  Future studies on the approach taken by online anatomy instructors are necessary to provide a concrete understanding of learner-teacher communication methods.

Most online and F2F students agreed that they could communicate socially with their teachers and were more engaged by them in their respective laboratories versus lecture.  This suggests that the way a learning environment (real or virtual) is used, and not the environment itself, influences student perception of communication and engagement with teachers.  Compared to a traditional,

didactic lecture, the laboratory demonstration setting allows for more conversation between students and teachers. Despite the fact that most online students viewed the lab demonstration as a recording, the instruction itself was less structured as the students attending live could interject and shape the course of the lesson to decrease the transactional distance (Moore, 1989).

Since the majority of students agreed that they could interact with their TA for social and academic purposes and that they were engaged during the laboratory, the implementation of virtual breakout rooms and the team teaching approach by the TAs was successful compared to the previous year. In 2012-13, the overall reasons that students preferred the F2F laboratory format were that they were more engaged by the TAs and it was easier to ask them questions in person (p. 83). Student engagement and the ability to ask the TA questions were not identified as reasons for preferring the online laboratory format. In all comparisons of student-teacher communication between the online and F2F group in 2013-14, a greater proportion of F2F students agreed that that they could interact with their instructors. Though the relationship between course format and agreement was weak, it may still suggest that for some students the online environment is not an adequate replacement for F2F in terms of communication.

## 5.4.2    Student-Student Communication

The majority of online students agreed that they could ask questions of their peers and could interact socially with them in both the lecture and laboratory settings. Since most online students did not attend lectures and laboratories during live times, it can be inferred that their primary means of communication with peers pertaining to the study of anatomy were texting from a mobile device, Facebook, and meeting up face-to-face (Figure 16). It is assumed that social interaction was included in these communications. Despite the intention for the forum on the course website to be a primary means of communication between students, most respondents in both sections reported that they used it rarely or

never.  The communication tool used most frequently was texting from a mobile device.  Students' desire to use personal mobile devices for educational correspondence has been observed world-wide.  In a recent survey of over 100 000 undergraduates across 14 countries, it was found that students seek to increase the use of their personal digital devices for learning outside of the classroom (Dahlstrom et al., 2013).  Since students expect access to course materials any time and from anywhere (Dahlstrom et al., 2013), it is reasonable to infer that they value timely communication with peers regarding course content.  The forum on the course website is not conducive to prompt responses since students are unable to receive alerts from a specific thread in the discussion.

More F2F students had access to archives than the online students reported to share.  This suggests that resource sharing was exponential such that an online student may have provided their login credentials with more than one F2F peer, who could have shared the same credentials with more than one person.  Likewise, viewing archives together could have occurred in groups.  It is common in studies of online anatomy learning resources to draw conclusions about student usage solely from access logs (Braco et al., 2010; McNulty et al., 2011; Nieder and Borges, 2012).  This study illustrates why logs alone may not provide an accurate representation of student usage and that it is also necessary for students to self-report as exemplified in other studies (McNulty et al., 2009, Braco et al., 2013; Gupta and Saks, 2013; Topping, 2014).

### 5.4.3    Use of Netter's 3D Interactive Anatomy

In the first study of the online course, survey respondents assessed the helpfulness of the same Netter's 3D Interactive Anatomy functions (p.45).  The top rated function (adding labels to body parts) was identified as helpful by only 59.3% of students, and overall ratings for each functions were lower than in the second course offering.  It should be noted that these survey respondents were F2F students who attended the course online for one week, which included

access to the 3D models. In the current study, respondents were students that were enrolled in the online section for two semesters. Their most favoured functions (dissecting models, adding labels, and viewing body parts by region) were each rated as helpful by more than 70% of students. Interestingly, of the students in both years who did not use the 3D models, approximately half perceived that they learned everything they need to without it. Since performance on laboratory assessments was not linked to survey responses, it is unknown if grades are correlative to 3D model use.

Comparison between the years suggests that increased time available for students to use the software and the modifications to the online course (additional training and technical support from the TAs, interactive drawing exercises with the 3D models) were successful in facilitating a more meaningful use of 3D models.

### 5.4.4    Academic Performance

The students' previous grades, and not course delivery format, predicted success in the anatomy course. This is consistent with outcomes of the preceding academic year (Attardi and Rogers, 2015). The only statistically significant difference between the sections was the online students' superior achievement on the first lab test. This may be attributed to the testing format. Lab test questions were pictures of cadavers and 3D models displayed on a screen at regular intervals. Using physical specimens is a more traditional approach to testing the students' ability to identify anatomical structures (Inuwa et al., 2012). The transfer of knowledge generally refers to the degree to which knowledge acquired in one context can be transferred to another (Barnett and Ceci, 2002). Online students were trained using 3D computer models and pictures on a computer screen. It may have been easier for them to interpret test questions in this format compared to students who studied from physical specimens, resulting in a greater transfer of knowledge in the online group. This phenomenon has been observed in other studies of anatomical education that compared academic

achievement between student groups who had used different types of learning materials. Hisley et al. (2008) reported that students who performed real dissections scored lower on tests using 3D anatomical models than students who performed digital dissections on 3D models. Similar results, but with an opposite study design, were observed by Saltarelli et al. (2014) when students learning from interactive digital cadaveric images were unable to transfer their knowledge to real cadavers. In our study, F2F students were able to adapt to the testing format and achieve the same grades as online students on subsequent tests. It is unknown if and how their approach to preparing for the lab test changed.

### 5.4.5    Future Directions

We have assessed student perceptions of the learning experience over a two year period. Future qualitative studies will be carried out to reveal professor and teaching assistant perspectives of teaching anatomy online during this same period.

## 5.5    Conclusion

Online virtual laboratory breakout rooms exposed students to 3 TAs each week and allowed them to learn in smaller groups. The new laboratory format facilitated the online students' use of Netter's 3D Interactive Anatomy. The majority of online students perceived that they could ask their professors, TAs, and peers questions about the course and interact socially with them. Few of these interactions, however, occurred within the virtual classroom during live lecture and laboratory times. The students' preferred methods of interacting with their peers was through texting from a mobile device, Facebook, and meeting F2F. It is unknown how they interacted with their professors outside of class. While use of virtual breakout rooms engaged online students in learning and the students were satisfied with their interactions between TAs and peers, online labs do not appear to adequately replace the F2F learning environment for all

students.  Consistent with the previous year, performance in anatomy was predicted by prior academic achievement, and not the course format.

## 5.6	Literature Cited

Attardi SM, Rogers KA.  2015. Design and implementation of an online systemic human Anatomy course with laboratory.  Anat Sci Educ 8: 53-62.

Barnett SM, Ceci SJ. 2002. When and where do we apply what we learn? A taxonomy for far transfer. Psych. Bull. 4:612-637.

Beale EG, Tarwater PM, Lee VH. 2014. A retrospective look at replacing face-to-face embryology instruction with online lectures in a human anatomy course. Anat Sci educ 7:234-241.

Bacro TRH, Gebregziabher M, Fitzharris TP. 2010. Evaluation of a lecture recording system in a medical curriculum. Anat. Sci. Educ. 3: 300-308.

Cardall S, Krupat E, Ulrich M. 2008. Live lecture versus video-recorded lecture: are students voting with their feet? Acad Med 83:1174-1178.

Dahlstrom E, Walker JD, Dziuban C. 2013. ECAR study of undergraduate students and information technology 2013. Louisville, CO: Educause Centre for Analysis and Research. URL: https://net.educause.edu/ir/library/pdf/ERS1302/ERS1302.pdf  [accessed 19 Feb 2015]

Gupta A, Saks NS. 2013. Exploring medical student decisions regarding attending live lectures and using recorded lectures. Med Teach 35: 767-771.

Hisley KC, Anderson LD, Smith SE, Kavic SM, Tracy JK. 2008. Coupled physical and digital cadaver dissection followed by a visual test protocol provides insights into the nature of anatomical knowledge and its evaluation. Anat Sci Educ 1: 27-40.

McNulty JA, Hoyt A, Gruener G, Chandrasekhar A, Espiritu B, Price R, Naheedy R. 2009. An analysis of lecture video utilization in undergraduate medical education: Associations with performance in the courses.  BMC Med Educ 9:6.

McNulty JA, Hoyt A, Chandrasekhar AJ, Espiritu B, Gruener G, Price R, Naheedy R. 2011. A three-year study of lecture multimedia utilization in the medical curriculum: associations with performance in basic sciences.

Moore MG. 1989. Three types of interaction.  Am J of Distance Ed 3:1-6.

Moore MG. 1993. Theory of transactional distance. In: Keegan D (Ed). Theoretical principles of distance education. New York, NY: Routledge, p.

Nieder GL, Borges NJ. 2012. An eight year study of online lecture use in a medical gross anatomy and embryology course. Anat Sci Educ 5:311-320.

Netter FH. 2012.  Netter's 3D Interactive Anatomy. Elsevier Inc., Philadelphia, PA.  URL: https://www.interactelsevier.com/netter [accessed 15 Feb 2015].

Saltarelli AJ, Roseth CJ, Saltarelli WA. 2014. Human cadaver vs multimedia simulation: A study of student learning in anatomy. Anat Sci Educ 7:331-339.

Topping DB. 2014. Gross anatomy videos: student satisfaction, usage, and effect on student performance in a condensed curriculum. Anat Sci Educ 7: 273 – 279.

Wang R, Mattick K, Dunne E. 2010. Medical students' perceptions of video-linked lectures and video streaming. Res in Learn Tech 18: 19-27.

## Chapter 6

# 6 Instructor Perspectives of Teaching Systemic Human Anatomy Online

This chapter describes the assessment of instructor perceptions (through interviews) of teaching anatomy online, and suggests methods by which the online teaching experience can be improved in future course offerings.

## 6.1 Introduction

A new fully online section of an undergraduate Systemic Human Anatomy course has been offered for two years (2012-2014). Though the outcomes associated with student performance (Attardi and Rogers, 2015; p. 91) and student perceptions of learning experience (p. 45; p. 91) have been studied thoroughly, it is unknown how addition of the online section has impacted its instructors.

### 6.1.1 Teaching Online Lectures

Lectures from the F2F classroom were broadcast to online students using Blackboard Collaborate (Blackboard Inc., Washington, DC) virtual classroom. The software, combined with a video camera and wireless microphone, streamed live audio and video of the professor. The professor could load Power Point slides (Microsoft Corporation, Redmond, WA) into the virtual classroom and add annotations to the slides for online students to see. It was not possible for the professors to use a laser pointer in the F2F lecture room because the laser's movements on the projected slides could not be captured in Blackboard Collaborate for online students. Professors pointed to features on their slides using the annotation tools, thus they were normally stationary at the podium and unable to move around the lecture room. An air mouse (Air Mouse GO Plus GYM110NA, Gyration, Camarillo, CA), which can be controlled without resting on a surface, was available to professors who wanted to be mobile while lecturing. This alternate setup required the professor to application (screen) share Power

Point rather than load the slides into the virtual classroom software.  A departmental technician and graduate teaching assistant (TA) set up the virtual classroom and hardware for the professor before the lecture. The TA remained in the F2F audience during the lecture to monitor the audio/video equipment and communicate with online students using the virtual classroom's instant messenger.  The TA answered the students' live questions or passed them on verbally to the professor, who answered the questions as part of the lecture. Live attendance was not mandatory for students and all lectures were archived for unrestricted future viewing.

## 6.1.2    Teaching Online Laboratories

Laboratories for online students were taught independently of the F2F students. In the inaugural year of the online course, one TA delivered all of the laboratories in the virtual classroom.  Structures were demonstrated on 3D models instead of cadaveric prosections. Most of the models were produced using Netter's 3D Interactive Anatomy (Netter, 2012).  Teaching assistants created custom models (virtual prosections) by selecting specific structures pertinent to a given lab. These could be saved as a special file type (*.cap) and opened by any user (professor or student) with the instructor version of Netter's 3D Interactive Anatomy.  The central nervous system was taught using 360° rotatable images of plastinated brains developed in house (www.360anatomy.uwo.ca). During the laboratory, the TA opened the virtual prosections or 360° images on the teaching computer and used the application share function to broadcast the desktop.  Live audio/video of the TA captured his/her lesson using the 3D models. Students were encouraged to use the virtual prosections on their own computers for independent study.  The length of the online laboratory was 1.5 hours with a 30 minute formal demonstration followed by a one hour tutorial where the  TA remained in the virtual classroom  to answer questions via the instant messenger.  Student attendance at laboratory was not mandatory and all demonstrations were archived for future viewing.

The format of the laboratory was modified for the 2013-14 academic year. Each lab was presented online by three TAs. Content for each lab was divided into two smaller lessons (stations) which ran simultaneously in two virtual classrooms (Blackboard Collaborate breakout rooms) with a TA facilitating each. Students were divided into two groups and rotated through the breakout rooms. The third TA was logged into both breakout rooms to help participants address technical issues unrelated to course content. This format allowed the students to learn in smaller groups, and gave students the opportunity to interact with three TAs in a lab session.

### 6.1.3   Objectives

This study was designed to:

      (1) Reveal instructor perceptions of teaching anatomy in an online distance format

      (2) Formulate modifications to the delivery of the course to optimize the teaching experience

## 6.2   Methods

Instructors were professors and teaching assistants for Systemic Human Anatomy between 2012 and 2014. Individual interviews were conducted in the summer of 2014, after the first two academic years of the online course. Participants self-selected a F2F interview format (4 professors, 1 TA) or online format (for those off-site) using Blackboard Collaborate (4 TAs).

A standardized open-ended interview approach (Patton, 1980) was employed where the exact wording of the questions was predetermined, but the participant could answer the question in whatever way he/she determined to be meaningful. Instructors were asked about their previous anatomy teaching experience and perceptions of communicating with online students, using the online teaching

aids, preparing for online teaching, and student engagement (Table 17).   Before the interviews commenced, the participants were emailed a proposed list of question subjects and were asked to identify other topics that they felt were important topics of discussion. The instructors did not propose additional matters to discuss.

**Table 17. Instructor interview questions.**

1. Tell me about your past anatomy teaching experiences. Which anatomy courses have you taught? What was your role as a teacher in these courses?

2. What were your experiences communicating with your online students in Systemic Human Anatomy?   Do you feel like this communication was sufficient?

3. New online teaching aids were used in the course, for example, Blackboard Collaborate, Netter's 3D Interactive Anatomy, and 360antaomy. What were your experiences using these resources to teach your students?

4. Describe the preparation work you had to do to be able to teach the online course.

5. Do you feel like you were able to engage your online Systemic Human Anatomy students as their teacher? Please explain.

6. What can be done to improve the online teaching experience for Systemic Human Anatomy instructors?

7. Are there any other questions you feel I should have asked you regarding your experiences as a Systemic Human Anatomy online instructor?

A MP3 recorder was used to capture the audio from the F2F interviews. Blackboard Collaborate interview recordings were converted to MP3 format using Elluminate Publish! (Blackboard Inc., Washington, DC). Visual cues from the interviewees were not part of the study, thus MP3 audio was sufficient to capture the data. Express Scribe v 5.57 (NCH Software, Greenwood Village, CO) was used to play the MP3 files while they were transcribed into a Word 7 document (Microsoft Corporation, Redmond, WA). The Word files were loaded as primary documents into Atlas.ti (Scientific Software Development GmbH, Berlin, Germany) for analysis.

A code is a researcher-generated word or short phrase applied to a portion of qualitative data to assign it a particular attribute or meaning (Saldana, 2013). A list of codes and their descriptions, a codebook (Saldana, 2013), was created by two researchers (S.A and N.M.) using the constant comparative method (Glaser, 1965). Each researcher independently created and assigned codes as many codes as possible to all of the interviews. As new codes were generated, they were compared with other codes pertaining to the same category, and previously named codes were modified as needed. The researchers compared their codes by discussing their meanings. A final codebook was created by integrating both researcher's codes and categories. The same researchers used the final codebook to independently apply codes to all of the interviews.

Fleiss' kappa was calculated from the 9 interviews using the Coding Analysis Toolkit (Lu and Shulman, 2008) to assess inter-rater reliability. The kappa measure was 0.82, suggesting that the application of codes by the researchers was almost identical; therefore the coding scheme was reliable.

Descriptive codes for perceptions of the teaching experience and suggestions for its improvement with a frequency of 2 instructors or greater were grouped into common themes and divided into smaller subthemes. Since the sample size was

small, the number of interviewees for each code was reported and not the percent of instructors.

## 6.3     Results

*(Please note that interview excerpts have not been edited for grammatical errors. Text within square brackets was added by the authors to clarify the context of the quote for the reader.)*

The participation rate for the study was 90% (nine of ten instructors).  The completion rate of enrolled participants was 100%

A total of 109 codes were applied to the data.  Ten codes categorized the instructors' previous anatomy teaching experiences, 87 described their perception of teaching anatomy online, and 12 described suggestions for improving the online teaching experience.

Prior to teaching the online section course, each of the participants had taught gross anatomy to undergraduate, graduate and/or professional students.  All of the instructors except for one professor and one teaching assistant had taught in dissection or prosection-based laboratories to F2F students, though the professor and TA had experience dissecting human cadavers and working with prosections.  Only one professor had substantial experience teaching online students using virtual classroom software, while the others had no previous experience in teaching an online distance course.

Four themes emerged from the data as seen in Table 18 and 19.
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**Table 18. Interview transcript code frequencies for instructors. Codes ending with a (+) indicate a positive perception of the represented phenomenon while codes ending with (-) indicate instructor dissatisfaction.**

| Theme | Subtheme | Code | # Professors (N = 4) | # TAs (N = 5) | Total (N = 9) |
|---|---|---|---|---|---|
| 1. Communica - tion means | Asynchronous | Email | 3 | 4 | 7 |
| | Virtual classroom | Group instant message | 0 | 4 | 4 |
| | | Private instant message | 0 | 3 | 3 |
| | | Drawing | 0 | 3 | 3 |
| | | Voice | 2 | 0 | 2 |
| | F2F | Optional F2F lab hours | 2 | 1 | 3 |
| | | No-pre/post class interaction (-) | 2 | 0 | 2 |
| | Overall sufficiency | Sufficient (+) | 2 | 4 | 6 |
| 2. Teaching without Seeing the Learner | Pedagogical effects | Engagement uncertain (-) | 3 | 3 | 6 |
| | | No engagement (-) | 1 | 1 | 2 |
| | | Cannot anticipate if student wants to speak (-) | 1 | 3 | 4 |
| | | Cannot sense if students are understanding (-) | 3 | 1 | 4 |
| | | Cannot identify student (-) | 3 | 1 | 4 |
| | | Cannot sense if students are attentive and engaged (-) | 2 | 1 | 3 |
| | | Easier for shy students to participate (+) | 0 | 3 | 3 |
| | | Cannot assess instructional pace (-) | 0 | 2 | 2 |
| | | Must constantly check in verbally  (-) | 0 | 2 | 2 |
| | Social effects | Impersonal teaching/learning experience (-) | 4 | 1 | 5 |
| | Suggestions for Improvement | Synchronous attendance better for teacher | 1 | 2 | 3 |
| | | Make live attendance mandatory | 1 | 1 | 2 |

**Table 19. Continuation of Table 18. Interview transcript code frequencies for instructors. Codes ending with a (+) indicate a positive perception of the represented phenomenon while codes ending with (-) indicate instructor dissatisfaction.**

| Theme | Subtheme | Code | # Professors (N = 4) | # TAs (N = 5) | Total (N = 9) |
|---|---|---|---|---|---|
| 3. Pros and cons of the instructional technology | Blackboard Collaborate | Overall positive review (+) | 1 | 4 | 5 |
| | | Not capable of Power Point slide animations (-) | 4 | 1 | 5 |
| | | Stationed at computer (lack of movement) (-) | 4 | 0 | 4 |
| | | Could not use laser pointer; hard to use air mouse (-) | 3 | 0 | 3 |
| | | Application share lagged (-) | 0 | 3 | 3 |
| | | Reliable (few or no failures) (+) | 1 | 1 | 2 |
| | | Request formal training | 0 | 2 | 2 |
| | | TA in lecture for tech support (+) | 2 | 0 | 2 |
| | Netter's | Navigation difficult (-) | 0 | 3 | 3 |
| | | Overall negative review (-) | 0 | 3 | 3 |
| | | Overall positive review (+) | 0 | 2 | 2 |
| | | Anatomically inaccurate (-) | 0 | 2 | 2 |
| | | Unrealistic appearance (-) | 0 | 2 | 2 |
| | 360 Anatomy | Overall positive review (+) | 0 | 3 | 3 |
| | | Vantage point control (+) | 0 | 2 | 2 |
| 4. Preparation work | Lecture (Profs) | Remove slide animations (-) | 4 | NA | 4 |
| | | Same or more than F2F (-) | 4 | NA | 4 |
| | | Support from researchers (+) | 3 | 0 | 3 |
| | Laboratory (TA) | Knowledge acquisition | NA | 5 | 5 |
| | | Create Power Point | NA | 4 | 0 |
| | | Take screen shots of 3D models | NA | 3 | 3 |
| | | Create .*cap files | NA | 2 | 2 |
| | | More than F2F (-) | 1 | 2 | 3 |

## 6.3.1    Communication Methods

When asked about their experiences communicating with online students, all of the instructors began their response by listing means of communication, the most common form of which was through email.  The online students emailed the TAs frequently.  One TA preferred communicating with students through email about course content as opposed to real-time methods because it gave him/her time to research the response: *"it's not the immediacy of having a question that the student's asking you during the lab in Blackboard.  There's kind of a sense of urgency there because I'm here right now instant messaging. So that's nice.  You can kind of double check yourself if you're unfamiliar."*  The professors received few emails and they were not able to decipher if they were from an online or F2F student.  Only one TA mentioned that he/she used the forum on the course website (Sakai 2.9, The Sakai Foundation, Ann Arbor, MI) to communicate with students.

During the laboratory demonstration, TAs communicated with the students through a live audio/video feed and the students conversed using the instant messenger in Blackboard Collaborate.  When asked about student-teacher communication, only the professor group elaborated on speaking into the microphone.  While the TAs spoke into microphones during the laboratories, they chose to discuss the use other tools in Blackboard Collaborate.  Students communicated primarily in the laboratory through instant messages to the whole group of students and TAs.  Some students preferred to type to only the TAs and did so using a private chat window.  As described by representative comments by two TAs, *"Some chat did occur in the private/moderator chat boxes.  That was mostly personal questions about something they had missed or if they were complaining about another student"* and *"If someone had a question they weren't comfortable asking in front of everybody, then they could have the option of doing a little private conversation with one of us"*. The TAs perceived that use of the drawing tool in Blackboard Collaborate was a method for students to communicate their understanding of the lesson to the TA.  As one TA described,

*"Communication with the students during the lab itself took place a lot with using the drawing tools as well. We asked a lot of questions and we'd ask the students to draw or type out or point to different items on a picture."*

Two of the professors noted that at the F2F lectures it was typical of students to speak with them to ask questions or socialize in the time immediately before and after the lesson. In contrast during lectures, a TA in the F2F audience was logged into the virtual classroom to interact with online students who would not have been able to interact with the professor directly in any way before, during, or after the lecture. Though the TAs would pass on live questions from students to the professor during the lecture, the professors thought that this loss of direct communication in the lecture room limited their ability to teach online students. As one professor illustrated, *"I'll be standing around after the class and I'll have 2 or 3 students come up to me with questions. That in my opinion, that might be a limitation [to the online format]. Them being physically present, getting to know me personally. There's sort of that level of intimacy where they can come up and talk to me in person. Whereas the online students, I don't know what their feelings are"*. Interestingly, one professor suggested that the loss of intimacy may be attributed to the increased class size, and not the delivery format of the course: *"When the [F2F] class was smaller around 60/70 students, the interaction with students was greater and I got to know the students a lot better. As it grew in size they just became a sea of faces when you're up to 350 students in a classroom. I didn't feel a real lack of communication associated with only the online class because we had already reached that point with F2F because the class had become so big. It wasn't a small intimate gathering."*

Despite the differences discussed between interacting with students F2F and online, three of four professors and 4/5 TAs thought that the means of communication that they described were sufficient in terms of teaching the course.

## 6.3.2    Teaching without Seeing the Learner

When asked if they felt they were able to engage online students as a teacher, two instructors thought that they were not able to engage students and 6 were not sure if they engaged their students.  A major theme that emerged when discussing student engagement was the instructors' difficulty teaching students whom they could not see.

The main concern was that they could not read the students' body language to assess whether they understood the material being presented online.  As one professor said, *"With the F2F [format], feedback is the class. Watching them"*. Another professor echoed this sentiment when comparing engaging online students versus F2F: *"Definitely not to the same extent as when there's a person physically present.  I don't feel that connection obviously as I would with a student who's actually physically in the room that I can look at and interact with.  I would say no.  I don't really feel engaged with them in that sense.  They're sort of this anonymous voyeur somewhere that I'm not really aware if they're there or not.  Somewhat of a detached experience. "*

In addition, the TAs had difficulty adjusting the instructional pace without visual cues from the students.  As one TA conveyed, "*You can't really read their body language or tell if people are really keeping up.  You kind of depend on if anyone's in the room watching it, if they have any questions there.  Otherwise you don't really know because they will watch it [the recording] at a later time when you're not around".* To rectify this, the TAs requested feedback from students during the lesson. One TA exemplified *"When I'm TAing, I'll ask them 'Am I going too fast? Does everyone understand?' or even just ask them simple questions and then they'll type it in the chat box.".*  However, this communication is dependent on the students answering in the chat box.  The same TA expressed frustration when some students attended laboratories live but did not give text feedback: *"Sometimes you'll sit there and nobody will answer you.*

*You're like 'ok I'm going to sit here and I'm not going to talk until somebody answers me'. I think the communication's a little bit hard because you don't know. Maybe they're sitting there glassy eyed and nobody has any idea, or maybe they know [the answer] and they don't want to say".*

Lack of visual feedback from students led the TAs to restrict student use of the microphones during the laboratory. One TA explained, "*We felt that if there were so many students that all had microphone access, there would be too many voices at once. Because we can't see them it would be confusing maybe. […] It would have been too many people talking at once possibly and they can't see each other and there's no body language to say 'oh I want to speak'".*

One of the professors and two TAs thought that teaching students who attended lessons live was better for the teacher. It was suggested that mandatory live online attendance in lectures and laboratories would improve the amount of pedagogical feedback from students. Though the instructors would still not see the students, a greater number of live participants would increase the amount of instant messages responses from students.

## 6.3.3    Pros and Cons of Instructional Technology

Much conversation about instructional technology pertained to how each software program was used to communicate with students. No one piece of software was unanimously accepted or rejected by the instructors in terms of its ease of use and effect on student learning, rather the successes and challenges of adapting to the software were discussed.

Blackboard Collaborate received an overall positive review. A limitation, that was the most frequently expressed (4 professors, 1 TA), was the software's inability to display Power Point's slide animations. The instructors did not believe this had a significant impact on their ability to teach, though they would have used slide animations if it was possible. Three of four professors experienced difficulty

using the air mouse where they would press a button and the computer would not respond, forcing them to stand at the podium to use the wired mouse. All of the professors expressed that remaining stationary at the computer during lecture to work Blackboard Collaborate interfered with their ability to teach the F2F students. As one professor exemplified, *"I like to move around a lot. Having to stay put as opposed to walking around and being more interactive with the [F2F] audience has been a bit of an issue".* This was not seen as an issue with Blackboard Collaborate itself, but its use for simultaneously teaching online and F2F students. The TAs did not experience this problem because they taught online students exclusively.

Blackboard Collaborate was described as reliable in terms of the instructors' ability to use it for teaching without technical issues. The only complications that arose were associated with internet connectivity problems on campus. On the rare occasion that technical difficulties presented during a lecture broadcast, the professors valued having the TA for online students in the classroom. One professor explained, "*I had a TA in the audience who knew really well how to use Blackboard. If there was a technical problem, she was there to troubleshoot. That was great because when you're giving a lecture you're really focused on the lecture and you don't want to be thinking about the technical things*".

Blackboard Collaborate was provided by the University's Instructional Technology Resource Centre where formal software training is offered. Due to unique uses of the virtual classroom for Anatomy (broadcasting from the F2F classroom and integration with 3D model software), the instructors were trained individually by the researchers (S.A. and K.R.). Two of the teaching assistants recognized a need for more formal training with the instructional team. One of the TAs proposed the format to be *"a 1 or 2 day intensive workshop where you learn the ins and outs rather than doing the independent learning that we've been doing. Like one person takes you through it and you do troubleshooting on your own. I think it might be useful if we had a whole team and that whole team would*

*be composed of brand new people and experienced people and you work together as a mentoring thing.  You kind of go through and do a couple practices on the day".*

The TAs had difficulty integrating Netter's 3D Interactive Anatomy and Blackboard Collaborate.  When they ran Netter's 3D Interactive Anatomy from the teaching computer and broadcast their desktop using Blackboard Collaborate's application share tool, students did not receive a seamless stream.  One TA elaborated *"The system [Blackboard Collaborate] would lag so if I was sharing my computer screen it would take a while for the system to refresh on the students' computer screens to the point where they were seeing exactly what I was seeing.  We spent a lot of time waiting for the system to catch up".*  As a workaround, the TAs created a Power Point presentation containing screen shots of the 3D models. Though the 3D models were not intended initially to be used in this manner, the TAs discovered pedagogical value in this alternative approach.  One TA explained, *"That allowed us I would say a bit more functionality in terms of using Netter's because it allows the students to draw on the images which we wouldn't necessarily be able to do if we shared our screen.  I found that this was a more effective way of teaching and a more effective way of communicating with students.  So I could say 'we just talked about the tensor fasciae lata.  Can anyone point out on this image of the lateral thigh exactly where the tensor fasciae lata is?'".*

Conversely, not using the application share limited the TAs ability to show the students how to use the 3D models for independent learning.  One TA expressed concern, *"I couldn't really show students how to use Netter's.  I would have really liked to be able to say 'so this is the tool you use to peel off the layers so we can use this tool in order to investigate the depth of certain muscles'.  This is important because in anatomy depth is important for us to know either for medical procedures or for talking about different functions of different muscle groups.  So I think that component was lost when we just went from screen*

*capturing to screen sharing"*.  Three of the TAs agreed that it was a difficult program to navigate.  Two of the TAs found anatomical inaccuracies in the 3D models and thought that the appearance of the tissues was unrealistic.  One explained why this was concerning:  *"It didn't look like cadaveric material at all.  It was very pixilated and shiny and the muscles were very rectangular.  In real life they're not really.  I felt like it wasn't representative of the actual anatomy which may be confusing for students down the road"*.  The other TA, despite not having previous experience teaching with cadaveric material, also warned, *"When you compare it to F2F I guess the prosections are a lot better for that […]If I had never seen a prosection before I'd think that the way the muscles look in Netter's"*.  Three of the TAs spoke about Netter's in mostly a negative manner while the other 2 thought that the software met their teaching needs.

Only 3 of the TAs thought it was important to discuss their experiences using 360anatomy.  The reasons for the positive review varied, but two TAs expressed that they valued being able to control their vantage point of the specimen.


## 6.3.4    Preparation Work

All of the professors reported that the amount of preparation time for teaching online students using the F2F broadcast was the same or more than preparing for F2F students exclusively.  The notable added workload came from Blackboard Collaborate's inability to broadcast Power Point slide animations.  The professors had given gross anatomy lectures in the past and thus had previously prepared PPT slides containing animations that they wanted to use.  To simulate items appearing and disappearing from a given slide, the professor had to create a series of slides. Three of four professors enlisted help from an undergraduate research assistant who created extra slides which resembled the animations.

Three of five TAs believed that they spent more time preparing for the online laboratory than they would have if they taught the F2F students. All of the TAs reported having spent a substantial amount of time reviewing concepts to be taught, though they recognized that this was dependent on the subject matter and not the instructional format. The additional work was attributed to creating custom *.cap files in Netter's 3D Interactive Anatomy for their students to use, taking screen shots of the 3D models in the *.cap files, and organizing them into a Power Point presentation.

## 6.4    Discussion

### 6.4.1    Instructional Technology

In discussing their experiences using instructional technology, a large focus was on communication with students. The most common means were email and instant messaging in the virtual classroom during a live lesson, while the most infrequently used tool was the forum on the course website. It may have not been a resource of choice for the students, thus the need for instructor participation in forum discussion was minimal. In a study of the 2013-14 online anatomy students, the online students reported that the most frequent means of communication with their peers were texting from a mobile device, Facebook, or meeting F2F (Figure 16). This suggests that they preferred communicating in ways that fostered immediate responses. The instructors' report of the students contacting them primarily through private email and instant messaging in the virtual classroom lends itself to this theory. An email to an instructor's personal address or an instant message during a lesson when the TA is present would yield a faster response than posting a questions or concerns on a website that is not used beyond the realm of the course.

Blackboard Collaborate was well received by the instructors in terms of ease of use, reliability, and their time invested to prepare for teaching with it.   Though all

of the instructors had to be trained before their first lesson, it was an isolated event and training did not persist during the semester. Despite the professors' acknowledgement of the additional work of removing slide animations from their Power Point files, it was perceived as more of an annoyance than a major issue. The professors exhibited a greater concern for how simultaneous delivery of lectures to two audiences using the virtual classroom impacted their ability to interact with F2F students since their mobility in the room was restricted.

The TAs were unable to integrate Netter's 3D Interactive Anatomy with Blackboard Collaborate as initially intended for broadcasting their manipulation of the models. Their creative solution of using screen captures of the models encouraged live students to contribute to the lesson using the drawing tools. Preparation for this lesson format required a greater time commitment compared to F2F labs, and they felt that this should be taken into account in the future when calculating instructional hours. Their overall concern with the software was that they perceived it to be challenging for students to navigate and they were unable to give a real-time demonstration on how to use the software. A less frequent concern was over the software's unrealistic representation of the appearance of real tissue and some anatomical inaccuracies. This may not be a specific problem with Netter's 3D Interactive Anatomy, but anatomical 3D models in general. Computer models will always be an iconic representation of what is real (Brenton et al., 2007).

## 6.4.2    Invisible Students

A major emergent theme was the teachers' inability to see students during a lesson and how this impacted the instructional experience. This led to uncertainty of their teaching effectiveness and student engagement. Moore (1989) described learner-instructor interaction in distance education as the communication between the teacher and the student during which the instructor motivates and facilitates learning. This definition explains the instructor's role, but does not describe how the student might contribute to the interaction. Our

results suggest that communication from students, specifically non-verbal forms, during a lesson provides the teacher with valuable information about the learners' engagement and understanding. This social phenomenon has been documented in literature on communication in the F2F classroom.  Woolfolk and Brooks (1983) recognized a wide range of communicatory events in the learning environment encompassed by non-verbal behaviour: coverbal behaviour (movements of the body such as facial expression, eye gaze, gestures and posture), paralanguage (speech behaviour that does not contribute to the linguistic content), and proxemics (one's position in the physical learning space). Non-verbal behaviours may be unintentional, but are communicative because others present will interpret the behaviour and draw assumptions (Woolfolk and Brooks, 1983).  As much as 65% of the social meaning of conversation occurs through non-verbal behaviour (Pennycook, 1985).

In this study, the instructors spoke specifically about their inability to see the students' coverbal behaviour and did not discuss paralanguage and proxemics. This could be due to the fact that during oral communication, the speaker uses coverbal behaviour to convey information to the listener and the listener signals mutual attentiveness by mimicking the speaker's body movements (Pennycook, 1985).  If the instructors were looking at the students for feedback on engagement, coverbal behaviour would be the greatest indicator.

Mottet (2000) studied how the absence of non-verbal cues from students influenced instructor's feelings about teaching from a distance in the 1990s. Before the internet was a common platform for distance education, audio/video streams were sent via satellite and viewed on a television.  Though the instructors in Mottet's (2000) study used telecommunication systems,  the images were often dulled or blurred (Storck and Sproull, 1995), thus they could not clearly see their students. Perceptions of the teaching experience were compared between F2F instructors and distance telecommunication instructors. It was found that as a teachers' ability to see coverbal behaviour increased, the

instructors had a more positive impression of their students, could better evaluate their teaching effectiveness, were more satisfied with their teaching, and thought that their social relationships with the students were more warm, close, and comfortable (Mottet, 2000; Mottet et al., 2004).  Mottet (2000) cautioned against using interactive communication technologies in distance education that are unable to adequately capture coverbal behaviours.

### 6.4.3    Moving Forward: How do we Assess Student Engagement and Comprehension?

The instructors concluded that seeing the online audience would assist in their assessment of student engagement and comprehension of the material. Teachers and students were equipped with software (Blackboard Collaborate) and hardware (web cameras and microphones) for live videoconferencing.  The number of online students, however, limited its use.  Blackboard Collaborate can display live video streams from multiple users, but it is only capable of transmitting six video feeds simultaneously; therefore, only the instructors used video cameras.   To improve the laboratory teaching experience, students could be divided into smaller groups of 6 to allow the use of web cameras.  This type of laboratory would only be possible if live attendance was mandatory, as suggested by the interviewees.  In the lecture it may not be as important for the professor to see the online students since they can receive non-verbal cues from the F2F class.  Despite this, all of the online professors wanted to see the online audience during lectures.

Introducing mandatory live attendance at lecture and laboratory (without student web camera use) could help the instructors assess student engagement and understanding while increasing the number of students using the communication tools in the virtual classroom (instant messenger, drawing).  However, meeting the needs of the instructors may not translate into a better learning experience for the students. Large meta-analyses of studies on interactivity in online higher education courses have concluded that temporal factors (synchronous versus

asynchronous communication) do not impact academic performance (Allen et al., 2004; Bernard et al., 2009). In the previous two years of Systemic Human Anatomy, online students valued learning from archived materials in the virtual classroom because its controls (pause, rewind, fast forward) allowed them to adjust the pace of instruction to suit their learning needs (p. 45; p. 91). By the second year of the course, the majority of online students felt that they were engaged by their instructors, were able to ask questions pertaining to the material, and could interact socially with them (p. 91). Finally, perhaps the greatest factor limiting mandatory attendance is that it might not be feasible. Many students enroll in the online section due to scheduling conflicts with other courses.

A novel approach to the assessment of students may enable instructors to receive feedback from individuals participating in the course asynchronously. In the current Anatomy curriculum, student assessment is for summative purposes, where students are evaluated at the end of an instructional unit to determine their competence (Gikandi et al., 2011). In comparison, formative assessment is the continuous process of determining the extent of student learning with respect to the learning objectives with the goal of providing individual feedback to students to support further learning (Gikandi et al., 2011). Though formative assessment is often intended to provide the learner with constructive feedback, it can be used by the instructor to inform better pedagogical practice (Nicol and Macfarlane-Dick, 2006). Online environments are conducive to collecting informal student feedback (Benson, 2003). The course website (Sakai) for Anatomy contains a variety of tools that can be used by instructors to collect data. Students' thoughts can be submitted as documents using the Assignment and Dropbox tools. Tests and Quizzes could be used to ask specific questions and generate class statistics. Student comments can be posted publically using Forums, whereas anonymous feedback can be collected using the Polling feature. These tools can be used to ask students questions about the course content in order to assess their learning progress, or to receive feedback about the instructional methods.

## 6.4.4    Study Design

The participant number was limited due to the small number of instructors who have taught the new online course.  The Department of Anatomy and Cell Biology at Western University offers two additional online undergraduate courses in Mammalian Histology (Barbeau et al., 2013) and Neuroscience using a virtual classroom.  These instructors were not included in the study due to major differences in the practical components of the courses.  A separate study of these other instructors may establish reliability in the themes that emerged from this study, since major themes were not specific to the study of gross anatomy.

Though the instructors were all interviewed in the summer semester after the 2013-14 academic year, the length of time between each instructor's teaching assignment and data collection varied.  The instructors for the second semester (winter) of the course had taught recently, while others who were responsible for the first semester (fall) had not taught for 6 months.  To improve consistency in data collection, it is suggested that interviews be staggered over the year so that they can be scheduled at the end of each instructor's teaching assignment.

## 6.5    Conclusion

Blackboard collaborate was reliable and easy to use to teach online students, although using the virtual classroom software impeded the professors' mobility in the large F2F lecture hall.  Live desktop sharing of computer models from Netter's 3D Interactive anatomy was not possible using Blackboard Collaborate, however,  the TAs found pedagogical value in  the students drawing on screen captures of the 3D models.  Preparation time for teaching online students was longer than for F2F, although the difference was not substantial.  The instructors perceived that the means of communication (email, instant messaging and drawing in the virtual classroom) with online students were sufficient.  The

biggest concern of the instructors was their inability to use coverbal student behaviour to assess class engagement and their teaching effectiveness. Mandatory synchronous participation may improve the quantity of feedback through instant messaging, however, it may not be feasible to implement. Instructors may have to organize formative assessments of the students to obtain feedback on student learning and engagement.

## 6.6    Literature Cited

Allen M, Mabry E, Mattrey M, Bourhis J, Titsworth S, Burrell N. 2004. Evaluating the effectiveness of distance learning: A comparison using meta-analysis. J. Commun. 54: 402–420.

Attardi SM, Rogers KA. 2015. Design and implementation of an online systemic human anatomy course with laboratory. Anat. Sci. Educ. 62: 53–62.

Barbeau ML, Johnson M, Gibson C, Rogers KA. 2013. The development and assessment of an online microscopic anatomy laboratory course. Anat. Sci. Educ. 6: 246–256.

Benson AD. 2003. Assessing participant learning in online environments. New Dir. Adult Contin. Educ. 2003: 69–78.

Bernard RM, Abrami PC, Borokhovski E, Wade C a, Tamim RM, Surkes M a, Bethel EC. 2009. A Meta-Analysis of Three Types of Interaction Treatments in Distance Education. Rev. Educ. Res. 79: 1243–1289.

Brenton H, Hernandez J, Bello F, Strutton P, Purkayastha S, Firth T, Darzi A. 2007. Using multimedia and Web3D to enhance anatomy teaching. Comput. Educ. 49: 32–53.

Gikandi JW, Morrow D, Davis NE. 2011. Online formative assessment in higher education: A review of the literature. Comput. Educ. 57: 2333–2351.

Glaser B. 1965. The Constant Comparative Method of Qualitative Analysis.  Soc. Probl. 12: 436–445.

Lu CJ, Shulman SW. 2008. Rigor and flexibility in computer-based qualitative research: Introducing the coding analysis toolkit. Int. J. Mult. Res. Approaches 2: 105–117.

Moore MG, Kearsley G. 2012. Distance education: A systems view of online learning. 3rd Edition. Belmont, CA: Wadsworth, Cengage Leanring. 384 p.

Mottet TP. 2000. Interactive television instructors perceptions of students nonverbal responses.pdf. Commun. Educ. 49: 146–164.

Mottet TP, Beebe S a, Raffeld PC, Medlock AL. 2004. The effects of student verbal and nonverbal responsiveness on teacher self-efficacy and job satisfaction. Commun. Educ. 53: 150–163.

Netter FH. 2012. Netter's 3D Interactive Anatomy. Elsevier Inc., Philadelphia, PA. URL: www.interactelsevier.com/netter [accessed 20 Feb 2015]

Nicol DJ, Macfarlane-Dick D. 2006. Formative assessment and selfregulated learning: a model and seven principles of good feedback practice 37–41.

Patton MQ. 1980. Qualitative evaluation methods. Beverly Hills, CA: Sage. 381p.

Pennycook A. 1985. Actions Speak Louder Than Words : Paralanguage, Communication, and Education. Tesol Q. 19: 259–282.
Saldana J. 2013. The coding manual for qualitative researchers. 2nd Ed. Thousand Oaks, CA: Sage. 303p.

Storck J, Sproull L. 1995. Through a Glass Darkly: What Do People Learn in Videoconferences? Hum. Commun. Res. 22: 197–219.

Woolfolk a E, Brooks DM. 1983. Chapter 5: Nonverbal Communication in Teaching. Rev. Res. Educ. 10: 103–149.

Chapter 7

# 7 General Conclusions and Future Directions

## 7.1 Conclusions

Two years of data analysis have assessed the effect of anatomy course delivery format on student grades and revealed student and instructor perceptions of the online environment to generate theory on the strengths and weaknesses of the online format.  Previous academic achievement, and not course delivery format, predicted performance in anatomy. Students valued pace control, schedule and location flexibility of learning from archived materials.  In the online laboratory, they had difficulty using the 3D models and preferred the unique and hands-on experiences of cadaveric specimens.  The F2F environment was conducive to learning in both lecture and lab because students felt more engaged by instructors in person and were less distracted by their surroundings. The introduction of virtual laboratory breakout rooms engaged online students in learning and the students were satisfied with their interactions with TAs and peers, though online laboratories did not adequately replace the F2F learning environment for all students.  The time for instructors to prepare for online teaching was greater than F2F, though it was a not a substantial increase.  The biggest concern of the instructors was their inability to see coverbal student behaviour and use it to assess class engagement and their teaching effectiveness.

## 7.2 Future Directions

In each of the studies with student participants, the online format was compared with the F2F format. These types of studies are often criticized in the literature, as some claim they serve to prove that one format is as good as the other but do not advance pedagogical practices in either format (Larreamendy-Joerns and

Leinhardt, 2006; Bernard et al., 2009, Cook, 2009). In the infancy of the course, where online students learned in a different format for the first time, yet received the same credit as F2F students, there were moral and ethical obligations to the students to compare the sections.  Moving forward, comparison of variations of the online format will provide a better way of observing the effects of instructional interventions (Bernard et al., 2009).  As major themes emerged surrounding student-instructor interaction and student-content interaction (lack of a general consensus for the usefulness of Netter's 3D Interactive Anatomy), future studies may examine the effects of different online communication methods and anatomical software.

## 7.3　　Literature Cited

Bernard RM, Abrami PC, Borokhovski E, Wade CA, Tamim RM, Surkes MA, Bethel EC. 2009. A meta-analysis of three types of interaction treatments in distance education. Rev. of Educ. Res. 79:1243-1289.

Cook DA. 2009. The failure of e-learning research to inform educational practice, and what we can do about it. Med. Teach. 31:158-162.

Larreamendy-Joerns J, Leinhardt G. 2006. Going the distance with online education. Rev. of Educ. Res. 76:567-605.

# Chapter 8

## 8 Appendices

**Appendix 1. Ethics approval notice for 2012-2014 student grade protocol.**

9



Western Research

Research Ethics

Use of Human Participants - Ethics Approval Notice

Principal Investigator: Dr. Kem Rogers
File Number:102631
Review Level:Delegated
Approved Local Adult Participants:1200
Approved Local Minor Participants:0
Protocol Title:Evaluation of an Online Systemic Human Anatomy Course
Department & Institution:Schulich School of Medicine and Dentistry\Anatomy & Cell Biology,Western University
Sponsor:
Ethics Approval Date:September 25, 2013 Expiry Date:April 30, 2015
Documents Reviewed & Approved & Documents Received for Information:

| Document Name | Comments | Version Date |
|---|---|---|
| Advertisement | Revised classroom announcement script | 2013/09/06 |
| Revised Letter of Information & Consent | Revised letter of information | 2013/09/06 |
| Revised Western University Protocol | Revised protocol | 2013/09/11 |

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The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the University of Western Ontario Updated Approval Request Form.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

The Chair of the HSREB is Dr. Joseph Gilbert. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Ethics Officer to Contact for Further Information

| Erika Basile | Grace Kelly | Vikki Tran |
|---|---|---|

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Western University, Research, Support Services Bldg., Rm. 5150
London, ON, Canada N6A 3K7 t. 519.661.3036 f. 519.850.2466 www.uwo.ca/research/services/ethics

# Appendix 2. Ethics approval notices for 2012-13 student interviews and surveys.

## Western 🛡

**Research Ethics**

### Use of Human Participants - Ethics Approval Notice

**Principal Investigator:** Dr. Kem Rogers
**File Number:**103359
**Review Level:**Delegated
**Approved Local Adult Participants:**80
**Approved Local Minor Participants:**0
**Protocol Title:**Qualitative Evaluation of an Online Systemic Human Anatomy Course
**Department & Institution:**Schulich School of Medicine and Dentistry\Anatomy & Cell Biology,
**Sponsor:**
**Ethics Approval Date:**January 16, 2013 **Expiry Date:**April 30, 2014
**Documents Reviewed & Approved & Documents Received for Information:**

| Document Name | Comments | Version Date |
|---|---|---|
| Other | Attachment 9B - Interview Instructions | 2012/11/30 |
| Other | Attachment 10 - Interview Script | 2012/11/30 |
| Other | Attachment 9a - Email Script to Accompany Interview Instructions | 2012/11/30 |
| Other | Attachment 8 - Email Script for Interview Sign Up | 2012/11/30 |
| Other | Attachment 7b - Netter's Instructions | 2012/11/30 |
| Other | Attachment 6b - Virtual Classroom Instructions | 2012/11/30 |
| Other | Attachment 7a - Email Script to Accompany Netter's Instructions | 2012/11/30 |
| Other | Attachment 6a - Email Script to Accompany Virtual Classroom Instructions | 2012/11/30 |
| Advertisement | Attachment 5 - Reminder Email for Section 650 Students | 2012/11/30 |
| Advertisement | Attachment 4 - Reminder Email for Section 001 Students | 2012/11/30 |
| Letter of Information & Consent | Attachment 3 - Letter of Information for Section 650 Students | 2012/11/30 |
| Letter of Information & Consent | Attachment 2 - Letter of Information for Section 001 Students | 2012/11/30 |
| Advertisement | Attachment 1 - Script for Classroom Announcement | 2012/11/30 |
| Western University Protocol | | |

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The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the University of Western Ontario Updated Approval Request Form.

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The Chair of the HSREB is Dr. Joseph Gilbert. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

**Ethics Officer to Contact for Further Information**

| Janice Sutherland | Grace Kelly | Shantel Walcott |
|---|---|---|

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**Western University,** Support Services Bldg Rm. 5150 London, ON, Canada N6A 3K7
t. 519.661.3036 f. 519.850.2466 www.uwo.ca/research/ethics

# Western

**Use of Human Participants - Ethics Approval Notice**

**Principal Investigator:** Dr. Kem Rogers
**File Number:**103359
**Review Level:**Delegated
**Approved Local Adult Participants:**405
**Approved Local Minor Participants:**0
**Protocol Title:**Qualitative Evaluation of an Online Systemic Human Anatomy Course
**Department & Institution:**Schulich School of Medicine and Dentistry\Anatomy & Cell Biology,
**Sponsor:**
**Ethics Approval Date:**February 01, 2013 **Expiry Date:**April 30, 2014
**Documents Reviewed & Approved & Documents Received for Information:**

| Document Name | Comments | Version Date |
|---|---|---|
| Revised Letter of Information & Consent | Letter of Information | |
| Recruitment Items | Script for Classroom Announcement | |
| Revised Western University Protocol | Revised Protocol - Our study met with overwhelming success in terms of recruitment, and we could not accommodate all who applied. This revision is designed to allow all students the opportunity to participate in the study. | |

This is to notify you that The University of Western Ontario Research Ethics Board for Health Sciences Research Involving Human Subjects (HSREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the Health Canada/ICH Good Clinical Practice Practices: Consolidated Guidelines; and the applicable laws and regulations of Ontario has reviewed and granted approval to the above referenced revision(s) or amendment(s) on the approval date noted above. The membership of this REB also complies with the membership requirements for REB's as defined in Division 5 of the Food and Drug Regulations.

The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the University of Western Ontario Updated Approval Request Form.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

The Chair of the HSREB is Dr. Joseph Gilbert. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

**Ethics Officer to Contact for Further Information**

| Janice Sutherland | Grace Kelly | Shantel Walcott |
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**Western Research**

Use of Human Participants - Ethics Approval Notice

**Principal Investigator:** Dr. Kem Rogers
**File Number:**103359
**Review Level:**Delegated
**Approved Local Adult Participants:**405
**Approved Local Minor Participants:**0
**Protocol Title:**Qualitative Evaluation of an Online Systemic Human Anatomy Course
**Department & Institution:**Schulich School of Medicine and Dentistry\Anatomy & Cell Biology,
**Sponsor:**
**Ethics Approval Date:**April 10, 2013 **Expiry Date:**April 30, 2014
**Documents Reviewed & Approved & Documents Received for Information:**

| Document Name | Comments | Version Date |
|---|---|---|
| Recruitment Items | Email Script | |
| Instruments | Survey Questions | |
| Revised Western University Protocol | Revised protocol | |

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The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the University of Western Ontario Updated Approval Request Form.

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The Chair of the HSREB is Dr. Joseph Gilbert. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

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# Appendix 3. Ethics approval notice for 2013-14 student survey protocol.

## Western Research

**Research Ethics**

Use of Human Participants - Revision Ethics Approval Notice

**Principal Investigator:** Dr. Kem Rogers
**File Number:** 103359
**Review Level:** Delegated
**Protocol Title:** Qualitative Evaluation of an Online Systemic Human Anatomy Course
**Department & Institution:** Schulich School of Medicine and Dentistry\Anatomy & Cell Biology,
**Sponsor:**
**Ethics Approval Date:** April 22, 2014 **Expiry Date:** April 30, 2014
**Documents Reviewed & Approved & Documents Received for Information:**

| Document Name | Comments | Version Date |
|---|---|---|
| Revised Letter of Information & Consent | Letter of Information | |
| Instruments | Survey Questions (face-to-face students) | |
| Instruments | Survey Questions (Online Students) | |
| Advertisement | Recruitment announcement | |
| Recruitment Items | Recruitment email | |
| Revised Western University Protocol | Revised protocol | |

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The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the University of Western Ontario Updated Approval Request Form.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

The Chair of the HSREB is Dr. Joseph Gilbert. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

**Ethics Officer to Contact for Further Information**

| ___ Erika Basile | ___ Grace Kelly | ___ Mina Mekhail | ___ Vikki Tran |
|---|---|---|---|

*This is an official document. Please retain the original in your files.*

**Appendix 4 Ethics approval notice for instructor interview protocol.**

Western Research

**Western University Health Science Research Ethics Board**
**HSREB Amendment Approval Notice**

**Principal Investigator**: Dr. Kem Rogers
**Department & Institution**: Schulich School of Medicine and Dentistry\Anatomy & Cell Biology,

**HSREB File Number**: 103359
**Study Title**: Qualitative Evaluation of an Online Systemic Human Anatomy Course
**Sponsor**:

**HSREB Amendment Approval Date**: June 18, 2014
**HSREB Expiry Date**: April 30, 2017

**Documents Approved and/or Received for Information**:

| Document Name | Comments | Version Date |
|---|---|---|
| Recruitment Items | Recruitment email - new | |
| Revised Letter of Information & Consent | Letter of Info/Consent - clean | |
| Instruments | Interview script - clean | |
| Revised Western University Protocol | protocol - clean | |

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the amendment to the above named study, as of the HSREB Initial Approval Date noted above.

HSREB approval for this study remains valid until the HSREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review. If an Updated Approval Notice is required prior to the HSREB Expiry Date, the Principal Investigator is responsible for completing and submitting an HSREB Updated Approval Form in a timely fashion.

The Western University HSREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use Guideline for Good Clinical Practice Practices (ICH E6 R1), the Ontario Personal Health Information Protection Act (PHIPA, 2004), Part 4 of the Natural Health Product Regulations, Health Canada Medical Device Regulations and Part C, Division 5, of the Food and Drug Regulations of Health Canada.

Members of the HSREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Ethics Officer to Contact for Further Information

| ___ Erika Basile | ✓ Grace Kelly | ___ Mina Mekhail | ___ Vikki Tran |
|---|---|---|---|

*This is an official document. Please retain the original in your files.*

## Appendix 5. 2012-13 Student Survey

Systemic Human Anatomy Survey 2012-13

Page #1

☐ Participating in this survey is voluntary. At any point you may refuse to participate, refuse to answer any of the questions, or withdraw from the study with no effect on your future academic status. If you wish to withdraw from the study, please contact Stefanie Attardi (                    ).

Any information you provide in your survey responses that may identify you as a participant will be permanently deleted by Stefanie Attardi. Your survey will only be analyzed by researchers in its anonymous format. No personal information will be held with the surveys at any time by the researchers.

Page #2

Part I: Demographic Information

What is your age in years? If you prefer not to answer this question, please leave the field blank.(Q1)

_____

What is your gender?(Q2)

• Female
• Male
• Other
• I prefer not to answer this question

What degree are you currently registered in?(Q3)

• Bachelor of Medical Science
• Bachelor of Science - Biology
• Bachelor of Science - Other
• PhD
• Other
• I prefer not to answer this question

Which year of your degree are you currently registered in?(Q4)

• 1st year
• 2nd year
• 3rd year
• 4th year
• Greater than 4th year
• I prefer not to answer this question

Which week did you attend Systemic Human Anatomy as an online student?(Q5)

• February 11-15: Systemic Circulation
• Feb 25-March 1: The Respiratory System
• March 4-8: Upper Digestive Tract
• March 11-15: Lower Digestive Tract
• March 18-22: Urinary System
• I prefer not to answer this question

Page #3

Simple Skipping Information

• If Q6 = a. I prefer to attend the face-to-face lecture (which is held in North Campus Building 101) then Skip to Page 4
• If Q6 = b. I prefer to attend lecture online then Skip to Page 5
• If Q6 = c. I do not have an overall preference then Skip to Page 9
• If Q6 = d. I prefer not to answer this question then Skip to Page 10

☐ Part II: Student Preferences and Perceptions

▤ This question focuses on Systemic Human Anatomy lectures. Which of the following lecture formats do you prefer?(Q6)

○ a. I prefer to attend the face-to-face lecture (which is held in North Campus Building 101)
○ b. I prefer to attend lecture online
○ c. I do not have an overall preference
○ d. I prefer not to answer this question

Page #4

Simple Skipping Information
- If Q6_1C = 1 - Not at all satisfied then Skip to Page 10
- If Q6_1C = 2 - A little satisfied then Skip to Page 10
- If Q6_1C = 3 - Somewhat satisfied then Skip to Page 10
- If Q6_1C = 4 - Quite satisfied then Skip to Page 10
- If Q6_1C = 5 - Very satisfied then Skip to Page 10
- If Q6_1C = I prefer not to answer this question then Skip to Page 10

Below are possible reasons why someone may prefer to attend lecture in the face-to-face format. Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating(Q6_1A)

|  | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - Quite important to me | 5 - Very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| Fewer distractions in the face-to-face lecture room | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Attending face-to-face lecture requires me to get to campus in the morning | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to ask questions of other students around me | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to interact socially with other students | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to interact in person with professor if I want to ask him/her a question | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to interact socially with the professor | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I feel more engaged by the professor when I am physically located in the same room as him or her | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It is easier to procrastinate (e.g. delay viewing the lecture) when lecture recordings are available online | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

If there are any other reasons why you prefer the face-to-face lecture format over the online lecture format, please write them in the field below.(Q6_1B)

_____
_____
_____

What is your overall satisfaction level with the face-to-face lecture format? Select the appropriate rating.(Q6_1C)

○ 1 - Not at all satisfied
○ 2 - A little satisfied
○ 3 - Somewhat satisfied
○ 4 - Quite satisfied
○ 5 - Very satisfied
○ I prefer not to answer this question

Page #5

Simple Skipping Information
• If Q6_2 = I prefer the "live" online lecture format (ie: logging into lecture at the same time it is happening) then Skip to Page 6
• If Q6_2 = I prefer to attend online lecture after it is has been recorded then Skip to Page 7
• If Q6_2 = I do not have an overall preference for online lecture format when comparing attending during live time or watching the recording then Skip to Page 8
• If Q6_2 = I prefer not to answer this question then Skip to Page 10

🔲 Which of the following online lecture formats do you prefer?(Q6_2)

⚪ I prefer the "live" online lecture format (ie: logging into lecture at the same time it is happening)
⚪ I prefer to attend online lecture after it is has been recorded
⚪ I do not have an overall preference for online lecture format when comparing attending during live time or watching the recording
⚪ I prefer not to answer this question

Page #6

Below are possible reasons why someone may prefer to attend lecture online in general. Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating.(Q6_2A)

|  | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - Quite important to me | 5 - Very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| It gives me the opportunity to attend lecture from a location of my choice | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of the professor through the video (compared to when I'm in face-to-face lecture) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of the professor's Power Point slides (compared to when I'm in the face-to-face lecture) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of what the professor is pointing to on his/her Power Point slides (compared to when I'm in the face-to-face lecture) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Below are reasons why someone may prefer to attend online lecture live (at the same time it is happening). Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating.(Q6_2A_3)

|  | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - Quite important to me | 5 - Very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| I know that I am likely to procrastinate (e: delay viewing the lecture) if I don't attend online lecture at live time | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to ask questions during lecture by sending instant messages to the teaching assistant | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to send instant messages to other online students during the lecture | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I feel more engaged knowing that I am watching the live broadcast | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

If there are any other reasons why you prefer to attend online lecture during live times, please write them in the field below.(Q6_2A_4)

_____
_____
_____

What is your overall satisfaction level with attending lecture online during live times? Select the appropriate rating.(Q6_2A_5)

○ 1 - Not at all satisfied
○ 2 - A little satisfied
○ 3 - Somewhat satisfied
○ 4 - Quite satisifed
○ 5 - Very satisfied
○ I prefer not to answer

Page #7

Below are possible reasons why someone may prefer to attend lecture online in general. Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating.(Q6_2B_1)

| | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - Quite important to me | 5 - Very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| It gives me the opportunity to attend lecture from a location of my choice | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of the professor through the video (compared to when I'm in face-to-face lecture) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of the professor's Power Point slides (compared to when I'm in the face-to-face lecture) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of what the professor is pointing to on his/her Power Point slides (compared to when I'm in the face-to-face lecture) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Below are reasons why someone may prefer to attend online lecture after it has been recorded. Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating.(Q6_2B_3)

| | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - Quite important to me | 5 - Very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| It gives me the opportunity to access the lecture as many times as I want | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to pause, fast forward, and rewind the lecture | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

If there are any other reasons why you prefer to attend lecture online after it has been recorded, please write them in the field below.(Q6_2B_4)

_____
_____
_____

What is your overall satisfaction level with the recorded format of online lecture? Select the appropriate rating.(Q6_2B_5)

○ 1 - Not at all satisfied
○ 2 - A little satisfied
○ 3 - Somewhat satisfied
○ 4 - Quite satisifed
○ 5 - Very satisfied
○ I prefer not to answer

Is there are particular reason why you don't have an overall preference for lecture format when comparing the face-to-face to online formats?(Q6_3A)

○ Yes
○ No
○ I prefer not to answer this question

If you answered "yes" to the last question, please explain in the text box below. (Q6_3B)

If you prefer not to answer this question, please do not write anything in the text box.

_____
_____
_____

Page #8

⊞ Below are possible reasons why someone may prefer to attend lecture online in general. Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating.(Q6_2C_1)

| | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - Quite important to me | 5 - Very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| It gives me the opportunity to attend lecture from a location of my choice | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of the professor through the video (compared to when I'm in face-to-face lecture) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of the professor's Power Point slides (compared to when I'm in the face-to-face lecture) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of what the professor is pointing to on his/her Power Point slides (compared to when I'm in the face-to-face lecture) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

🔡 If there are any other reasons why you prefer to attend online lecture in general, please write them in the box below.(Q6_2C_2)

_____
_____
_____

⊟ Is there are particular reason why you don' t have an overall preference for the online lecture format when comparing attending during live time or watching the recordings?(Q6_2C_3)

○ Yes
○ No
○ I prefer not to answer this question

🔡 If you answered "yes" to the previous question, please explain in the text box below. (Q6_2C_4)

If you prefer not to answer this question, please do not write anything in the text box.

_____
_____
_____

Page #9

Is there are particular reason why you don't have an overall preference for lecture format when comparing the face-to-face to online formats?(Q6_3A)

○ Yes
○ No
○ I prefer not to answer this question

If you answered "yes" to the last question, please explain in the text box below. (Q6_3B)

If you prefer not to answer this question, please do not write anything in the text box.

_____
_____
_____

Page #10

Simple Skipping Information
• If Q7 = I prefer to attend the face-to-face laboratory demonstration (which is held in Dental Sciences Building 2005) then Skip to Page 11
• If Q7 = I prefer to attend the online laboratory demonstration then Skip to Page 12
• If Q7 = I do not have an overall preference then Skip to Page 16
• If Q7 = I prefer not to answer this question then Skip to Page 17

This question focuses on Systemic Human Anatomy laboratory demonstrations. A laboratory demonstration is the part of your lab where the teaching assistant helps you to understand anatomical concepts while using pictures, models, and specimens (real human specimens or 3D computer models). Which of the following laboratory demonstration formats do you prefer? (Q7)

Please note that this question is only asking about the demonstration part of lab and not the quiz portion of lab.
○ I prefer to attend the face-to-face laboratory demonstration (which is held in Dental Sciences Building 2005)
○ I prefer to attend the online laboratory demonstration
○ I do not have an overall preference
○ I prefer not to answer this question

Page #11

Below are possible reasons why someone may prefer to attend <u>laboratory demonstration</u> in the <u>face-to-face format</u>. Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating.(Q7_1)

| | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - Quite important to me | 5 - Very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| Fewer distractions in the face-to-face lab room | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The time length of the online lab is too long | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| There are other students around me in the face-to-face lab who are learning | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to ask questions of other students around me | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to interact socially with other students | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to interact in person with the teaching assistant if I want to ask him/her a question | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to interact socially with the teaching assistant | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to choose which teaching assistant I want for my lab demonstration | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It is easier to be engaged by the teaching assistant when physically located in the same room as him/her | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It prevents me from procrastinating (ie: delay attending lab) because there is no recording of the face-to-face lab | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Learning from real human specimens is a privilege (ie: not many people get to work with real human specimens) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to physically feel plastic models and human speicmens | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

It gives me the opportunity to move parts on the plastic models and real human specimens

○ ○ ○ ○ ○ ○ ○

It gives me the opportunity to see the actual size of the parts of the body

○ ○ ○ ○ ○ ○ ○

It gives me the opportunity to apply course concepts to real life by learning from real human specimens

○ ○ ○ ○ ○ ○ ○

If there are any other reasons why you prefer to attend the face-to-face laboratory demonstration, please write them in the box below.(Q7_1B)

_____
_____
_____

What is your overall satisfaction level with the face-to-face laboratory demonstrations? Select the appropriate rating.

○ 1 - Not at all satisfied
○ 2 - A little satisfied
○ 3 - Somewhat satisfied
○ 4 - Quite satisfied
○ 5 - Very satisfied
○ I prefer not to answer this question

Page #12

Simple Skipping Information
• If Q7_2 = I prefer to attend online laboratory during live time (ie: at the same time it is happening) then Skip to Page 13
• If Q7_2 = I prefer to attend online laboratory after it has been recorded then Skip to Page 14
• If Q7_2 = I do not have an overall preference then Skip to Page 15
• If Q7_2 = I prefer not to answer this question then Skip to Page 17

▤ Which of the following online laboratory demonstration formats do you prefer?(Q7_2)

◯ I prefer to attend online laboratory during live time (ie: at the same time it is happening)
◯ I prefer to attend online laboratory after it has been recorded
◯ I do not have an overall preference
◯ I prefer not to answer this question

Page #13

Below are possible reasons why someone may prefer to attend the laboratory demonstrations online in general. Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating.(Q7_2A_1)

| | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - Quite important to me | 5 - Very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| It gives me the opportunity to attend the laboratory demonstration from a location of my choice | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of the teaching assistant through the video (compared to when I'm in the face-to-face lab) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to clearly hear the teaching assistant's voice (compared to when I'm in the face-to-face lab) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of the pictures that the teaching assistant shows (compared to when I'm in the face-to-face lab) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of what the teaching assistant is pointing to on his/her pictures (compared to the face-to-face lab) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The teaching assistant provides his/her Power Point slides to students in the course website | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The time length of the face-to-face lab is too short | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Too many students have to share one plastic model or cadaver in the face-to-face lab | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to use my own 3D models in Netter's 3D Interactive Anatomy | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I have access to my own 3D models in Netter's 3D Interactive Anatomy outside of lab time | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Unlike the face-to-face lab, online labs to not take place on Fridays | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Below are reasons why someone may prefer to attend online lab "live" (at the same time it is happening). Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating.(Q7_2A_3)

|  | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - quite important to me | 5 - very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| I know that I am likely to procrastinate (ie: delay viewing the lab) if I do not attend online lab at live time | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to ask questions during lab by sending instant messages to the teaching assistant | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to send instant messages to other online students | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I feel more engaged knowing that I am watching the live broadcast | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

If there are any other reasons why you prefer to attend the laboratory demonstration online at live time, please write them in the box below.(Q7_2A_4)

_____
_____
_____

What is your overall satisfaction level for attending the online laboratory demonstration during live times? Select the appropriate rating.(Q7_2A_5)

○ 1 - Not at all satisfied
○ 2 - A little satisfied
○ 3 - Somewhat satisfied
○ 4 - Quite satisfied
○ 5 - Very satisfied
○ I prefer not to answer this question

Page #14

Below are possible reasons why someone may prefer to attend the laboratory demonstrations online in general. Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating.(Q7_2B_1)

|  | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - Quite important to me | 5 - Very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| It gives me the opportunity to attend the laboratory demonstration from a location of my choice | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of the teaching assistant through the video (compared to when I'm in the face-to-face lab) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to clearly hear the teaching assistant's voice (compared to when I'm in the face-to-face lab) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of the pictures that the teaching assistant shows (compared to when I'm in the face-to-face lab) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of what the teaching assistant is pointing to on his/her pictures (compared to the face-to-face lab) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The teaching assistant provides his/her Power Point slides to students in the course website | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The time length of the face-to-face lab is too short | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Too many students have to share one plastic model or cadaver in the face-to-face lab | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to use my own 3D models in Netter's 3D Interactive Anatomy | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I have access to my own 3D models in Netter's 3D Interactive Anatomy outside of lab time | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Unlike the face-to-face lab, online labs to not take place on Fridays | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Below are reasons why someone may prefer to attend online lab <u>after it has been recorded</u>. Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating.(Q7_2B_3)

|  | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - quite important to me | 5 - very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| It gives me the opportunity to attend lab at a time of my choice | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to watch the laboratory demonstration as many times as I want | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to pause, rewind, and fast forward the laboratory demonstration | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

If there are any other reasons why you prefer to attend the laboratory demonstration online after it has been recorded, please write them in the box below.

_____
_____
_____

What is your overall satisfaction level for attending the <u>online laboratory demonstration after it has been recorded</u>? Select the appropriate rating.

○ 1 - Not at all satisfied
○ 2 - A little satisfied
○ 3 - Somewhat satisfied
○ 4 - Quite satisfied
○ 5 - Very satisfied
○ I prefer not to answer this question

Page #15

⚃ Below are possible reasons why someone may prefer to attend the laboratory demonstrations online in general. Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating.(Q7_2C_1)

| | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - quite important to me | 5 - very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| It gives me the opportunity to attend the laboratory demonstration from a location of my choice | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of the teaching assistant through the video (compared to when I'm in the face-to-face lab) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to clearly hear the teaching assistant's voice (compared to when I'm in the face-to-face lab) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of the pictures that the teaching assistant shows (compared to when I'm in the face-to-face lab) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to have a close-up view of what the teaching assistant is pointing to on his/her pictures (compared to the face-to-face lab) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The teaching assistant provides his/her Power Point slides to students in the course website | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The time length of the face-to-face lab is too short | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Too many students have to share one plastic model or cadaver in the face-to-face lab | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to use my own 3D models in Netter's 3D Interactive Anatomy | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I have access to my own 3D models in Netter's 3D Interactive Anatomy outside of lab time | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Unlike the face-to-face lab, online labs to not take place on Fridays | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

If there are ny other reasons why you prefer to attend the laboratory demonstration online in general, please write them in the field below.(Q7_2C_2)

_____
_____
_____

Is there a particular reason why you don't have a preference for the online laboratory demonstration format when comparing the live to recorded versions?(Q7_2C_3)

○ Yes
○ No
○ I prefer not to answer this question

If you answered "yes" to the last question, please explain in the text box below. (Q7_2C_4)

If you prefer not to answer this question, please leave the text box blank.

_____
_____
_____

What is your overall satisfaction with the online laboratory demonstrations? Select the appropriate rating.(Q7_2C_5)

○ 1 - Not at all satisfied
○ 2 - A little satisfied
○ 3 - Somewhat satisfied
○ 4 - Quite satisfied
○ 5 - Very satisfied
○ I prefer not to answer this question

Page #16

Is there are particular reason why you don't have an overall preference for the laboratory demonstration format when comparing the face-to-face to online formats?

○ Yes
○ No
○ I prefer not to answer this question

If you answered "yes" to the last question, please explain in the text box below.

If you prefer not to answer this question, please leave the text box blank.

_____
_____
_____

Page #17

Simple Skipping Information
• If Q8 = Yes then Skip to Page 18
• If Q8 = No then Skip to Page 19
• If Q8 = I prefer not to answer this question then Skip to Page 20

You were provided with a username and password for a software program called Netter's 3D Interactive Anatomy, which has 3D models of the body's structures. Did you use this software?(Q8)

○ Yes
○ No
○ I prefer not to answer this question

Page #18

In Netter's 3D Interactive Anatomy there are a variety of things you can do with the 3D models. Please rate how helpful the following functions were to your learning.(Q8_1_1)

|  | 1 - Not at all helpful | 2 - A little helpful | 3 - Somewhat helpful | 4 - Quite helpful | 5 - Very helpful | I did not use this function | I prefer not to answer this question |
|---|---|---|---|---|---|---|---|
| Rotating the 3D models so I could see them from a different view | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Making the 3D models appear bigger or smaller on the computer screen | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| "Dissecting" the 3D models (ie: removing body parts one at a time) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Making body parts transparent so I could see through them | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Adding more body parts the 3D model | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Adding labels to the body parts | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Viewing body parts by system | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Viewing body parts by region | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Loading 3D models that the teaching assistant had already prepared (eg the "cap" files) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

If there are any other functions not listed about that you used in Netter's 3D Interactive Anatomy, please list them below and comment on how helpful they were to your learning.

_____
_____
_____

Page #19

Why didn't you use Netter's 3D Interactive Anatomy? Check all that apply. You can also add other reasons to the blank text boxes.(Q8_2)

If you prefer not to answer this question, please leave the boxes unchecked.
☐ I didn't know I had access to this software
☐ My login credentials didn't work
☐ I wasn't able to open the software
☐ I didn't know how to use the software after I opened it
☐ I didn't have time to use the software
☐ I learned everything I needed to learn without using the software
☐ I didn't think I'd needed to use the software to get questions right on the quiz
☐ I didn't think that using the software would help me learn
☐ I didn't care to try the software
☐ It wasn't mandatory to use the software
☐ _____
☐ _____
☐ _____

Page #20

Simple Skipping Information
• If Q9 = I prefer to write my quiz in the face-to-face lab then Skip to Page 21
• If Q9 = I prefer to write my quiz online then Skip to Page 22
• If Q9 = I do not have an overall preference then Skip to Page 23
• If Q9 = I prefer not to answer this question then Skip to Page 24

▤ This question focuses on your weekly quizzes. Which quiz format do you prefer?(Q9)

○ I prefer to write my quiz in the face-to-face lab
○ I prefer to write my quiz online
○ I do not have an overall preference
○ I prefer not to answer this question

Page #21

▤ Below are possible reasons why someone may prefer to write the quiz in the face-to-face lab. Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating.(Q9_1)

|  | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - Quite important to me | 5 - Very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| It gives me the opportunity to ask the teaching assistant a question about the quiz when I am writing the quiz | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to ask teaching assistant to give me more time to answer a question | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| There is no visual timer displayed that counts down during the face-to-face quiz, as there is on the online quiz | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to change my answers on the answer sheet at any time during the quiz | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The teaching assistant keeps track of the time for me | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

▨ If there are any other reasons why you prefer to write the quiz in the face-to-face lab, please write them in the text box below.(Q9_1_2)

_____
_____
_____

▤ What is your overall satisfaction level with writing the quiz in the face-to-face laboratory? Select the appropriate rating.

○ 1 - Not at all satisfied
○ 2 - A little satisfied
○ 3 - Somewhat satisfied
○ 4 - Quite satisfied
○ 5 - Very satisfied
○ I prefer not to answer this question

Page #22

Below are possible reasons why someone may prefer to write the quiz online. Please rate how important each of the following reasons are to you. If you disagree with a statement, please select "not applicable to me" instead of giving it a rating.(Q9_2)

|  | 1 - Not at all important to me | 2 - A little important to me | 3 - Somewhat important to me | 4 - Quite important to me | 5 - Very important to me | Not applicable to me | I prefer not to answer |
|---|---|---|---|---|---|---|---|
| It gives me the opportunity to use resources during the quiz (e.g. text book, notes, internet, software) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to work on the quiz with other people | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to spend time studying for the quiz after the lab demonstration | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to set my own pace during the quiz (ie: spend more time on harder questions and less time on easier questions) | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It can be difficult to see the questions that are projected onto the screen in the face-to-face lab. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It gives me the opportunity to write the quiz at a time of my choice within a 16 hour time frame | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

If there are any other reasons why you prefer the online format of the quiz, please write them in the text box below.(Q9_2_2)

_____
_____
_____

What is your overall satisfaction level with writing the quiz online? Select the appropriate rating.

○ 1 - Not at all satisfied
○ 2 - A little satisfied
○ 3 - Somewhat satisfied
○ 4 - Quite satisfied
○ 5 - Very satisfied
○ I prefer not to answer this question

Page #23

Is there a particular reason why you don't have an overall preference for the quiz format when comparing the face-to-face to online formats?(Q9_3_1)

○ Yes
○ No
○ I prefer not to answer this question

If you answered "yes", please explain in the text box below. (Q9_3_2)

If you prefer not to answer this question, please do not write anything in the text box.

_____
_____
_____

Page #24

Part III: Reserach Participant Suggestions

This question is about all parts of the face-to-face course (lectures, laboratories, quizzes, and anything else you think is part of the face-to-face student experience). What changes could be made to the face-to-face course that would make it a better learning experience for you?(Q10)

If you prefer not to answer this question, please do not write anything in the text box below.

_____
_____
_____

11. This question is about all parts of the online course (lectures, laboratories, quizzes, and anything else you think is part of the online student experience). What changes could be made to the online course that you think would make it a better learning experience for the online students?(Q11)

If you prefer not to answer this question, please do not write anything in the text box below.

_____
_____
_____

Page #25

Part IV: Final Comments

If you feel like there is something important you would like to tell the researchers, but you were not specifically asked about it in this survey, please feel free to add any comments below.

If you prefer not to answer this question, please do not write anything in the text box below.

_____
_____
_____

To submit your survey answers, please press the "submit" button below.

# Appendix 6. 2013-14 Online Student Survey

Systemic Human Anatomy Survey 2013-14 Version 1: Online Students

Page #1

☐ Part 1: Demographic Information

🔤 1. What is your age in years?(Q1_1)
If you prefer not to answer this question, please leave the field blank.

_____

▤ 2. What is your gender?(Q1_2)
○ Male
○ Female
○ Other
○ I prefer not to answer

▤ 3. What degree are you currently registered in?(Q1_3)
○ Bachelor of medical sciences
○ Bachelor of science - Biology
○ Bachelor of science - Other
○ PhD
○ I prefer not to answer

▤ 4. Which year of your degree are you currently registered in?(Q1_4)
○ 1st year
○ 2nd year
○ 3rd year
○ Greater than 4th year
○ I prefer not to answer

☐ Part 2: Perceptions of the Learning Experience

▤ 1. Which of the following statements best describes how you attended your LECTURES?(Q2_1)

○ I attended most of the lectures by logging in during "live" times (i.e. at the same time that the face-to-face class was happening)
○ I attended most of the lectures by watching the recorded version.
○ Some of the lectures I logged in live, and some of the lectures I watched as recordings.
○ Other. Please describe. _____
○ I prefer not to answer

▦ 2. Below are statements pertaining to your online LECTURES. Please rate how much you agree with each statement. (Q2_2)

 If you prefer not to rate a statement, please leave the circle unchecked.

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| I am able to interact socially with my online peers if I choose to. | ○ | ○ | ○ | ○ | ○ |
| I am able to ask my online peers questions about the course if I choose to | ○ | ○ | ○ | ○ | ○ |
| I am able to interact socially with my professors if I choose to | ○ | ○ | ○ | ○ | ○ |
| I am able to ask my professor questions if I choose to. | ○ | ○ | ○ | ○ | ○ |
| I feel engaged by the professors when I attend lectures online | ○ | ○ | ○ | ○ | ○ |
| I tis important to me to be able to see a video of the professor during lecture | ○ | ○ | ○ | ○ | ○ |
| I value having the ability to watch lecture recordings as many times as I choose. | ○ | ○ | ○ | ○ | ○ |
| I value having the ability to fast forward, rewind, and pause lecture recordings. | ○ | ○ | ○ | ○ | ○ |
| I find that I often procrastinate (i.e. delay viewing lectures) because I know they are available to me at any time. | ○ | ○ | ○ | ○ | ○ |
| The knowledge I gained from LECTURES helped me to prepare for my lab exams. | ○ | ○ | ○ | ○ | ○ |
| The knowledge I gained form LECTURES helped me to prepare for my quarterly tests (multiple choice tests). | ○ | ○ | ○ | ○ | ○ |

▤ 3. Which of the following statements best describes how you attended your LABORATORY DEMONSTRATIONS?(Q2_3)

○ I attended most of the labs by logging in during "live" times (i.e. at the same that the teaching assistant was there)
○ I attended most of the labs by watching the recorded version.
○ Some of the labs I logged in live, and some of the labs I watched as recordings.
○ Other. Please describe. _____
○ I prefer not to answer

▦ 4. Below are statements pertaining to your online LAB DEMONSTRATION. Please rate how much you agree with each statement.(Q2_4)

If you prefer not to rate a statement, please do not check the circle.

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| The length of the online lab (1.5 hours) is appropriate for learning the material to be covered. | ○ | ○ | ○ | ○ | ○ |
| I am able to interact socially with my online peers if I choose to | ○ | ○ | ○ | ○ | ○ |
| I am able to ask my online peers questions about the course if I choose to. | ○ | ○ | ○ | ○ | ○ |
| I am able to interact socially with my teaching assistants if I choose to. | ○ | ○ | ○ | ○ | ○ |
| I am able to ask my teaching assistants questions if I choose to. | ○ | ○ | ○ | ○ | ○ |
| I feel engaged by the teaching assistants during online lab. | ○ | ○ | ○ | ○ | ○ |
| If I had a technical problem, it was easy to contact my teaching assistant and have it solved. | ○ | ○ | ○ | ○ | ○ |
| I value having the opportunity to drop into the face-to-face lab on Fridays at 12:30PM if I would like to look at real specimens. | ○ | ○ | ○ | ○ | ○ |
| I find that I often procrastinate (i.e. delay viewing lectures) because I know they are available to me at any time. | ○ | ○ | ○ | ○ | ○ |
| The knowledge I gained from online LAB DEMONSTRATIONS helped me to prepare for my lab exams. | ○ | ○ | ○ | ○ | ○ |
| The knowledge I gained from online LAB DEMONSTRATIONS helped me to prepare for my quarterly tests (multiple choice tests). | ○ | ○ | ○ | ○ | ○ |

Page #3

Simple Skipping Information
- If [Q3_1] 1. Have you used Netter's 3D Interactive Anatomy? = Yes then Skip to Page 4
- If [Q3_1] 1. Have you used Netter's 3D Interactive Anatomy? = No then Skip to Page 5
- If [Q3_1] 1. Have you used Netter's 3D Interactive Anatomy? = I prefer not to answer then Skip to Page 6

☐ Part 3: Use of Computer Assisted Learning Resources

▤ 1. Have you used Netter's 3D Interactive Anatomy?(Q3_1)

○ Yes
○ No
○ I prefer not to answer

Page #4

2. In Netter's 3D Interactive Anatomy there are a variety of things you can do with the 3D models. Please rate how helpful the following functions were to your learning.(Q3_2)

If you prefer not to rate a function, please leave the circle blank.

| | Not at all helpful | A little helpful | Somewhat helpful | Quite helpful | Very helpful | I did not use this function |
|---|---|---|---|---|---|---|
| Rotating the 3D models so I could see them from a different view | ○ | ○ | ○ | ○ | ○ | ○ |
| Making the 3D models appear bigger or smaller on the computer screen | ○ | ○ | ○ | ○ | ○ | ○ |
| "Dissecting" the 3D models (i.e. removing body parts one at at time) | ○ | ○ | ○ | ○ | ○ | ○ |
| Making body parts transparent so I could see through them | ○ | ○ | ○ | ○ | ○ | ○ |
| Adding more body parts to the 3D model | ○ | ○ | ○ | ○ | ○ | ○ |
| Adding labels to the body parts | ○ | ○ | ○ | ○ | ○ | ○ |
| Viewing body parts by system | ○ | ○ | ○ | ○ | ○ | ○ |
| Viewing body parts by region | ○ | ○ | ○ | ○ | ○ | ○ |
| Loading 3D models that the teaching assistant prepared (i.e. the "cap files") | ○ | ○ | ○ | ○ | ○ | ○ |

3. Below are statements pertaining to Netter's 3D Interactive Anatomy. Please rate how much you agree with each statement.(Q3_3)

If you prefer not to rate a statement, please leave the circle blank.

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly Agree |
|---|---|---|---|---|---|
| I value having the 3D models available to me at any time that I want | ○ | ○ | ○ | ○ | ○ |
| I value being able to use the 3D models from different physical locations (e.g. at school, at home, in the Dental Sciences Building computer labs) | ○ | ○ | ○ | ○ | ○ |
| I value having my own set of 3D models and not having to share them with other students | ○ | ○ | ○ | ○ | ○ |

Page #5

☑ 4. Why didn't you use Netter's 3D Interactive Anatomy? Check all that apply. You can also add other reasons in the blank text boxes.(Q3_4)

If you prefer not to answer this question, please leave the boxes unchecked.
☐ I didn't know I had access to this software
☐ My login credentials didn't work
☐ I wasn't able to open the software
☐ I didn't know how to use the software after I opened it
☐ I didn't have time to use the software
☐ I learned everything I needed to learn without using the software
☐ I didn't think using the software would help me learn
☐ I didn't think using the software would help me prepare for lab exams
☐ I didn't care to try the software
☐ It wasn't mandatory to use the software
☐ _____
☐ _____
☐ _____

Page #6

☐ Part 4: Peer Collaboration

🎲 1. Please rate how often you communicate with YOUR CLASSMATES (i.e. other students taking this course) regarding the course (e.g. to ask a question, to study) using the following means of communication.(Q4_1)

If you prefer not to rate a means of communication, please leave the circle unchecked

|  | Never | Rarely | Occasionally | A moderate amount | A great deal |
|---|---|---|---|---|---|
| Email | ○ | ○ | ○ | ○ | ○ |
| Forum (on the OWL course website) | ○ | ○ | ○ | ○ | ○ |
| Forum (other) | ○ | ○ | ○ | ○ | ○ |
| Meeting face-to-face | ○ | ○ | ○ | ○ | ○ |
| Telephone call | ○ | ○ | ○ | ○ | ○ |
| Video conferencing software (e.g. Skype, Facetime) | ○ | ○ | ○ | ○ | ○ |
| Texting (e.g. SMS text, iPhone Instant Messenger, Black Berry Messenger) | ○ | ○ | ○ | ○ | ○ |
| Facebook | ○ | ○ | ○ | ○ | ○ |
| File storage software (e.g. Google Drive) | ○ | ○ | ○ | ○ | ○ |

▤ 2. Have you ever shared your access to lectures and laboratory recordings with one of your peers in the face-to-face section of the course?(Q4_2)

○ Yes
○ No
○ I prefer not to answer

☑ 3. If you answered "yes" above, how did you provide your peer with access to lecture and laboratory recordings? Please check all that apply.(Q4_3)

☐ I shared my Blackboard Collaborate user ID and password
☐ I allowed my peer to watch recordings with me
☐ I sent my peer a link to the recordings
☐ Other. Please describe: _____
☐ I prefer not to answer

▤ 4. Have you ever shared your access to Netter's 3D Interactive Anatomy with one of your peers in the face-to-face section of the course?(Q4_4)

○ Yes
○ No
○ I prefer not to answer

☑ 5. If you answered "yes" above, how did you provide your peer with access to Netter's 3D Interactive Anatomy? Please check all that apply.(Q4_5)

☐ I shared my Netter's user ID and password
☐ I allowed my peer to use Netter's while he/she was with me
☐ Other. Please describe: _____
☐ I prefer not to answer

---

Page #7

Part 5: Final Comments

1. If you feel like there is something important you would like to tell the researchers, but were not specifically asked about it in this survey, please feel free to add any comments below.(Q5_1)

If you prefer not to answer this question, please leave the text box blank.

_____

_____

_____

Thank you for participating in this survey! Please press the "submit" button below. If you have any questions, please contact Stefanie Attardi at

## Appendix 7. 2013-14 F2F student survey

Systemic Human Anatomy Survey 2013-14 Version 2: Face-to-Face Students

Page #1

Part 1: Demographic Information

1. What is your age in years?(Q1_1)
If you prefer not to answer this question, please leave the field blank.

_____

2. What is your gender?(Q1_2)
○ Male
○ Female
○ Other
○ I prefer not to answer

3. What degree are you currently registered in?(Q1_3)
○ Bachelor of medical sciences
○ Bachelor of science - Biology
○ Bachelor of science - Other
○ PhD
○ I prefer not to answer

4. Which year of your degree are you currently registered in?(Q1_4)
○ 1st year
○ 2nd year
○ 3rd year
○ Greater than 4th year
○ I prefer not to answer

Page #2

☐ Part 2: Perceptions of the Learning Experience

⚁ 1. Below are statements pertaining to your LECTURES. Please rate how much you agree with each statement. (Q2_1)
 If you prefer not to rate a statement, please leave the circle unchecked.

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| I am able to interact socially with my peers if I choose to. | ○ | ○ | ○ | ○ | ○ |
| I am able to ask my peers questions about the course if I choose to | ○ | ○ | ○ | ○ | ○ |
| I am able to interact socially with my professors if I choose to | ○ | ○ | ○ | ○ | ○ |
| I am able to ask my professor questions if I choose to. | ○ | ○ | ○ | ○ | ○ |
| I feel engaged by the professors when I attend lectures | ○ | ○ | ○ | ○ | ○ |
| The knowledge I gained from LECTURES helped me to prepare for my lab exams. | ○ | ○ | ○ | ○ | ○ |
| The knowledge I gained form LECTURES helped me to prepare for my quarterly tests (multiple choice tests). | ○ | ○ | ○ | ○ | ○ |

⚁ 2. Below are statements pertaining to your LAB DEMONSTRATION. Please rate how much you agree with each statement.(Q2_2)
If you prefer not to rate a statement, please do not check the circle.

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| The length of the lab demonstrations (1 hour) is appropriate for learning the material to be covered. | ○ | ○ | ○ | ○ | ○ |
| I am able to interact socially with my peers if I choose to | ○ | ○ | ○ | ○ | ○ |
| I am able to ask my peers questions about the course if I choose to. | ○ | ○ | ○ | ○ | ○ |
| I am able to interact socially with my teaching assistants if I choose to. | ○ | ○ | ○ | ○ | ○ |
| I am able to ask my teaching assistants questions if I choose to. | ○ | ○ | ○ | ○ | ○ |
| I feel engaged by the teaching assistants when I attend the lab demonstrations. | ○ | ○ | ○ | ○ | ○ |
| The knowledge I gained from online LAB DEMONSTRATIONS helped me to prepare for my lab exams. | ○ | ○ | ○ | ○ | ○ |

The knowledge I gained from online LAB DEMONSTRATIONS helped me to prepare for my quarterly tests (multiple choice tests).

| | | | | |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

3. Below are statements pertaining to using human specimens and plastic models during your lab demonstrations. Please rate how much you agree with each statement. (Q2_3)

If you prefer not to rate a statement, please leave the circle unchecked.

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| I value the privilege of learning from real human specimens | ○ | ○ | ○ | ○ | ○ |
| I value the opportunity to physically feel the human specimens and plastic models | ○ | ○ | ○ | ○ | ○ |
| I value the opportunity to move parts on the human specimens and plastic models | ○ | ○ | ○ | ○ | ○ |
| Learning from real specimens gives me the opportunity to apply course concepts to real life | ○ | ○ | ○ | ○ | ○ |
| There are enough human specimens and models in the lab for the students to share | ○ | ○ | ○ | ○ | ○ |

Page #3

☐ Part 4: Peer Collaboration

▦ 1. Please rate how often you communicate with YOUR CLASSMATES (i.e. other students taking this course) regarding the course (e.g. to ask a question, to study) using the following means of communication.(Q4_1)

If you prefer not to rate a means of communication, please leave the circle unchecked

|  | Never | Rarely | Occasionally | A moderate amount | A great deal |
|---|---|---|---|---|---|
| Email | ○ | ○ | ○ | ○ | ○ |
| Forum (on the OWL course website) | ○ | ○ | ○ | ○ | ○ |
| Forum (other) | ○ | ○ | ○ | ○ | ○ |
| Meeting face-to-face | ○ | ○ | ○ | ○ | ○ |
| Telephone call | ○ | ○ | ○ | ○ | ○ |
| Video conferencing software (e.g. Skype, Facetime) | ○ | ○ | ○ | ○ | ○ |
| Texting (e.g. SMS text, iPhone Instant Messenger, Black Berry Messenger) | ○ | ○ | ○ | ○ | ○ |
| Facebook | ○ | ○ | ○ | ○ | ○ |
| File storage software (e.g. Google Drive) | ○ | ○ | ○ | ○ | ○ |

▤ 2. Has one of your peers in the online section of the course ever shared access to lectures and laboratory recordings with you?(Q4_2)

○ Yes
○ No
○ I prefer not to answer

☑ 3. If you answered "yes" above, how did your peer provide you with access to the lecture and laboratory recordings?(Q4_3)

☐ My peer shared his/her Blackboard Collaborate user ID and password with me
☐ I watched recordings with my peer
☐ My peer sent me links to the recordings
☐ Other. Please describe: _____
☐ I prefer not to answer

▤ 4. Has one of your peers in the online section of the course ever shared access to Netter's 3D Interactive Anatomy with you?(Q4_4)

○ Yes
○ No
○ I prefer not to answer

☑ 5. If you answered "yes" above, how did your peer provide you with access to Netter's 3D Interactive Anatomy? Please check all that apply.(Q4_5)

☐ My peer shared his/her Netter's user ID and password with me
☐ I used Netter's with my peer
☐ Other. Please describe: _____
☐ I prefer not to answer

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Part 5: Final Comments

1. If you feel like there is something important you would like to tell the researchers, but were not specifically asked about it in this survey, please feel free to add any comments below.(Q5_1)

If you prefer not to answer this question, please leave the text box blank.

_____
_____
_____

Thank you for participating in this survey! Please press the "submit" button below. If you have any questions, please contact Stefanie Attardi at

# Curriculum Vitae

**Name:**  Stefanie M. Attardi

**Post-secondary Education and Degrees:**
Queen's University
Kingston, Ontario, Canada
2001-2005 B.Sc.Hons.

Queen's University
Kingston, Ontario, Canada
2006-2007 M.Sc.

The University of Western Ontario
London, Ontario, Canada
2011-2015 Ph.D.

**Honours and Awards:**
Queen Elizabeth II Graduate Scholarship in Science & Technology
2012-2013

Teaching Honour Roll, Western University Students Council
2012-2013

Drs. Madge and Charles Macklin Fellowship for Teaching and Research in Medical Education
2013

Teaching Honour Roll, Western University Students Council
2013-2014

Ontario Graduate Scholarship
2014-2015

**Related Work Experience:**
Teaching Assistant
Queen's University, Kingston, ON
2006-2007

Lecturer
University of Guelph-Humber, Toronto, Ontario, Canada
2010

Professor
Humber College, Toronto, Ontario, Canada
2010-2011

Teaching Assistant
Western University, London, Ontario, Canada
2011-2015

**Publications:**

Attardi and Rogers. 2015. Design and implementation of an online systemic human anatomy course with laboratory. Anatomical Sciences Education 8:53-61.