2016

EVALUATING THE USE OF SECOND LIFE™ FOR VIRTUAL TEAM-BASED LEARNING IN AN ONLINE UNDERGRADUATE ANATOMY COURSE

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Digital Object Identifier: <http://dx.doi.org/10.13023/ETD.2016.172>

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EVALUATING THE USE OF SECOND LIFE™ FOR
VIRTUAL TEAM-BASED LEARNING IN AN ONLINE
UNDERGRADUATE ANATOMY COURSE

THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in the
College of Medicine
at the University of Kentucky

By

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Lexington, Kentucky

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2016

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ABSTRACT OF THESIS

EVALUATING THE USE OF SECOND LIFE™ FOR VIRTUAL TEAM-BASED LEARNING IN AN ONLINE UNDERGRADUATE ANATOMY COURSE

Team-based learning (TBL) is one strategy for improving team-work and critical thinking skills. It has proven to be an engaging teaching pedagogy in face-to-face classes, however, to our knowledge, has never been implemented online in a 3-D virtual world. We implemented virtual TBLs in an online undergraduate anatomy course using Second Life™, and evaluated whether it engaged students. This study was conducted over 2 semesters with 39 total students. Surveys and content analysis of transcripts were used to evaluate student engagement. Our results indicate virtual TBLs were engaging for most students. The average engagement score was 7.8 out of 10 with 89.2% of students reporting a score of 6 or above. Students exhibited high levels of cognitive engagement during the clinical application portion of the TBL process. Males felt more emotionally engaged than females, however, most measures of engagement indicated no differences between groups of students (mode of communication, previous technology experience, gender, and performance); therefore, virtual TBLs may be engaging for a broad range of students. 95% of students agreed that this was a worthwhile experience. In light of this evidence, we feel that virtual TBL sessions are valuable, and could be implemented in other online courses.

KEYWORDS: Team-Based Learning, Second Life™, Engagement, Anatomy Education, Content Analysis
Multimedia elements used: JPEG (.jpg), TIFF (.tif)

Christena Merrill Gazave
April 18, 2016

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April 18, 2016

Dedicated to my beloved family
{Curtis, Ben, Katie, & Heidi}

ACKNOWLEDGMENTS

I would like to thank all of the people that made the completion of this thesis possible. First, my Thesis Chair, Dr. April Richardson-Hatcher, who tirelessly encouraged me, provided endless feedback, and helped me at every stage of the thesis process. In addition, I would like to thank my thesis committee members, Dr. Brian MacPherson and Dr. Brueckner-Collins, for your time, patience, and insight. Next, I would like to thank Mr. Hazzard, Dr. Johnson, Dr. Kramer, Dr. Parmelee, Dr. Lane, Dr. Richardson, Ms. Yuan, and Mr. Huang for your valuable advice and technical assistance. Thank you to Sydney Crawley, Kyle Skaggs, and Charlotte Stewart for the many hours you put into analyzing and coding the transcripts. In addition, I would like to thank the Biology Department for the Teaching Assistantship that enabled me to fund my education. Most of all, I am truly grateful for my family. To my parents and extended family members, I'm grateful for your encouragement, and endless hours of babysitting. To my children, I'm grateful for your cheerfulness and understanding through this long process. Most of all, I'm grateful for my husband, Curtis Gazave, who has been a tremendous support to me. Thank you for always believing in me.

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1 INTRODUCTION

1.1 Background

Online learning has become increasingly popular over the last several years [1-12]. According to a 2015 Babson survey report, over 5 million students were enrolled in at least one online course in the United States [13]. 99.6% of large universities (20,000+ students), and 70.7% of all U.S. universities were offering online courses [13]. The goal of all these universities is to prepare students for their future careers. With so many universities enrolling students in online courses, the question is, how well are these online courses preparing students for their future careers?

According to the Babson survey report, “Only 28.0% of chief academic officers say that their faculty members accept the ‘value and legitimacy of online education,’” [13]. Some believe online courses are inferior to face-to-face courses because they lack the simultaneous interaction among peers and faculty that occurs in a traditional classroom [10, 14, 15]. Some also feel important twenty-first century skills such as team-work and critical thinking are lacking in online courses [16, 17].

1.2 Team-Based Learning

One strategy for improving team-work and critical thinking skills is Team-Based Learning (TBL) [18]. This strategy was developed by Larry Michaelsen “to facilitate active learning in large undergraduate classes, but which has

subsequently proven to be effective in a wide range of instructional settings” [19]. Michaelson points out, “the advantages of TBL include improved attendance, increased pre-class preparation, better academic performance, and the development of interpersonal and team skills, in class sizes ranging from 10 to 400-plus, with courses in hundreds of academic disciplines and students ranging from freshmen on academic probation, to doctoral level students” [19]. Not only does it affect student performance, but “TBL has also been shown to reduce faculty burnout by promoting increased student responsibility, engagement in the learning process, and increased opportunities for positive teacher-student interactions” [19].

Medical Schools have been using TBL to engage students across the country [5, 19-24]. However, as far as the authors know, TBL has not been implemented in an online virtual world in the past. In considering the creation of a novel undergraduate anatomy course (ANA 309), it was proposed that TBL be implemented in an online format.

TBL is a well-defined teaching pedagogy [18, 19]. First, students must complete the Readiness Assurance Process (RAP) [18]. This three-step process ensures students have adequately prepared for team discussions. Students independently study the course material for a particular topic, and then complete an individual readiness assurance test (iRAT). This test is a multiple choice, single attempt test covering the assigned independent study material.

The student then takes the same multiple choice test within their group, known as the group readiness assurance test (gRAT, group has been changed to team in Michaelsen's TBL). The formation of teams is an important aspect of TBL. They are purposely formed, consist of 5-7 people, and remain the same throughout the course. During the gRAT, students get immediate feedback on their answers with immediate feedback assessment technique (IF-AT) forms (Figure 1.1).

The figure is a placeholder for an image of an IF-AT form. The text "(Figure 1.1)." is followed by the caption "Figure 1.1. IF-AT Form".

IF-AT forms are similar to lottery scratch-off cards. Following an intrateam discussion to decide the correct answer to a question, students scratch off the answer on the card. The card indicates a correct answer with a symbol, such as a star. If the answer is incorrect, the team will not see a star, and they must make a second attempt to answer the question correctly. Students are awarded points based on the number of attempts it takes them to answer each question correctly. If students disagree with any of the RAT answers, they may appeal to the instructor for added points.

The RAP process ensures students have a basic understanding of the topics being covered. Following this process, students complete one or more application sessions related to the material. Students participate in an intrateam discussion over a set of application questions. These multiple choice questions are written to promote discussion of the answer choices. Answers are simultaneously reported using letter cards or other visual means during an interteam discussion of each clinical application question.

Application questions are written to follow the 4S rule – same question, significant problem, simultaneous reporting, and specific choices [18]. All of the groups discuss and answer the same set of application questions. The problems have to be significant to the students – real world applications they may encounter in their future studies or careers, for example. There should be specific answer choices to all of the questions as opposed to open ended responses, and they simultaneously reveal these answers for optimal discussion of the material.

The final component of the TBL process is peer review. This encourages group participation and individual preparation. The peer review is often included as a part of the student's grade in the course.

1.3 Online Delivery Methods

While TBL has been successfully implemented in face-to-face classrooms, transferring this pedagogy online took some careful consideration. There are two common types of online student interactions – asynchronous and synchronous [25].

Asynchronous discussions often involve posting a question or topic to an online discussion board through platforms such as Blackboard™, Canvas™, or Google Docs™. Students reflect on and respond to the discussion topic at their own convenience within the given response timeframe. They may also comment on other student posts within the discussion forum, but their interactions are asynchronous – separated by time – sometimes minutes, hours, or even days

apart. This type of discussion would not be conducive to TBL. In order for the TBL process to be effective, students need to be able to have active, synchronous discussions within their teams.

Synchronous discussions have been delivered in several different ways. One way is through the use of online chat rooms [25]. Students are able to instantaneously interact with each other and with the instructor by typing in responses on the chat screen. While this method could be used to present TBLs, it may be difficult to facilitate intrateam discussions, and to seamlessly share information from visuals, such as PowerPoints. This method also lacks the ability to hear audio feedback from participants.

Two other synchronous methods that offer the ability to both communicate simultaneously and view visuals include video conferencing and online virtual worlds. Video conferencing services such as Blackboard Collaborate™, Skype™, or Google Hangouts™ can be used to show visuals, such as PowerPoints and documents, and allows for synchronous chat, audio, and video, however, they do not allow manipulation of the content and simultaneous viewing in a personal way. Online virtual worlds such as Second Life™, OpenSim™, and Unity™ allow for an immersive 3D experience with voice and chat capabilities, and interaction with imbedded visuals such as PowerPoints and 3D objects. Both of these methods of synchronous delivery are viable options for TBLs.

We chose to use a virtual world to deliver TBLs online for ANA 309. We felt the immersive nature of this technology would be most suitable for TBL. We

specifically chose to use the virtual world Second Life™ because it has been used by other educational institutions [8, 9, 26, 27]. It has also been successfully used at our institution, and has been supported by our institution's administration [27] . For these reasons we felt Second Life™ was our best option for the course.

1.4 Second Life™

Second Life™ is an immersive virtual world that was created by Linden Research, Inc. In Second Life™, individuals are represented by avatars (virtual representations of themselves) that can interact simultaneously with other avatars in world. Users can customize their avatar to look nearly identical to themselves in real life, or they can be completely different identities (Figure 1.2.). You can communicate “in world” using either a microphone (voice chat) or instant message (IM). Communication is designed to be similar to real life. Avatars move their mouths when they speak, make facial expressions, and hand gestures. Voice volume is proximal, so the closer you are to someone, the louder you are, and vice versa if you are far away - just like in real life. While Avatars can walk and talk like real people, they can also fly. This unique feature is advantageous for moving quickly from place to place, or for viewing tall objects up close.

The environment in Second Life™ is user-created [9]. You can create anything you can imagine, which makes for endless possibilities for teaching and learning [9]. Some educators have created virtual library reference desks and

health information libraries, while others have created spaces for online conferences [8, 9, 26, 28]. Individuals may purchase virtual space upon which to build, just as you would purchase land on which to build a house. The University of Kentucky maintains its own virtual space called the “University of Kentucky Island” (Figure 1.3.). On the island, university staff members have created virtual campus buildings, one of which is the virtual anatomy lab [5].

1.5 Main Lab

The virtual anatomy lab is a large dome structure that was created to simulate a real classroom (Figure 1.4.). It contains four group tables with enough chairs for six avatars at each table (Figure 1.5.). The tables are arranged in a square facing the center of the room where there is a large 3-way projector screen in the air (Figure 1.6.). The projector screen allows students to view TBL session material, similar to a projector screen in a face-to-face classroom (Figure 1.7.). Each table contains a letterbox and timer used for simultaneous reporting during TBLs (Figure 1.8.). At the entrance to the lab, students can obtain virtual scrubs to wear during labs (Figure 1.9.), and can access one of four group rooms via colored portal balls (Figure 1.10.). The students first meet for announcements here in the main lab, and then begin the virtual TBL process in their respective group rooms. Once a colored portal ball is clicked, students are transported to a virtual group room instantly.

1.6 Group Rooms

There are four group rooms located at different corners of the island (Figure 1.11.). These rooms were strategically placed in order to maintain the privacy of each group's discussion. Since communication is proximal, the rooms needed to be far enough apart to avoid eavesdropping. Secondly, the rooms needed to be separated by space, so that avatars could not easily travel from room to room to listen in on a neighboring group's discussion.

Each group room contains a block of seating (for up to 6 avatars) in the center, and two projector screens - one at each end of the room (Figure 1.12.). The screens contain TBL session content, and can be controlled by students using interactive arrows (Figure 1.13.). The first screen is used to display the gRAT questions with 2-3 questions displayed per page (Figure 1.14.). Next to this screen is a virtual IF-AT form (Figure 1.14.).

The interactive IF-AT form allows students to get instantaneous feedback on their answers to gRAT questions. Once the group has decided on an answer, a group member clicks the corresponding letter on the IF-AT form. If the answer is correct, the letter appears green, if the answer is incorrect, the letter appears red (Figure 1.15.). Once all the gRAT questions are answered correctly, the group's score is automatically emailed to the professor.

1.7 Clinical Application

The second screen on the opposite wall contains the clinical application content (Figure 1.16.). A timer next to each of the screens allows students to see

the time remaining for each part of the intrateam discussion (20 minutes for the gRAT and 15 minutes for the clinical) (Figure 1.17.). Following discussion of the clinical content, students travel back to the main room by clicking on portal balls in the group rooms (Figure 1.18.). In the main lab, students participate in interteam discussions and simultaneously report their answers to clinical application questions

1.8 Engagement

TBL has been shown to be an engaging strategy in face-to-face classrooms [20, 29]. Our question: will it also prove to be an engaging strategy for online learning? In order to determine this, we must define engagement.

The Glossary of Educational reform defines student engagement as:

...the degree of attention, curiosity, interest, optimism, and passion that students show when they are learning or being taught, which extends to the level of motivation they have to learn and progress in their education. Generally speaking, the concept of 'student engagement' is predicated on the belief that learning improves when students are inquisitive, interested, or inspired, and that learning tends to suffer when students are bored, dispassionate, disaffected, or otherwise 'disengaged' [30].

So, how can we tell whether we are inspiring and engaging our students, and keeping them from becoming bored and dispassionate? We can ask them directly, and we can observe their behavior to determine their actual level of engagement.

In order to measure a student's engagement, we must understand the key components of engagement. There have been many studies that have attempted to measure engagement [29, 31-38]. One study suggests a recent search produced over 32,000 articles on the subject [39]. While researchers disagree on the number of factors involved in a student's engagement, they agree that engagement is multidimensional [33]. For the purposes of this study, we defined engagement as having four components: behavioral, cognitive, social, and emotional [32-34, 38].

Behavioral engagement has been defined by the degree to which students participate in class [29, 38, 40], pay attention [29, 38, 40], put forth effort [34], persist [34], have positive conduct [34, 40], and refrain from negative conduct [34, 40, 41]. These features of behavioral engagement have been evaluated using surveys [29, 40, 42], direct observation [40, 42], and evaluation of online discussion transcripts [43].

Cognitive engagement has been defined by the degree to which students engage in higher order thinking, self-regulate their learning, and are willing to exert effort in learning difficult concepts and solving complex problems [33, 38, 41, 42]. These components have been measured from content analysis of transcripts [12, 44] and surveying students [42, 45].

Wang et. al describes social engagement as "the quality of social interactions with peers and adults, as well as the willingness to invest in the formation and maintenance of relationships while learning" [38]. Social

engagement has been measured by surveys [46, 47], content analysis of transcripts [12], as well as direct observation [48].

Studies have defined emotional engagement as the degree to which a student feels a sense of belonging [2, 3], values learning [41], and has positive emotions towards their teachers, peers [38], and the learning environment [33, 38, 41]. Emotional engagement has been measured by student surveys [2, 3, 49].

There were three specific aims of this study:

1.8.1 Specific Aim 1

Will students be engaged in team-based learning in Second Life™?

1.8.2 Specific Aim 2

What type of students will report and demonstrate the greatest engagement?

- Is there gender bias in engagement score?
- Will students who used voice chat as opposed to instant messaging have higher engagement scores?
- Will higher performing students have higher engagement scores?
- Will students with more technology experience have higher engagement scores?

1.8.3 Specific Aim 3

Will student's reported engagement scores correlate with their demonstrated engagement in class?

We hypothesized that TBL in Second Life™ will engage students in learning anatomy.

1.9 Chapter One Tables and Figures

	A	B	C	D	E	Score
1.		★				4
2.				★		3
3.		★				2
4.						
5.						
6.						
7.						
8.						
9.						
10.						

© 2008 M.L. & B.B. Epstein Form#E010

Figure 1.1. IF-AT Form

The Immediate Feedback Assessment Technique form is used for face-to-face TBL sessions. A star indicates a correct answer; a blank indicates an incorrect answer. Students may earn partial credit on each question (each incorrect answer reduces the student's score by one point).

Figure 1.2. Customizing your Avatar
Your avatar can be customized to look identical to you (B) [50], or different from your real identity (A).

Figure 1.3. University of Kentucky Island

The University of Kentucky Island is a plot of land in Second Life™ maintained by the University. The island contains virtual campus buildings and meeting spaces.

Figure 1.4. Virtual Anatomy Lab

The University of Kentucky Virtual Anatomy Lab is located on the University of Kentucky's Island. It is the main laboratory classroom for ANA 309.

Figure 1.5. Group Tables

There are four group tables in the main lab with enough chairs for six avatars at each table. The instructor can be seen in the middle in blue in this image, and the green sound bars indicate she is speaking to the class.

Figure 1.6. Main Lab Table Arrangement
 Four tables face the center of the room. A 3-way projector screen hangs above for viewing PowerPoints. The instructor controls this 3 way projector to avoid confusion.

Figure 1.7. Projector Screen

The 3-way projector screen allows students to view TBL session material. It is similar to a projector screen in a face-to-face classroom. Avatars can advance preloaded PowerPoint slides by clicking on the screens.

Figure 1.8. Letterbox

Each table contains a letterbox and timer used for simultaneous reporting during TBLs. The letterbox is interactive. A timer counts down above the letterboard after it is remotely started by the instructor. During this time, students click on their letter choice. Once the timer is complete, and all groups have entered their answers, a large letter appears above each desk corresponding to each group's answer choice. This counts as the simultaneous reporting of the clinical application session in TBL.

Figure 1.9. Virtual Scrubs

At the entrance to the lab, a virtual assistant welcomes students, and gives them information about the lab and navigating in Second Life™. Students are informed that they can obtain virtual scrubs by clicking on the skull on the desk. All students are required to wear these scrubs during labs to maintain a professional appearance.

Figure 1.10. Main Lab Portal Balls
Students can click on one of these portal balls to go to their respective group rooms.

Figure 1.11. Group Rooms

There are four group rooms located at different corners of the island. These group rooms float above the island in the air. Students meet in their assigned group room for the intrateam discussion of the gRAT and clinical application questions.

Figure 1.12. Side View of Group Rooms

Each group room contains a block of seating in the center, and two projector screens - one at each end of the room.

Figure 1.13. TBL Interactive Screens

The TBL interactive screens contain TBL session content. PowerPoint slides can be uploaded to these screens prior to each TBL session. The screens can be controlled by students using interactive arrows at the bottom of the screen.

Figure 1.14. gRAT

The gRAT wall contains an interactive screen used to display the gRAT questions with 2-3 questions displayed per page. A virtual IF-AT form and timer sits to the left of the interactive screen.

Figure 1.15. Virtual IF-AT

The virtual Immediate Feedback Assessment Technique (IF-AT) form allows students to get instantaneous feedback on their answers to gRAT questions. Once the group has decided on an answer, a group member clicks the corresponding letter on the IF-AT form. If the answer is correct, the letter appears green, if the answer is incorrect, the letter appears red.

Figure 1.16. Clinical Application

The Clinical Application wall contains an interactive screen that contains the clinical application content. One clinical application question is displayed per screen. Students can scroll through these questions using the interactive arrows at the bottom of the screen. Students must discuss their answer to these questions and be prepared to justify their answer in the main lab.

Figure 1.17. Timer

A timer next to each of the screens allows students to see the time remaining for each part of the intrateam discussion (20 minutes for the gRAT and 15 minutes for the clinical).

Figure 1.18. Group Room Portal Ball
 Portal balls in the group rooms allow students to return to the main lab for interteam discussion and simultaneous reporting of answers to clinical application questions.

2 METHODS

2.1 Course Description

Anatomy 309: An Introduction to Regional Anatomy, a 5 credit hour, online undergraduate level course, was offered during the spring 2013 and 2014 semesters at the University of Kentucky. It was created as a transitional course to bridge the gap between the systems-based introductory anatomy courses, and the regional-based graduate-level anatomy courses. There were 20 students in the 2013 class and 19 students in the 2014 class that were included in this study. Three students were excluded from this study because they dropped the course. One student was excluded that did not wish to participate in the study (this student was surveying the course). One student received an incomplete for the 2013 semester, and completed the course in 2014. This student's data was included in this study (only his 2013 survey data was used, and his content analysis scores were averaged between the two semesters).

Students met virtually in Second Life™ once a week for 15 weeks during the semester for synchronous TBL sessions. Each session lasted 90 minutes. This included introduction/announcements (5 minutes), intrateam discussion via the gRAT (20 minutes), clinical application (15 minutes), and interteam discussion (50 minutes). Each TBL session was facilitated by one faculty member with two years prior experience with face-to-face TBLs. A technical specialist and teaching assistant (two TAs in 2014) assisted during the sessions as well.

The course was delivered online with the exception of four in-class exams. These exams covered the regional anatomy content from independent study modules and TBL sessions, as well as a practical component of cadaveric image identification. Student assessment was determined by the following: exams (68%), TBL (iRAT 10.5%, gRAT 17.5%), and class participation (4%).

We chose to follow Michaelsen's TBL process for ANA 309 with the exception of a few elements. In Michaelsen's TBL process, groups are formed purposely – students are divided so that there is diversity in ability and experience in each group. Students are involved in the group formation process, so they feel the groups were divided fairly. Because we were delivering TBLs using a technology that many of the students were unfamiliar with, we wanted the first day of class to run seamlessly. Therefore, to avoid confusion, the groups were arranged prior to the first class by counting off from an alphabetized list. Students were informed of this process, and were emailed their respective group number.

Traditional TBL also includes peer review and a formal appeals process. While no formal appeals process was offered for contending RAT questions, opportunities for bonus points were available. Peer review was also not used in this course, however, class participation points were used as an incentive to motivate students to participate in the TBL process. The instructor kept a log of student attendance and carefully observed participation of each student in their

respective groups. A class participation score was assigned at the end of the course.

2.2 Course Preparation

It was assumed that few, if any, students would have previous experience with TBL and Second Life™, therefore, prior to the first virtual TBL (vTBL) session, students were emailed a set of instructions on the general TBL process, along with the basics of Second Life™ navigation and avatar creation (APPENDIX B). Each student was required to create their own avatar with a unique code name. Students were not allowed to use their real names to maintain anonymity. Students were required to come to one of two virtual office sessions in Second Life™ to test their computer access, voice capability, and ability to navigate in Second Life™. This process ensured students were prepared for their first virtual TBL session on the first day of class.

2.3 Initial TBL Session

The first vTBL session was an introduction to the TBL process in Second Life™. Students were required to study the syllabus posted on Blackboard prior to this initial vTBL session. Once logged on to Second Life™, students convened in the main lab to receive announcements. Students were instructed to sit at their respective group tables. They were informed that groups had been randomly selected by the instructor prior to the start of the course, and that they would remain in these groups for the remainder of the course. There were two

groups of five students, one group of six students, and one group of five that was reduced to three (one student dropped, and one student was absent for several sessions) in 2013. In 2014, there were two groups of six students, one group of six students that was reduced to five (one student dropped), and one group of four students.

Students were also informed that they would be graded on participation, and that they would be expected to contribute to their group's discussion as well as the interteam discussion in the main lab. The syllabus detailed that active participation constituted thoughtful input during discussions, not simply a "yes" or "I agree" answer. They were required to explain their reasoning behind why they agreed or disagreed on a certain question. They were informed that while they may choose to meet in person to discuss the material, only their virtual discussions could be graded for participation. Students were also required to be present and awake (Avatars fall asleep when they are inactive) for the duration of the TBL session to receive full participation points.

Students were informed of the opportunity to participate in this research study during this initial vTBL session. A subsequent email was also given to students (Appendix C) to notify them of the study, and provide access to an electronic consent form (Appendix D). Those that chose to participate in the study signed the consent form electronically with their avatar name. Students were incentivized to complete the surveys involved in this study with a 5% (3% in 2014) bonus given to supplement the student's grade in the course, only if all

surveys were completed within the given timeframe. An alternate assignment was offered for those that did not wish to participate in the study to earn the same amount of bonus points for an equal investment of time. After the announcements were completed, the instructor dismissed the groups to their respective group rooms. Students teleported to their group rooms via the teleport balls in the main lab.

Once everyone was in their group room, they decided which mode of communication they would use as a group, either voice chat or instant messaging. Once this was decided upon, everyone was required to use that mode of communication. This was done to ensure that everyone had an equal voice in the group (for example, if one person used voice chat, they might dominate the discussion while everyone else used instant messaging). All of the groups chose to use instant messaging in 2013, and all but one group chose to use voice chat in 2014. Once each group decided their respective mode of communication, they completed a mock TBL (gRAT and clinical application) covering material from the syllabus.

2.4 Virtual TBL Process

2.4.1 Independent Study

From the first day on, the subsequent sections describe a typical TBL over the course content. The first part of the TBL process is independent study. Students were assigned a module to independently study one week prior to each vTBL session. These modules were detailed, animated PowerPoints that were

accessible through BlackBoard (Figure 2.1.). Aside from the initial syllabus assignment, these modules covered a specific anatomical region, such as the posterior triangle of the neck, forearm, etc. Corresponding cadaver images were also assigned via Anatomy & Physiology Revealed™ (Published by McGraw-Hill Education) – an online digital bank of cadaver images broken down into muscles, nerves, vasculature, lymphatics, and innervation. This was customized for the students by region. They typed in a code that corresponded to a specific set of structures for each regional topic.

2.4.2 iRAT

The second part of the TBL process is the iRAT. An iRAT was administered each week via Blackboard, and covered material from that week's independent study module (Appendix A). In 2013, students had 20 minutes within a 4 hour timeframe immediately prior to the vTBL to complete the 10 multiple-choice, single-attempt iRAT questions. No outside resources or notes were allowed to be used to answer these questions. The questions were difficult and integrated several points – if the students had no background on the subject, they would not have enough time to look up all the answers. The average iRAT score was a 7/10.

Additional efforts were made to minimize cheating online. The iRAT was designed to have one question per page. The questions were randomized for each student, and they could not backtrack to previous questions. In 2014, the timeframe to complete the 20-minute iRAT was reduced to one hour, from the

original four, to minimize opportunities for looking up the information prior to class. This ensured that students discussed questions thoroughly during the gRAT portion of the vTBL.

2.4.3 gRAT

The remainder of the TBL process was completed in Second Life™ and started with the gRAT. During the gRAT, groups discussed and answered the same 10 multiple-choice questions from the iRAT in their respective group rooms. These multiple choice questions tested the foundational anatomy content that was explained in their independent study modules. They were given 20 minutes to complete the multiple-attempt gRAT questions and submit their answers for immediate feedback via the virtual IF-AT form (Figure 2.2.). No outside resources were allowed to be used in this part of the TBL. Students were awarded points based on the number of attempts it took them to answer each question correctly. Each incorrect attempt reduced their score by one point. There was a total of 40 possible points, 4 points for each question. Once each group correctly answered the 10 questions, their score was automatically emailed to the instructor.

2.4.4 Clinical Application

Following the gRAT, students remained in their group rooms to complete the final phase of the TBL process – a series of clinical application questions. These questions were complex clinical scenarios that the students would likely encounter in their future medical careers. While the cases related to the

independent study content, they were an extension of the information that they were required to know – some of the vocabulary may have been unfamiliar to them. For this reason, students were allowed and encouraged to use outside resources (e.g. atlases, books, internet) to answer these questions. Each group had 15 minutes for an intrateam discussion of 2-3 multiple-choice clinical application questions (Figure 2.3.). Once the group had determined their letter response to each question, they returned to the main lab for the final 50 minutes of class to simultaneously report their answers.

2.4.5 Main Lab

Once all the groups returned to the main lab, the instructor first reviewed any difficult gRAT questions, and addressed any common misconceptions students had during their discussions. Following this, the instructor facilitated an interteam discussion over the clinical application questions. The instructor first read the clinical application question aloud, then started a one minute timer located on top of the group tables (Figure 2.4.). Each group entered their answers via the virtual letter boards at their tables. Once the minute timer was up, and all groups had entered their answers, each group's letter choice would simultaneously appear above their table. The instructor would then facilitate an interteam discussion based on each group's letter choice using voice chat (Figure 2.5.). Students were required to use instant messaging to respond. We found that it was more manageable to facilitate the discussion in this way, so that

students didn't all speak at once. Each question was discussed until a satisfactory answer was agreed upon.

2.5 Measuring Engagement

2.5.1 Surveys

We measured both student-reported engagement and demonstrated engagement. Student-reported engagement was measured via Qualtrix surveys (Appendix E). The surveys contained questions concerning the following topics: demographics, prior technology and TBL experience, sense of engagement, sense of community, sense of team cohesiveness, sense of anonymity, comfort using Second Life™ technology, and perceived value of the experience. Each survey was available to students for one week. Students were required to enter their avatar name on the surveys in order to assign bonus points. There were no other compulsory questions asked on the surveys.

Five surveys were given over the course of the 2013 semester – one at the beginning, middle, and end of the semester, and two surveys in-between these time points (Figure 2.6.). During the 2014 semester, students completed one survey at the beginning, end, and midpoint of the semester (Figure 2.6.). Investigators reduced the number of surveys to three as this would adequately reflect student opinions over time. Data from these three surveys from the 2014 semester, and data from surveys 1, 3, and 5 from the 2013 semester were used for analysis of student engagement in this study.

2.5.2 Class Participation

Class participation was used as a measure of behavioral engagement. Students were informed that class participation would be graded as part of the course, and that they would be randomly video recorded throughout the semester in order for the instructor to evaluate class participation. Individual participation points were assigned at the end of the semester by the instructor based on these video observations. Four classes were video recorded during the semester (Figure 2.6.). In order to record each session, an invisible avatar was stationed above each group room and the main lab. Everything each avatar saw and heard was recorded on a separate laptop using Echo360 software.

2.5.3 Transcript Coding

These video recordings were transcribed. The number of student comments was tallied. The level of social and cognitive engagement of students was then evaluated by coding the student discussions. Students spoke using either voice chat or instant message during each session. For coding purposes, each instant message was considered one coding unit. For example, here are 4 coding units from a group using instant messaging:

Student A: I kind of have a question, it's one I got right I just was debating on it. How come 9 couldn't have been a also?
Student B: it says greatest effect
Student A: I know the vastus muscles but what about rectus femoris?
Student C: the vasti muscles only extend the knee

Each time a student spoke using voice chat (whether one or more sentences) was considered one coding unit. For example, here are 4 coding units from a group using voice chat:

Student A: Well, um, if we look at A, I'm pretty sure A is true. If you think about that NAVEL thing, I remember her mentioning that the artery and the vein were both enclosed in a sheath.
Student A: B, I think that's true as well. I remember that the deep femoral gave off a medial and lateral circumflex.
Student B: Yeah, D is definitely true. Um, and, so is E, and I went with C because the, um, exits. I think it's renamed as soon as it enters the femoral triangle.
Student C: Yeah, I said C 'cause the NAVEL...that little NAVEL acronym. It's for femoral artery, not external iliac artery.

Three coders, the investigator and two undergraduate researchers, coded 10,482 lines of student comments using Bloom's revised taxonomy to analyze the quality of their comments. Bloom's has been used by others to analyze online discussions [4, 44, 51] and was chosen to evaluate the level of cognitive engagement that was displayed during the vTBL sessions. The undergraduate researchers were trained by the investigator to code each comment based on the

level of Bloom's taxonomy that it represented (Figure 2.7.). Social comments (greetings, congratulations, off-topic, etc.) were also indicated in the coding (Table 2.2). If a coding unit could be coded with more than one code, the highest level code was assigned to that unit. The average of the three coder's scores was used for data analysis. A Cohen's Kappa value of 0.455 indicated a moderate level of agreement between the three raters [52].

2.6 Data Analysis

We collected general demographics of the students on the initial survey. The average of each of these general demographics was calculated, along with standard statistical information on each question.

Student engagement was measured across four dimensions: behavioral, cognitive, social, and emotional. Behavioral engagement was measured by the average number of comments made by individuals across four time points for each part of the TBL process. Cognitive engagement was measured by the average percentage (across three raters) of codes for each level of Bloom's taxonomy out of their total number of comments, and then the percentage of codes for each level of Bloom's taxonomy out of the total comments for each section of the TBL process. Social engagement was measured by the average percentage of social comments coded out of their total number of comments. Emotional engagement was measured through a series of survey questions (Table 2.1) that were collapsed into a single score. In particular, questions measuring a student's sense of community, value of teams, and comfort using

Second Life™. Survey questions responses were given a numerical value in Qualtrics (Strongly disagree = 1, strongly agree = 5). Questions were coded in such a manner that the most desirable response was given the highest score. For example, the survey question, “I feel my educational needs are not being met”, was normally coded with 1 equal to strongly disagree. In order to make the most desirable score the highest score, it was reverse coded to make 5 equal to strongly disagree. A score was tallied for each individual for each survey category for each of the three surveys. All three categories were then combined into a single score for each individual. The higher the score, the more emotionally engaged the individual. The highest score possible was a 110. Those students that did not answer every survey question were excluded from the analysis.

Each of these dimensions were compared to several factors (gender, mode of communication, performance, or experience with technology). Gender was divided into males and females and compared for each dimension. The final letter grade of students was used to group dimension results for comparison (ex. Level of participation for all A students vs. all B students). Those people that used voice chat in the group rooms were divided from those individuals that used IM in the group rooms (even though both groups used IM in the main lab, they were compared as separate groups in the main lab). Results from the dimensional analysis was also compared to previous technology experience. On the initial survey, students were asked to report their average time spent using various technologies per week (see Appendix E, scale: 1=0-30 min, 2=30min-

1hr, 3=1-2hrs, 4=2-4hrs, 5=4+ hrs). These numbers were combined to give a technology score. The higher the number, the higher the experience with technology. The technology scores were ranked and assigned to a high (21-40) or low group (1-20).

Reported Engagement was the score from a single survey question, “rate how engaging Second Life™ sessions were for you.” (scale from 1-10) The higher the score, the higher the level of engagement. Standard statistical analyses were performed on survey responses. This score was also compared to the dimensional engagement results as well as the four factors (gender, mode of communication, performance, or experience with technology). In order to compare the four dimensions of engagement to the reported engagement score, reported engagement responses were divided into low (1-6), medium (7-8), and high (9-10) level groups. These groups were then used to divide the results of the engagement dimensions for comparison.

Qualitative comments were also analyzed from the surveys and the top reported themes are listed in the results.

2.7 Chapter Two Tables and Figures

Table 2.1. Survey Questions

The following survey questions were used to calculate the emotional engagement score of students.

Sense of Community Questions	
1	I feel that other students do not help me. (survey 2)
2	I feel that other students do not help me. (survey 3)
3	I feel that I can rely on others in this course. (survey 2)
4	I feel that I can rely on others in this course. (survey 3)
5	I feel uneasy exposing gaps in my understanding. (survey 2)
6	I feel uneasy exposing gaps in my understanding. (survey 3)
7	I feel that my educational needs are not being met. (survey 2)
8	I feel that my educational needs are not being met. (survey 3)
Value of Teams Questions	
9	There was mutual respect for other teammates' viewpoints during Second Life™ discussion sessions. (survey 2)
10	There was mutual respect for other teammates' viewpoints during Second Life™ discussion sessions. (survey 3)
11	My team worked well together. (survey 2)
12	My team worked well together. (survey 3)
13	Rate your comfort level in your group (10= very comfortable, 1= very uncomfortable). (survey 2)
14	Rate your comfort level in your group (10= very comfortable, 1= very uncomfortable). (survey 3)
Comfort Using Second Life™ Questions	
15	Rate your comfort level in using Second Life™ technology on a scale of 1-10 (10=very comfortable, 1=very uncomfortable) (survey 1)
16	Rate your comfort level in using Second Life™ technology on a scale of 1-10 (10=very comfortable, 1=very uncomfortable) (survey 2)
17	Rate your comfort level in using Second Life™ technology on a scale of 1-10 (10=very comfortable, 1=very uncomfortable) (survey 3)

Table 2.2. Example Coded Comments

The following are examples of coded comments. The comments are not taken from a single discussion, so the comments are not linear in this example. Social = greetings, congratulations, off-topic, house-keeping type comments. 1-5 corresponds to each Bloom's taxonomy level (1=remembering, 2=understanding, 3=applying, 4=analyzing, 5=evaluating). There were no level 6 (creating) comments observed during the 4 transcribed sessions.

Code	Comment
Social	Hello
Social	who is putting them in
Social	yay
1	1 B
1	[Ir6so4
2	glossphyrageal[sic] supplies sensory to the pharngeal[sic] wall and toungue[sic]
2	yupp directly drains into the confluens
3	happened to some celebrities wife on a ski trip
3	epidural they have to drill into the skull to relieve pressure
4	Wouldn't[sic] a subdural cause more pressure
4	subdural is not as fast as the epidural, epidural usually deals with a tear in the artery
5	I still feel D makes perfect sense
5	yeah I agree. it'd been[sic] explain the fever

Beginning with the **common hepatic artery**, we can see that this vessel gives off two branches that supply the stomach. Just above the pyloric sphincter, the **gastroduodenal artery** branches off the common hepatic, followed shortly by the **right gastric artery**. The gastroduodenal a. travels behind the pylorus before giving rise to the **right gastroepiploic artery**.

Branching from the celiac trunk, the **left gastric artery** runs along the superior portion of the lesser curvature of the stomach, and along the way it meets to form an anastomosis with the right gastric artery.

The **left gastroepiploic artery** branches from the splenic artery (seen posterior to the stomach), traveling from right to left just below the greater curvature of the stomach. Along its route, the left gastroepiploic forms an anastomosis with the right gastroepiploic artery. Together, these anastomoses (circled in black) serve as safeguards for maintaining blood flow in case one of these vessels becomes blocked or compromised due to trauma.

Figure 2.1. Example PowerPoint Slide

This is an example of a PowerPoint slide from one of the modules for independent study. It is highly detailed and animated for independent study.

Figure 2.2. gRAT

The gRAT wall in each group room contains an interactive screen on the right to display the gRAT questions, a timer (visually counts down once remotely started by instructor), and an Immediate Feedback Assessment Technique form on the left.

A patient (Patient A) is rushed to the emergency room due to an embolus in his anterior interventricular artery. Due to this sudden occlusion, portions of his heart have become infarcted. Another patient (Patient B) is admitted with similar symptoms of a heart attack. This man has had a history of slowly progressive coronary artery disease. Coincidentally, he also had a sudden blockage of the anterior interventricular artery.

1. Which of these patients will most likely suffer less necrosis of the heart muscle? Why?

- A. Patient A
- B. Patient B

2. In Patient B, surgeons decide to use coronary angioplasty (also known as percutaneous transluminal coronary angioplasty) to reduce the atherosclerotic plaque in his coronary arteries. What route would be used to access his anterior interventricular artery?

- A. a catheter would be inserted in the superior vena cava
- B. a catheter would be inserted in the pulmonary artery
- C. a catheter would be inserted into the brachial artery
- D. a catheter would be inserted directly into the aorta

A 58 year old woman is brought to the emergency room after falling down the steps in her home. She is complaining of severe chest pain when she breathes. Her heart rate is elevated to a 115 beats/minute and she is experiencing shortness of breath. Her blood pressure is 90/50. Her skin is cold and clammy and she appears to be going into shock. She can't remember much about the fall only that she tripped over something in the floor.

3. Which of the following conditions may be the cause of the patient's symptoms?

- A. pulmonary embolism
- B. hemothorax
- C. heart attack
- D. pleurisy

Figure 2.3. Example Clinical Application

This is an example of a clinical application question set. Students had 15 minutes to discuss and come to a consensus on the answers to these questions during each session.

Figure 2.4. Main Lab Timer

A timer, controlled by the instructor, counts down to the simultaneous reveal of each group's answer choice.

Figure 2.5. Main Lab Interteam Discussion

The Instructor facilitated an interteam discussion of the clinical application questions. The instructor used voice chat, while the students responded via instant message.

Figure 2.6. Class Timeline
Fifteen vTBL sessions were held over the course of the semester (1-15). Sessions 2,7,10, & 14 were video recorded. A survey was administered after sessions 2, 9, and 15.

Figure 2.7. Bloom's Taxonomy Coding Chart
This chart was adapted from Bloom's revised taxonomy [53], and was used as a reference for Bloom's taxonomy coding.

3 DEMOGRAPHICS

The student population in ANA 309 across both semesters consisted of 4 post-baccalaureate students, 27 seniors, 4 juniors, 3 sophomores, and 1 freshman (Figure 4.1). Most students took the course to prepare for medical professional schools (Figure 4.2). There was roughly equal numbers of males (19) and females (20). 85% of the students had taken an online course in the past (Figure 4.3), however, only 15% had taken an online course with a discussion component (Figure 4.4). 87% of the students had not taken a course involving TBL in the past (Figure 4.4). ANA 309 did not have any prerequisite requirements, however, 74% of the students had taken an anatomy course previously (Figure 4.4).

Most students accessed Second Life™ off campus (Figure 4.5). 59% of students felt it was easy or very easy to learn to use Second Life™. 72% of students spent 30 minutes or less learning to use Second Life™ (i.e. navigate, walk, teleport, etc.). 77% of students spent less than 15 minutes personalizing their avatar.

79% of students reported that having been through this experience, they would take this course again (Figure 4.6). 56% of students said they would take another course that involved discussion groups in Second Life™ again (Figure 4.7).

In the final survey, 69% students agreed or strongly agreed that their experiences in Second Life™ improved their ability to work as a team. 62% of

students reported that the course improved their ability to communicate. 87% of students said they agreed or strongly agreed that discussions of the clinical examples (TBL learning issues) improved their understanding of basic anatomy content. 69% of students said that discussion sessions for this course were more helpful than discussion sessions they had, had for other courses. In the final survey, 72% of students disagreed or strongly disagreed that using Second Life™ for discussion sessions was not effective. 95% of students agreed or strongly agreed that this was a worthwhile experience.

4 ENGAGEMENT

4.1 Behavioral engagement

Behavioral engagement was measured by the degree to which students participated in class. Participation was measured by the average number of comments across four time points that students made during a TBL session. The higher the participation, the more the student was behaviorally engaged. On average, students made 65 ± 34 comments during a 90 minute TBL session with a range of 13 to 158 comments per session. Students participated more during the gRAT portion of the TBL than the clinical application or main lab discussion (Figure 4.8). Those students that used voice chat as opposed to instant message participated less during the main lab discussion (Figure 4.9). There was no significant difference between the performance of students in the course and their level of participation (Figure 4.10.). There was no significant difference between the participation of male and female students (Figure 4.11.). Participation was no different for those students that had more or less technology experience (Figure 4.12.).

4.2 Cognitive Engagement

Cognitive engagement was measured by the degree to which students engaged in higher order thinking. Higher order thinking was measured using Bloom's taxonomy to code student comments across four TBL sessions. The percentage of comments coded at a particular level across a TBL session was calculated. On average, 25.1% of all comments were at the remembering level,

6.5% were at the understanding level, 1.2% were at the applying level, 14.2% were at the analyzing level, 14.4% were at the evaluating level, and 0% were at the creating level (Figure 4.13.). There were significantly more Bloom's level 4 and 5 comments made during the clinical application part of the TBL (Figure 4.14.). There were fewer Bloom's level 1 and 2 comments made during the clinical application than the gRAT or main lab parts of the TBL process (Figure 4.14.). There were more Bloom's level 4 comments during the main lab discussion than the gRAT part, however there were more Bloom's level 5 comments made during the gRAT than the main lab (Figure 4.14.).

There was no significant difference between voice and IM users for each Bloom's level with the exception of Bloom's level 5 (Figure 4.15.). There was no significant difference between males and females for all of the Bloom's levels (Figure 4.16.). There was no significant difference between low and high performing students for all of the Bloom's levels (Figure 4.17.), or between students with low and high levels of technology experience for all of the Bloom's levels (Figure 4.18.).

4.3 Social Engagement

Social engagement was measured by the mean percentage of social comments students made (across four time points) out of the mean total comments made during a TBL session. The greater the percentage of social comments, the more the student was socially engaged. On average 39% of student comments during a TBL session were social comments with a range of

5-58%. Students displayed significantly more social engagement during the gRAT and clinical application portions compared to the main lab component of the TBL process (Figure 4.19.). There was no difference in social engagement between voice chat and instant message users (Figure 4.20.). There was no difference in the social engagement of male and female students (Figure 4.21.). Social engagement did not vary in relation to student performance (Figure 4.22.), or in relation to the amount of prior technology experience (Figure 4.23.).

4.4 Emotional Engagement

Emotional engagement was measured by the responses to key survey questions. The responses to key questions were combined into a single score to indicate the level of engagement. The higher the score, the more the student was emotionally engaged. The highest score possible was 110. The average emotional engagement score was 89.1 ± 10.5 with a minimum score of 64 and a maximum score of 106. There was no significant difference in emotional engagement between those students that used voice chat and those that used instant messaging (Figure 4.24.). Males were significantly more emotionally engaged than females (Figure 4.25.). There was no difference in emotional engagement among students of varying performance levels (Figure 4.26.), or among students with different levels of technology experience (Figure 4.27.).

4.5 Reported Engagement

Reported engagement was measured by a single survey question: "Rate how engaging Second Life™ discussions were for you (10= highly engaging, 1=

not engaging)”. The average reported engagement score was 7.8 with a range of 2-10, and a median and mode of 8. 10.8% of students reported an engagement score of 5 or less. There was no significant difference between male and female reported engagement scores (Figure 4.28.), and between voice chat and instant message users reported engagement scores (Figure 4.29.). There was also no difference in reported engagement among students of varying performance levels (Figure 4.30.), or based on previous technology experience (Figure 4.31.).

Reported engagement was also compared to the four measured components of engagement – behavioral, cognitive, social, and emotional. Those students that reported having a low level of engagement also participated less than those that reported a medium or high level of engagement (Figure 4.32.). There was no difference in the level of student’s reported engagement compared to the percentage of comments at each Bloom’s level, with one exception - those students that reported a low level of engagement had a significantly higher percentage of Bloom’s level one comments than those that reported a medium level of engagement (Figure 4.33.). There was no difference in student’s reported engagement score compared to their social engagement (Figure 4.34.). Those students that reported a low level of engagement had a significantly lower emotional engagement score than those that reported a high level of engagement (Figure 4.35.).

4.6 Qualitative Comments

Several questions on the surveys allowed for students to provide qualitative feedback on the course. When asked what they liked about the course, students responded that they liked the discussions (8%), and that they could access class from anywhere (62%) (Table 4.1).

When asked what they disliked about the course, some said they had technical issues (36%), and some had communication issues (21%) (Table 4.2).

Students were asked to report why they did or did not feel comfortable expressing their ideas in Second Life™. They responded that they liked the sense of anonymity that Second Life™ afforded them (28%). 18% of the students said that they were naturally extroverted, so they felt comfortable expressing their ideas like in any other course (Table 4.3).

When asked what they attributed their engagement to in Second Life™, some responded they had a desire to learn the material (33%), and others reported that they enjoyed group discussions (21%) (Table 4.4).

When asked what was valuable about the course and how it could help with their future goals, one student reported that it “taught me to work in a group effectively and not just provide answers and it taught me that sometimes I get answers correct but approach them in incorrect ways. This was very helpful for me to recognize and will be helpful in the future”. Another student reported, “A sense of family existed in the groups. So, teamwork skills were greatly enhanced. Learning to trust others was also a perk.”

Some students said they enjoyed the course in Second Life™: “Second Life mimics the classroom environment and is an effective way to learn material.” Another student said, “this course has been much more helpful and enjoyable compared to my other more traditional science courses. I feel like the discussions in second life allowed me to hear other students' ways of analyzing information and being able to relate anatomy content to clinical examples further solidified what I've learned.” While other students said, “I still would rather meet in person...”.

4.7 Chapter 4 Tables and Figures

Table 4.1. Example Responses from “What do you like about your experience thus far with Second Life™?”

“I like the class atmosphere, even though its[sic] only a virtual class”
“easy access, easy to communicate with class/group/teacher”
“I like how I feel relaxed at home while I am still in a classroom setting.”
“Communication is easier than I thought and makes the online aspect more personal”
“Feel more comfortable participating that[sic] I would in a regular classroom and still feel as engaged in learning as I would in an actual classroom.”

Table 4.2. Example Responses from “What do you dislike about your experience thus far with Second Life™?”

“We are not physically taught by a teacher and it is hard to learn the material by oneself.”
“the technical problems that happen, although they are improving”
“...I have had difficulty controlling my avatar at times, especially when viewing slides, etc. that contain material in the virtual environment. With time, though, this has gotten easier for me.”

Table 4.3. Example Responses from “Explain why you did/did not feel comfortable expressing your ideas in Second Life™.”

“I do feel comfortable because discussion[sic] is how you learn, during the last class I learned a lot via small group discussion.”
“Second life eliminates the anxiety of answering questions in a traditional large lecture hall setting.”
“I felt comfortable expressing my ideas because it was a more impersonal environment; however, there still remains some pressure to be correct (as in any environment) and, it does take a little longer to type them out in the Chat bar, which sometimes discourages me from actually doing so.”
“You can't read people's faces nor[sic] see their reactions based of[sic] the expression of ideas”

Table 4.4. Example Responses from “What do you attribute your engagement to in Second Life™?”

“Going over the course work in our groups was vrey[sic] engaging”
“The clinical examples were most engaging, because it allowed me to make connections and applications of my knowledge to the actual practice of medicine.”
“I’m just not a big talker in class or at expressing my ideas, so that was hard for me.”

Figure 4.1. Class Standing
Most students were undergraduate seniors (n=39).

Figure 4.2. Purpose of Course

The majority of students reported that they were taking the course to prepare for medical school (n=44 responses).

Figure 4.3. Number of Online Courses Taken by Students
A majority of students had taken three or more online courses, while only a small percentage of students had never taken an online course before.

Figure 4.4. Previous Educational Experience

Most students had taken at least one anatomy course, and one online course in the past; however, only 15% of students had taken an online course with a discussion component, and 13% had taken a course involving TBL in the past.

Figure 4.5. Frequency of Second Life™ Access on Campus
Most students never accessed Second Life™ on campus, and of those 63% reported accessing Second Life™ from home.

Figure 4.6. Percentage of Students Willing to Retake Course
Most students reported that having been through this experience, they would take this course again.

Figure 4.7. Percentage of Students Willing to Take a Similar Course
Most Students would take another course that involved discussion groups in Second Life™ in the future.

Figure 4.8. Mean Participation in Each Part of the TBL Process
Number of comments (across 4 time points) made by students for each part of the TBL process. More comments were made during the gRAT part of the TBL process than the clinical or main lab. Data are presented as means $\pm$ SD; $n=39$ students. $p < 0.001$ by Kruskal-Wallis Test and Dunn's Multiple Comparison's Test.

Figure 4.9. Percent Participation for IM vs. Voice Users
 Number of comments (across 4 time points) made by voice chat and instant message users for each part of the TBL process. Voice chat users participated less than IM users during the main lab discussion. Data are presented as means $\pm$ SD; $n=39$ students (IM=24, Voice=15). * $p=0.046$ by Mann-Whitney U test. T-tests were performed on each pair individually (ex. voice vs IM for gRAT).

Figure 4.10. Average Participation in Relation to Final Grade
Mean number of comments (across 4 time points) made by students of varying performance levels during a TBL session. There was no significant difference between the performance of students in the course and their level of participation. Data are presented as means $\pm$ SD; $n=39$ students (A=17, B=14, C=5, D=3); n.s. by Kruskal-Wallis test.

Figure 4.11. Participation by Gender

Mean number of comments (across 4 time points) made by male and female students during a TBL session. There was no difference between males and females. Data are presented as means $\pm$ SD; $n=39$ students (Males=19, Females= 20); n.s. by Mann-Whitney U test.

Figure 4.12. Participation vs. Experience with Technology
Mean number of comments (across 4 time points) made by students with low and high technology experience during a TBL session. There was no difference between students with low or high technology experience. Data are presented as means $\pm$ SD; $n=36$ students (low=13, high=23) ; n.s. by Mann-Whitney U test.

Figure 4.13. Average Bloom's Taxonomy Level Frequency During a TBL Session
 Average percentage of comments coded to each level of Bloom's taxonomy. All of the levels were significantly different from one another with the exception of levels four and five. Most comments were Bloom's level one followed by levels four and five. Data are presented as percent means $\pm$ SEM; $n=39$ students; * $p<0.0001$ by Kruskal-Wallis test and Dunn's multiple comparison's test).

Figure 4.14. Average Bloom's Taxonomy Level Frequency During Each Part of the TBL Process

Average percentage of comments coded to each level of Bloom's taxonomy for each part of the TBL process. The Bloom's level for each part of the TBL process was analyzed separately. All of the levels were significantly different across parts of the TBL process, with the exception of Bloom's level one for the gRAT and main lab parts of the TBL process. Data are presented as percent means $\pm$ SEM; $n=39$ students; $p<0.0001$ by Kruskal-Wallis test and Dunn's multiple comparison's test.

Figure 4.15. Average Bloom's Taxonomy Level Frequency for Voice Chat and IM Users

Average percentage of comments coded to each level of Bloom's taxonomy for voice chat and instant message users. Each Bloom's level (Voice vs. IM) was analyzed separately. There was no significant difference between voice and IM users for each Bloom's level, with the exception of Bloom's level 5. Data are presented as percent means $\pm$ SEM; $n=39$ students (IM=24, voice=15); $**p=.0018$ by Mann-Whitney U test.

Figure 4.16. Average Bloom's Taxonomy Level Frequency for Males and Females
Average percentage of comments coded to each level of Bloom's taxonomy for males and females. Each Bloom's level (males and females) was analyzed separately. There was no significant difference between males and females for all of the Bloom's levels. Data are presented as percent means $\pm$ SEM; $n=39$ students (Males=19, Females=20); n.s. by Mann-Whitney U test.

Figure 4.17. Average Bloom's Taxonomy Level Frequency for Low and High Performing Students

Average percentage of comments coded to each level of Bloom's taxonomy for low and high performing students (high=A or B final grade, low =C or D final grade). Each Bloom's level (high and low performance) was analyzed separately. There was no significant difference between low and high performing students for all of the Bloom's levels. Data are presented as percent means $\pm$ SEM; n=39 students (high=31,low=8); n.s. by Mann-Whitney U test.

Figure 4.18. Average Bloom's Taxonomy Level Frequency Based on Technology Experience

Average percentage of comments coded to each level of Bloom's taxonomy for students with low and high technology experience (low = 1-20 tech score, high = 21-40 tech score). Each Bloom's level (high and low tech experience) was analyzed separately. There was no significant difference between students with low and high levels of technology experience for all of the Bloom's levels. Data are presented as percent means $\pm$ SEM; $n=36$ students (low=13, high=23); n.s. by Mann-Whitney U test.

Figure 4.19. Percent Social Engagement for Each Part of the TBL Process
The average percentage of social comments (across 3 raters) out of the total number of comments for each section of the TBL process. More social comments were made during the gRAT and clinical parts of the TBL process than the main lab discussion. Data are presented as percent means $\pm$ SEM; $n=39$ students. **** $p < 0.0001$ by Kruskal-Wallis Test and Dunn's Multiple Comparison's Test.

Figure 4.20. Percent Social Engagement of Voice and IM Users

The average percentage of social comments (across 3 raters) out of the total number of comments for voice chat and instant message users during a TBL session. There was no difference in the social engagement of students who used voice chat or instant messaging. Data are presented as percent means $\pm$ SEM; $n=39$ students (IM=24,voice=15); n.s. by Mann-Whitney U test.

Figure 4.21. Percent Social Engagement by Gender

The average percentage of social comments (across 3 raters) out of the total number of comments for males and females during a TBL session. There was no difference in the social engagement of male and female students. Data are presented as percent means $\pm$ SEM; $n=39$ students (Males=19, Females=20); n.s. by Mann-Whitney U test.

Figure 4.22. Percent Social Engagement Based on Performance

The average percentage of social comments (across 3 raters) out of the total number of comments during a TBL session. There was no difference in social comments made among students of varying performance levels. Data are presented as percent means $\pm$ SEM; $n=39$ students (A=17, B=14, C=5, D=3). n.s. by Kruskal-Wallis Test.

Figure 4.23. Percent Social Engagement Based on Technology Experience
The average percentage of social comments (across 3 raters) out of the total number of comments for students with low and high technology experience during a TBL session (low = 0-20 tech score, high = 21-40 tech score). There was no difference in the social engagement of students with more or less technology experience. Data are presented as percent means $\pm$ SEM; $n=36$ students (low=13, high=23); n.s. by Mann-Whitney U test.

Figure 4.24. Emotional Engagement Based on Mode of Communication

The average emotional engagement score of voice chat and instant message users (higher score = greater emotional engagement). There was no difference in the emotional engagement of students using voice chat versus instant messaging. Data are presented as means $\pm$ SD; $n=30$ students (IM=17, voice=13); n.s. by Mann-Whitney U test.

Figure 4.25. Emotional Engagement of Males and Females

The average emotional engagement score of males and females (higher score = greater emotional engagement). Males were more emotionally engaged than females. Data are presented as means $\pm$ SD; $n=30$ students (males=15, females=15); $**p=0.0018$ by Mann-Whitney U test.

Figure 4.26. Emotional Engagement Based on Performance
The average emotional engagement score of students with varying performance levels. There was no difference in emotional engagement among students of varying performance levels. Data are presented as means $\pm$ SD; n=30 students (A=13, B=12, C=3, D=2). n.s. by Kruskal-Wallis Test.

Figure 4.27. Emotional Engagement Based on Technology Experience

The average emotional engagement score of those students with low or high technology experience (low=1-20 score; high=21-40 score). There was no difference in the emotional engagement of students based on previous technology experience. Data are presented as means $\pm$ SD; n=28 students (low=9, high=19); n.s. by Mann-Whitney U test.

Figure 4.28. Reported Engagement Scores by Gender

The average reported engagement score of male and female students (10 = highly engaging, 1=not engaging). There was no significant difference between males and females. Data are presented as means $\pm$ SD; $n=39$ students (males=19, females=20); n.s. by Mann-Whitney U test.

Figure 4.29. Reported Engagement of Voice Chat and IM Users
The average reported engagement score of voice chat and instant message users (10 = highly engaging, 1=not engaging). There was no significant difference between voice chat and instant message users. Data are presented as means $\pm$ SD; n=39 students (IM=24, voice=15); n.s. by Mann-Whitney U test.

Figure 4.30. Reported Engagement by Level of Performance

The average reported engagement score of students with varying performance levels. There was no difference in reported engagement among students of varying performance levels. Data are presented as means $\pm$ SD; $n=39$ students (A=17, B=14, C=5, D=3). n.s. by Kruskal-Wallis Test.

Figure 4.31. Reported Engagement Based on Technology Experience

The average reported engagement score of those students with low or high technology experience (low=1-20 score; high=21-40 score). There was no difference in the reported engagement of students based on previous technology experience. Data are presented as means $\pm$ SD; n=36 students (low=13, high=23); n.s. by Mann-Whitney U test.

Figure 4.32. Reported Engagement vs. Behavioral Engagement
The average number of comments (across 4 time points) made by students during a TBL session in comparison to their reported engagement score (high = 9 or 10, medium = 7 or 8, low = 6 or less). The high and low reported engagement categories were significantly different from one another, and the low and medium categories were significantly different from one another. Data are presented as means $\pm$ SD; $n=39$ students (high=13, medium=19, low=7). $p<0.01$ by Kruskal-Wallis Test and Dunn's Multiple Comparison's Test.

Figure 4.33. Reported Engagement vs. Cognitive Engagement
 Average percentage of comments coded to each level of Bloom's taxonomy in comparison to student's level of reported engagement (high = 9 or 10, medium = 7 or 8, low = 6 or less). Each Bloom's level (high, medium, low engagement) was analyzed separately. There was no difference in the level of student's reported engagement compared to the percentage of comments at each Bloom's level, with one exception. Those students that reported a low level of engagement had a significantly higher percentage of Bloom's level one comments than those that reported a medium level of engagement. Data are presented as percent means $\pm$ SEM; $n=39$ students (high=13, medium=19, low=7). $p<0.04$ by Kruskal-Wallis Test and Dunn's Multiple Comparison's Test.

Figure 4.34. Reported Engagement vs. Social Engagement

The average percentage of social comments (across 3 raters) out of the total number of comments compared to student's reported engagement score (high = 9 or 10, medium = 7 or 8, low = 6 or less). There was no difference in student's reported engagement score compared to their social engagement. Data are presented as percent means $\pm$ SEM; $n=39$ students (high=13, medium=19, low=7). n.s. by Kruskal-Wallis Test.

Figure 4.35. Reported Engagement vs. Emotional Engagement

The average emotional engagement score of students compared to student's reported engagement score (high = 9 or 10, medium = 7 or 8, low = 6 or less). Those students that reported a low level of engagement had a significantly lower emotional engagement score than those that reported a high level of engagement. Data are presented as means $\pm$ SD; $n=30$ students (high=11, medium=13, low=6). $p<0.01$ by Kruskal-Wallis Test and Dunn's Multiple Comparison's Test.

5 DISCUSSION AND CONCLUSIONS

Some educators believe that online courses lack the simultaneous interactions that occur in a face-to-face classroom [10, 14, 15], and that online students are missing out on important skills such as team-work and critical thinking [16, 17]. TBL is one strategy for improving team-work and critical thinking skills [18]. This has proven to be an engaging teaching pedagogy in face-to-face classes [5, 19-24]; however, to our knowledge, has never been implemented in a 3-D environment online. Our goal was to implement TBL online, and to evaluate whether it was an engaging teaching strategy for students.

We implemented TBL online using the virtual world Second Life™ for a novel undergraduate anatomy course. We evaluated the course over two spring semesters (2013-2014) with 39 total students participating in our study. We surveyed students at the beginning, middle, and end of the semester, as well as, transcribed and evaluated their participation in class.

Our results indicate virtual TBLs were engaging for most students. The average engagement score was 7.8 out of 10 with 89.2% of students reporting a score of 6 or above. Students exhibited high levels of cognitive engagement during the clinical application portion of the TBL process. Males felt more emotionally engaged than females, however, most measures of engagement indicated no differences between groups of students (mode of communication, previous technology experience, gender, and performance); therefore, virtual

TBLs may be engaging for a broad range of students. While there were both positive and negative qualitative comments, 95% of students agreed that this was a worthwhile experience. In light of this evidence, we feel that virtual TBL sessions are valuable, and could be implemented in other online courses.

There were three specific aims of this study. The first aim of this study was to determine whether TBL in Second Life™ would engage students in learning anatomy. Most students reported being engaged with an engagement score of 7.8 out of 10 points, with 10 representing “highly engaged” on a single survey question. A small percentage (10.8%) of students reported an engagement score of 5 or less. Our hypothesis was supported that TBL in Second Life™ would engage students, however, not all students may find it very engaging.

Not only did we measure engagement by directly asking students, we also measured engagement indirectly through surveys and content analysis of four TBL sessions. We defined engagement as having 4 components – behavioral, cognitive, social, and emotional.

The behavioral component was measured by a student’s level of participation in class, which was determined by the average number of comments a student made during a TBL session. Some students were highly engaged with an average of 158 comments per session, while others were not very behaviorally engaged with an average of 13 comments during a 90 minute TBL. This may have been due to personality differences – some may have

naturally been introverted, and some may have naturally been extroverts. One student commented, ““I’m just not a big talker in class or at expressing my ideas, so that was hard for me”. A student’s behavioral engagement may have also been related to the individual’s comfort in using instant messaging as a mode of communication. One student said, “...it does take a little longer to type them out in the Chat bar, which sometimes discourages me from actually doing so”.

In general, students were more behaviorally engaged during the gRAT portion of the virtual TBL. One lesson learned in this course was to hide the iRAT scores from students in BlackBoard. Initially, students in the 2013 class were immediately notified of their overall iRAT score. This decreased the discussion during the gRAT portion of the TBL process because students who had perfect scores knew all the answers, and there was no debate over the questions. Following the first couple of surveys, the scores were hidden in Blackboard, and there was an increase in the level of discussion over the gRAT questions.

Students likely participated more during the gRAT due to the fact that they had more questions to respond to during this part of the TBL process than the other parts of the TBL process. The gRAT questions were designed to be identical to the iRAT questions, therefore, students had more of an opportunity for discussion of these questions with their prior experience. Groups also received a grade for the number of correct answers on gRAT, as opposed to the clinical application portion of the TBL process that was only graded for

participation, so they had a direct interest in making sure they agreed or disagreed with the answer choices.

In specific aim two, we wanted to determine what type of students would report and demonstrate the greatest engagement. We were specifically interested in looking at differences between males and females, those that used voice chat versus instant message, higher versus lower performing students, and those students that had more or less technology experience.

Voice chat and IM users did not have significantly different amounts of comments in their group rooms. During the coding process, coding units were determined to be each instant message and each spoken comment, which could be one or more sentences in length. Because the number of comments did not significantly differ in the group room, we can assume that the coding units were valid.

While there was no difference between voice chat and IM users in the amount of behavioral engagement during the gRAT and clinical application portions of the TBL process, there was a difference during the main lab discussion. IM users were more behaviorally engaged than voice chat users. During this time, both the IM users and the voice chat users were only using instant messages to communicate. It's possible that those students that used voice chat in their groups did not feel as comfortable using a different mode of communication in the main lab, and thus made fewer comments. In the future, it may be more engaging for students to use voice chat in the main lab as well.

Our results indicated that students were not hindered in their level of participation by having less experience with technology because those with more and less technology experience had the same level of behavioral engagement. Students of varying performance levels and different genders were also equally behaviorally engaged in virtual TBL sessions.

Cognitive engagement was measured using Bloom's taxonomy to code student comments to determine levels of higher order thinking. The majority of comments were at the remembering level (25.1%) during the gRAT and main lab discussions. This was likely due to the fact that the gRAT questions had been previously seen by the students during the iRAT, and students were mainly recalling information they used to answer these questions during the gRAT portion of the TBL process. During the main lab discussion, students reviewed the gRAT questions, and discussed the clinical application questions. Since they had also previously discussed these questions in the group rooms, they were mostly recalling the information they had used to answer these questions. This is a similar pattern to what we would expect to see in a face-to-face classroom.

The clinical application portion of the TBL process was where the majority of higher order thinking was taking place, with significantly more analyzing and evaluating level comments. There were more analyzing level comments made during the main lab portion of the TBL process than the gRAT portion because most of the analyzing for the gRAT portion was done by the individual during the iRAT, and students were mainly evaluating their peer's comments to decide on

their final answer choices for the gRAT (which is why there were greater percentages of evaluating comments over the main lab discussion). Students made analysis level comments in response to questions from the instructor during the interteam discussion, which is why they had greater numbers of analyzing comments than the gRAT portion of the TBL process. These patterns of engagement are similar to what we would expect to see in face-to-face TBLs, which indicates TBLs can be successfully translated to an online virtual world.

Male and female students and those with more or less technology experience were equally cognitively engaged in TBLs. While there was a difference in performance level in the course, there was no difference in the level of cognitive engagement during virtual TBL sessions. Voice users had slightly more evaluating level comments than IM users, but otherwise were equally cognitively engaged. Again, it may be beneficial to have all users use voice chat in the future to allow for greater student engagement.

Social engagement was measured by the percentage of social comments made during a TBL session. Overall, students were highly socially engaged with an average of 39% of their total comments being social remarks. They were also more socially engaged in their group rooms than in the main lab. This indicates that they were very comfortable in their groups. Based on observations of these groups, they often gave congratulatory comments (ex. "YAYYY", "excellent!", "Suhweet"). If they arrived in their groups early, or completed a part early, they also spent time chatting with one another, as opposed to in the main lab where

most of the time was spent discussing the material. Students were equally socially engaged using either mode of communication, across genders, performance levels, and regardless of prior technology experience. This high level of social engagement across groups of students suggests that students felt a sense of community during vTBLs [54]. Rovai suggests that a sense of community may help increase student retention in online courses [54], therefore, vTBLs may be useful in online courses with low student retention.

Student's emotional engagement was measured by their responses to key survey questions regarding their sense of community, value of teams, and level of comfort using the technology. Students reported a high level of emotional engagement with an average score of 89.1 out of 110 possible points. There was no difference in the level of emotional engagement among students using different modes of communication, students with different technology experience, or students with varying performance levels. However, males were more emotionally engaged than females. Looking further into their emotional engagement scores, males reported significantly greater comfort levels using Second Life™ technology than females. This finding is similar to studies that have shown males feel more comfortable using technology than females [55]. Males also had significantly greater experience with video gaming than females, similar to other studies [56, 57], which may have influenced their reported level of emotional engagement. One study, by Kron et. al., also found that male medical students were significantly more interested than females in "multiplayer online healthcare simulations that realistically replicate the experience of what it's

like to be in professional practice,” which was similar to the experience students had during the clinical application portion of the TBL process [57]. These findings may mean that virtual TBLs may be more appealing to males than females.

Most students reported that they felt engaged using Second Life™ for TBL sessions, and there was no difference in the engagement of students based on their gender, previous technology experience, mode of communication, or performance level, which suggests that this method of delivering TBLs would be effective across many different groups of students.

The final aim of the study was to determine if student's reported engagement scores correlated with their demonstrated engagement in class. Those students that reported a low level of engagement, also participated less, had a greater number of lower order comments, and were less emotionally engaged. This suggests that those students that reported lower levels of engagement also demonstrated lower levels of engagement. This suggests that their reported engagement scores were valid.

The qualitative comments suggest that there were a few students who did not feel engaged by virtual TBLs, but the majority felt engaged in virtual TBLs. Like in any class, there are different strategies you can use to reach each student. TBL itself is a unique strategy that is very different from traditional pedagogies, and was novel to 87% of the class. Some students are uncomfortable with the independent nature of the TBL process, as evidenced by

one student's comment, "We are not physically taught by a teacher and it is hard to learn the material by oneself". While some may have struggled with the TBL process, students reported improvements in several areas at the end of the course. 69% of students agreed or strongly agreed that their experiences in Second Life™ improved their ability to work as a team, 62% said this course improved their ability to communicate, 87% said discussions of clinical examples improved their understanding of anatomy, and 69% said that discussion sessions for this course was more helpful than discussion sessions they have had in other courses. 72% of students disagreed or strongly disagreed that Second Life™ discussion sessions were not effective, therefore the majority of students felt virtual TBLs are an effective method for teaching. Most measures indicated no difference in engagement between several different groups of students (based on mode of communication, previous technology experience, gender, and performance), and therefore, may be an engaging strategy for a broad range of students. While student qualitative data expressed both positives and negatives about virtual TBL sessions, 95% agreed that this was a worthwhile experience. In light of this evidence, we feel that virtual TBL sessions are engaging, and could be used in other disciplines for online learning.

5.1 LIMITATIONS

This study had several limitations. This course had a very specific population of highly motivated, pre-professional students, which may affect whether this pedagogy could generalize to other populations. Several of the measures were self-reported, so students may have skewed their responses. Some of the measures were based on content analysis, which is subjective in nature.

5.2 FUTURE RESEARCH

In the future, it would be helpful to include a personality trait questionnaire along with the surveys in order to help determine which students (ex. introverts vs. extroverts) would benefit most from this type of online course. It would also be useful to compare this course to a face-to-face course in the future.

APPENDICES

APPENDIX A

This is an example of an individual readiness assurance test (iRAT). Students would complete this test through Blackboard.

1. A red blood cell entering the left atrium would immediately pass through which of the following structures?

- A. tricuspid valve
- B. pulmonary semilunar valve
- C. aortic semilunar valve
- *D. bicuspid valve
- E. coronary sinus

Points: 1

2. Which of the following coronary arteries curves to the left in the coronary sulcus, moving to the posterior surface of the heart?

- A. anterior interventricular/LAD artery
- B. posterior interventricular artery
- *C. circumflex artery
- D. marginal artery
- E. right coronary artery

Points: 1

3. Which of the following CORRECTLY describes the foramen ovale?

- A. it is a remnant of a fetal shunt that connected the pulmonary artery to the aorta
- *B. it is an opening between the atria that allows a right-to-left shunt of blood in the fetus
- C. it is a pathway for oxygen-poor blood from the heart to return to the right atrium
- D. it is an opening between the ventricles that allows a right-to-left in the fetus
- E. it is an open connection between the pulmonary artery and the aorta

Points: 1

4. If a pacemaker was inserted into the inferior and posterior portion of the right atrium near the opening of the coronary sinus, which of the following structures would it influence directly?

- A. sinoatrial (SA) node
- B. ventricles
- C. AV Bundle of His
- D. papillary muscles
- *E. atrioventricular (AV) node

Points: 1

5. Which of the following relationships is TRUE?

- *A. atrioventricular valves; attached to chordae tendinae
- B. pectinate muscles; located in the ventricles
- C. parasympathetic innervation of heart; synapse in paravertebral ganglia
- D. contraction of the ventricles; atrioventricular valves open
- E. coronary sinus; empties deoxygenated blood from heart into left atrium

Points: 1

6. The layer lining the posterior surface of the thoracic cage is:

- *A. costal pleura
- B. diaphragmatic pleura
- C. cervical pleura
- D. mediastinal pleura
- E. visceral pleura

Points: 1

7. Which of the following features is unique to the right lung?

- A. two lobes
- *B. a horizontal fissure
- C. pulmonary ligament
- D. the hilum
- E. superior lobe

Points: 1

8. Which of the following structures forms a boundary around an individual bronchopulmonary (BPS) segment and is therefore important in the resection of lung tumors?

- A. pulmonary artery
- *B. pulmonary vein
- C. bronchial artery
- D. tertiary bronchus
- E. none of the above

Points: 1

9. Which of the following statements is TRUE?

- A. lymph from the lung drains directly to the right lymphatic duct and thoracic duct
- B. sympathetic innervation to the lung causes constriction of the airways
- C. a secondary bronchus supplies a bronchopulmonary segment (BPS) segment of the lung
- D. the left primary bronchus is shorter and wider than the right primary bronchus
- *E. lung tissue is supplied with blood through the bronchial arteries

Points: 1

10. Which of the following structures is the most superficial?

- A. parietal pleura
- B. visceral pleura
- C. lung tissue
- *D. endothoracic fascia

Points:1

APPENDIX B

The Team-based learning (TBL) Process

TBL consists of the readiness assurance process and a clinical application. The readiness assurance process includes two components: the **individual readiness assurance test (iRAT)** and the **group readiness assurance test (gRAT)**. The iRAT is an individual quiz over the anatomy material, and the gRAT is a group quiz. In this course, the iRAT will be administered on Bb. So, before you attend class virtually on Wednesday afternoons, you will log into Bb and access the individual quiz under the “QUIZZES for iRAT” tab on the left. This will be a timed quiz of 10 questions. You will have 15 minutes to answer these questions, so you only need a 15 minute time frame within the four hour time frame (12-4pm) on Wednesdays to complete the assignment.

The gRAT and clinical application will be administered in the weekly virtual meetings in Second Life™ from 4:00-5:30pm on Wednesdays. After the class is dismissed to go to their individual group rooms, students will teleport to their respective rooms. Approximately 6-7 students will be grouped together (a total of four groups). Use the teleport balls in the main lab to reach your group rooms (see below).

Create landmarks for your group rooms and for the main lab to more easily teleport between each space.

Group 1: green, Group2 : red, Group 3: blue, Group 4: purple

In the group rooms, the first task will be the gRAT. The gRAT is set up on one wall in the group room (see below). Each group will have an immediate feedback assessment technique (IFAT) form that looks like a bubble sheet. This is called an immediate feedback form because you will know whether your answer is correct or not immediately; green indicates a correct answer and red indicates a wrong answer.

There are a total of 10 questions worth 4 points each, for a total of 40 points. If your group is correct the first time, the team receives 4 points for that question. If you are not correct, reconsider your answers and discuss it within your group. Try again. If you are correct the second time, the team receives 3 points out of the 4, if correct the third time, the team receives 2 points, and so on. Once all 10 questions have been answered correctly, the team score will automatically be emailed to me.

A few important notes about the gRAT process:

-each team should designate a team-leader for the session to click on the answers to the gRAT. If several people try to click the answer and multiple choices are clicked, there will be no opportunity to undo this, even if someone accidentally clicks the wrong answer. *Each clicked answer counts*, so make sure your team is organized in answering this form.

-books/power points/internet CANNOT be used on the gRAT—it is a closed-note quiz

-the gRAT exercise is designed to promote discussion of anatomy content *within* the group. Each team must decide as a group which answer is best. This means that each person is entitled to their justification of the answer and the overall group dynamics are dependent on each person contributing to the discussion. Please be respectful as fellow peers and encourage all team members to give their input. Healthcare professionals routinely have to work together to accomplish a task, so consider this early training for establishing good group relationships.

-the questions for the gRAT are loaded onto the power point presentation on the wall and can be accessed by the forward and back buttons located at the bottom of the presentation viewer. You can zoom in and out using the camera controls to find a comfortable view for reading the questions.

-there is also a timer on the same wall as the gRAT (shown as the green bar in the picture above). Each team will have **20 minutes** to complete the gRAT. All ten questions must be completed by the end of this time frame. The results will automatically be emailed to me once 10 correct answers are selected. Points will be deducted from the group score if the gRAT is not completed within the 20 minute time frame.

The last component of the TBL is the clinical application. On the opposite wall in your team's room, a clinical application will be displayed (see below).

This will consist of a description of a clinical scenario that relates to the anatomy topic for that week. Your knowledge of the basic regional anatomy content will be used to answer a series of questions that integrates these concepts together. Each clinical vignette will be followed by 2-4 multiple choice questions that will be discussed among the group while in the group rooms. It is the group's responsibility to discuss the answers to these questions and to be prepared to justify their answers once they are reported to the class in the main lab. You will be given **15 minutes** to discuss your answers to the clinical application process. Once the timer is up, everyone will teleport back to the main lab and take a seat at their group table number.

Once everyone has teleported back to the main anatomy lab, each group will take their seats at their respective group tables. Each group will report their answers in the main lab. This will be done simultaneously using the panel marked A-E on top of the table (see below).

A timer will count down 1 minute during which time ONE person from each group should click on the letter that corresponds to their group's answer choice. At the end of the minute, all answers will display on the top of each table. This process allows each team to see what other teams chose as an answer, and to follow with discussion. This process promotes *inter* team discussion. Each group must be able to defend their reasons for choosing/not choosing an answer. The clinical application questions will not be simple questions. They are designed to promote thoughtful discussion, so the goal is to more thoroughly understand the anatomy by applying it to relevant clinical scenarios.

A few important notes about the clinical application process:

- each team should designate a team leader that will click on the correct answer in the A-E panel. The last letter clicked before the 1 minute timer is up will be the letter that is displayed.

- Books/power points/internet may be used to answer these questions

- the clinical vignette can be viewed from the group table by zooming in on the tri-screen display in the center of the room. NOTE: the instructor will advance the slides as each question is discussed.

- the clinical application will be graded in the form of class participation points. Four percent (4%) of your final grade is calculated from your attendance and thoughtful participation in these sessions. Four class meetings will be randomly recorded in order to evaluate this aspect of your grade.

One last note: your performance in this class is dependent on your individual and group effort. The TBL exercises are critical in staying on top of the material and understanding it to the level of detail that is expected in this course; therefore, it is essential that you take the time to be prepared for these sessions and thoughtfully contribute to the discussions in order to maximize your understanding of regional anatomy.

APPENDIX C

Dear student,

You are receiving this email because you are currently enrolled in ANA 309. I am a graduate student here at the University of Kentucky in the Master's in Medical Sciences program. I am working under the direction of Dr. Richardson-Hatcher who is conducting a research study involving the evaluation of this course. This course involves a virtual team-based learning component that is the first of its kind to be offered here at UK, and as far as we know, the first of its kind to be offered anywhere! We are excited about the prospects of using virtual worlds in anatomical education in the future, and want to invite you to participate in a study to evaluate the effectiveness of the online discussion sessions in this course.

If you choose to take part in this study, you will be one of approximately 50 students to do so. You will be asked to complete 3 online surveys throughout the semester to gauge your opinions about the course over time. These surveys will be available to you via an anonymous survey link that I will email to you. The surveys will consist of approximately 30-35 multiple choice/open-ended questions each and will be available for a 72 hour time frame. We anticipate it will take approximately 15-20 minutes to complete each survey.

In addition, four random discussion sessions will be analyzed for trends in peer interactions and group participation, and these findings will be correlated with final grades in the course. At the end of the semester, we will also hold an optional focus group to discuss your opinions about the course. The total amount of time you will be asked to volunteer for this study is 1-1.5 hours over the semester for the surveys, and an additional hour if you choose to participate in the focus group.

While Dr. Richardson-Hatcher is the Principle Investigator for this study, she will not see any of the data collected until after final grades have been posted for the semester. If you decide to take part in the study, it should be because you really want to volunteer. You will not lose any benefits or rights you would normally have if you choose not to volunteer. You can stop at any time during the study and still keep the benefits and rights you had before volunteering. As a student, if you decide not to take part in this study, your choice will have no effect on your academic status or grade in the class. Students that choose to participate in the study and complete all three surveys will receive 50 bonus points. These 50 points will equate to an additional 5% that will be added to your course grade. These points will only be added if all three surveys are completed; no partial points will be given as it is important to understand your opinions regarding the virtual learning over time. If you choose not to participate in the study, you will be given the opportunity to complete an alternative assignment to receive the same 50 bonus points. This assignment will consist of reading a

research paper and writing a 3 page critique, and will require an equivalent amount of time compared to completing the three surveys. The alternate assignment will be posted under the “Miscellaneous” tab in Bb.

Our intent is to publish the results of this study to share this innovative teaching approach with others around the world. Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. You will not be personally identified in these written materials; we will keep your name and other identifying information private. I hope you will take this opportunity to impact the education of others, and represent UK at the forefront of online education. Thank you for your consideration.

If you choose to take part in this research study, please click on the following link:

https://uky.az1.qualtrics.com/SE/?SID=SV_b44asTCZgdu6MAAt

enter the password: ana309

A new window will appear with information regarding the consent form that must be signed before you can participate in the research study. You will be asked to submit your avatar name to indicate your consent. As co-investigator I will correspond with research participants from this point forward. Dr. Hatcher will not be aware of your participation/non-participation in the study until the final grades have been submitted.

Sincerely,

Christena M. Gazave

christena.gazave@uky.edu

APPENDIX D

Consent to Participate in a Research Study Assessing the Value of Second Life™ in Teaching Regional Anatomy to Undergraduates Through a Virtual Team-based Learning Experience

WHY ARE YOU BEING INVITED TO TAKE PART IN THIS RESEARCH?

You are being invited to take part in a research study about the value of virtual team-based learning experiences in anatomy education. You are being invited to take part in this research study because you are a student enrolled in ANA 309. If you volunteer to take part in this study, you will be one of approximately 50 people to contribute opinions toward this new approach in virtual team-based learning in anatomy education.

WHO IS DOING THE STUDY?

The person in charge of this study is Dr. April Richardson-Hatcher of the University of Kentucky Department of Anatomy and Neurobiology. Dr. Hatcher will be assisted in the study by Mrs. Christena Gazave, who will be collecting the survey data, and Mr. Matt Hazzard, who will assist in all technological aspects of the project.

WHAT IS THE PURPOSE OF THIS STUDY?

By doing this study, we hope to learn about the value of virtual team-based learning experiences in anatomical education.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST?

The research procedures will be conducted online. The total amount of time you will be asked to volunteer for this study is 1-1.5 hours over the spring semester.

WHAT WILL YOU BE ASKED TO DO?

You will be asked to complete 3 surveys throughout the semester. An anonymous survey link will be emailed to you following the first official anatomy discussion (session 2) and after all four exams. The surveys will be available for 72 hours. The data from the surveys will be accessed by a graduate student investigator (Mrs. Gazave) and will not be available to the course director until the end of the semester after grades have been submitted. You will be asked for your avatar name when you complete these surveys; your avatar name and survey opinions will only be accessed by the student investigator. Your avatar name will be needed to credit your bonus points for participation in the study.

If you choose to participate in the study, the recorded sessions will be analyzed for trends in peer interaction and group participation, and these findings will be correlated with final

grades for the course. By signing this form, you grant Mrs. Gazave permission to access your grades in this course and to quote your open-ended responses to survey questions to illustrate research findings. Again, this data will not be linked in any way to your real identity.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

To the best of our knowledge, participating in this study will have no more risk of harm than you would experience in everyday life.

WILL YOU BENEFIT FROM TAKING PART IN THIS STUDY?

There is no guarantee that you will get any benefit from taking part in this study. Your willingness to take part, however, may, in the future, help society as a whole better understand this research topic.

DO YOU HAVE TO TAKE PART IN THE STUDY?

If you decide to take part in the study, it should be because you really want to volunteer. You will not lose any benefits or rights you would normally have if you choose not to volunteer. You can stop at any time during the study and still keep the benefits and rights you had before volunteering. As a student, if you decide not to take part in this study, your choice will have no effect on your academic status or grade in the class.

IF YOU DON'T WANT TO TAKE PART IN THE STUDY, ARE THERE OTHER CHOICES?

If you do not want to take part in the study, you can still participate in the course without penalty.

WHAT WILL IT COST YOU TO PARTICIPATE?

There are no costs associated with taking part in the study.

WILL YOU RECEIVE ANY REWARDS FOR TAKING PART IN THIS STUDY?

You will receive 30 bonus points on your final grade for completing all three surveys in this study. All three surveys must be completed in order to receive the 30 points. If you do not wish to participate in this study, you will be given the choice to complete an alternate assignment to earn the same number of bonus points. This assignment will require an equivalent amount of time to complete, and will involve reading a research paper and providing a three page written critique of the research topic. Therefore, if you wish to withdraw from the study early, you must complete the alternate assignment to receive the 30 bonus points.

WHO WILL SEE THE INFORMATION THAT YOU GIVE?

Mrs. Gazave will be the only person viewing the results of the surveys and other data collected during the semester. Dr. Hatcher will not see any of the data until after final grades have been posted. We will make every effort to keep confidential all research records that identify you to the extent allowed by law.

Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. You will not be personally identified in these written materials. We may publish the results of this study; however, we will keep your name and other identifying information private.

We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or the nature of that information. Your avatar name will not be linked to your personal information (i.e. real name and student number) in any publication of the results. The student investigator, Mrs. Gazave, will keep all electronic data secure via password protected storage databases, which are secured via firewalls managed by the UK Information Technology Services.

We will keep private all research records that identify you to the extent allowed by law. We may be required to show information which identifies you to people who need to be sure we have done the research correctly; these would be people from such organizations as the University of Kentucky.

Please be aware, while we make every effort to safeguard your data once received from the online survey/data gathering company, given the nature of online surveys, as with anything involving the Internet, we can never guarantee the confidentiality of the data while still on the survey/data gathering company's servers, or while en route to either them or us. It is also possible the raw data collected for research purposes may be used for marketing or reporting purposes by the survey/data gathering company after the research is concluded, depending on the company's Terms of Service and Privacy policies.

CAN YOUR TAKING PART IN THE STUDY END EARLY?

If you decide to take part in the study you still have the right to decide at any time that you no longer want to continue. You will not be treated differently if you decide to stop taking part in the study. You will still have the opportunity to earn the 30 bonus points if you complete the alternate assignment. If you choose to withdraw from the study, you may notify Christena Gazave via email at christena.gazave@uky.edu. She will give you details on how to earn the 30 points by reading a research paper and writing a three page critique instead of completing the surveys.

WHAT ELSE DO YOU NEED TO KNOW?

There is a possibility that the data collected from you may be shared with other investigators in the future. If that is the case the data will not contain information that can identify you unless you give your consent or the UK Institutional Review Board (IRB) approves the research. The IRB is a committee that reviews ethical issues, according to federal, state and local regulations on research with human subjects, to make sure the study complies with these before approval of a research study is issued.

WHAT IF YOU HAVE QUESTIONS, SUGGESTIONS, CONCERNS, OR COMPLAINTS?

Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions, suggestions, concerns, or complaints about the study, you can contact the co-investigator, Christena Gazave at christena.gazave@uky.edu. If you have any questions about your rights as a volunteer in this research, contact the staff in the Office of Research Integrity at the University of Kentucky at 859-257-9428 or toll free at 1-866-400-9428.

By electronically signing this form I agree to participate in this study as outlined above. Please type your AVATAR name below (this is how you will electronically sign the consent form).

APPENDIX E

Survey 1

Spring 2014

Section 1: The following are questions involving your previous experiences and general information.

Avatar name:

College Standing:

- ☐ Freshman (1)
- ☐ Sophomore (2)
- ☐ Junior (3)
- ☐ Senior (4)
- ☐ Post-Bacc (5)
- ☐ Graduate (6)

Technology Use	I have used the following:	On average, how much time do you spend using this per week?				
	(check all that apply) (1)	0 to less than 30 minutes (1)	30 minutes up to 1 hour (2)	1 hour to less than 2 hours (3)	2 hours to less than 4 hours (4)	4 or more hours (5)
iPad/ Tablet PC (1)	☐	☐	☐	☐	☐	☐
iPod/ MP3 Player (2)	☐	☐	☐	☐	☐	☐
BlackBoard™ (3)	☐	☐	☐	☐	☐	☐
Game console (e.g. Xbox™, Wii™, PlayStation™) (4)	☐	☐	☐	☐	☐	☐
First or third-person video games (e.g., Resident	☐	☐	☐	☐	☐	☐

Evil™, Medal of Honor™) (5)						
First or third-person cooperative online video games (e.g., Call of Duty™) (6)	☐	☐	☐	☐	☐	☐
Virtual World (e.g., Second Life™, OpenSim™) (7)	☐	☐	☐	☐	☐	☐
Online social network (e.g., Facebook™, Myspace™, Twitter™) (8)	☐	☐	☐	☐	☐	☐
Texting or instant messaging (9)	☐	☐	☐	☐	☐	☐
Online video chat (e.g., Facetime™, Skype™) (10)	☐	☐	☐	☐	☐	☐
Online voice call (e.g., Skype™) (11)	☐	☐	☐	☐	☐	☐
Online chat rooms (12)	☐	☐	☐	☐	☐	☐

I have taken the following (check all that apply):

- ☐ online course (1)
- ☐ anatomy course (2)
- ☐ online course with a discussion component. If so, please describe your experience: (3)

Which of the following best reflects the number of online courses you have taken in the past? (Do not include this course)

- ☐ 0 (1)
- ☐ 1 (2)
- ☐ 2 (3)
- ☐ 3 (4)
- ☐ 4 or more (5)

Have you taken a course involving team based learning in the past?

- ☐ no (1)
- ☐ yes (2)

Which of the following best reflects how difficult it was to learn to use Second Life™?

- ☐ Very Easy (1)
- ☐ Easy (2)
- ☐ Neutral (3)
- ☐ Somewhat Difficult (4)
- ☐ Very Difficult (5)

Which of the following best reflects the amount of time you spent personalizing your avatar?

- ☐ less than 15 minutes (1)
- ☐ 30 minutes (2)
- ☐ 1 hour (3)
- ☐ 2-3 hours (4)
- ☐ 4+ hours (5)

Which of the following best reflects the amount of time you spent learning how to use (i.e. navigate, walk, teleport, etc.) Second Life™?

- ☐ less than 15 minutes (1)
- ☐ 30 minutes (2)
- ☐ 1 hour (3)
- ☐ 2-3 hours (4)
- ☐ 4+ hours (5)

Why are you taking this course?

What grade do you expect to get in this course?

- ☐ D (1)
- ☐ C (2)
- ☐ B (3)
- ☐ A (4)

Section 2: The following are questions involving your perceptions of Second Life™ and your avatar as it relates to yourself.

Rate your comfort level in using Second Life™ technology on a scale of 1-10 (10=very comfortable, 1=very uncomfortable)

- ☐ 1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)
- ☐ 10 (10)

What do you like about your experience thus far with Second Life™?

What do you dislike about your experience thus far with Second Life™?

Please rate the following statements according to your level of agreement.

I feel a sense of anonymity as my avatar.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

If something embarrassing happened to my avatar, I would feel embarrassed.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I feel that my avatar is an extension of myself in Second Life™.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Section 3: The following are questions involving your participation in discussion sessions and the nature of your group interactions. Please rate the following statements according to your level of agreement.

I prefer face-to-face interaction in a classroom setting as opposed to virtual interaction in Second Life™.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I am more likely to ASK my PROFESSOR questions during a discussion in Second Life™ than in a regular classroom.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I am more likely to ANSWER questions from my PROFESSOR during a discussion in Second Life™ than in a regular classroom.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I am more likely to ASK my PEERS questions during a discussion in Second Life™ than in a regular classroom.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I am more likely to ANSWER questions from my PEERS during a discussion in Second Life™ than in a regular classroom.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I feel comfortable expressing my ideas in Second Life™ discussions.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Explain why you did/did not feel comfortable expressing your ideas in Second Life™:

How important is your anonymity as an avatar in your comfort level in asking and answering questions in Second Life™. (10=very important, 1=not at all important)

- ☐ 1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)
- ☐ 10 (10)

Survey 2

Spring 2014

Section 1: The following are questions involving your perceptions of Second Life™ and your avatar as it relates to yourself.

Avatar name:

Rate your comfort level in using Second Life™ technology on a scale of 1-10 (10=very comfortable, 1=very uncomfortable)

- ☐ 1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)
- ☐ 10 (10)

What do you like about your experience thus far with Second Life™?

What do you dislike about your experience thus far with Second Life™?

Please rate the following statements according to your level of agreement.

If something embarrassing happened to my avatar, I would feel embarrassed.

- ☐ Strongly Disagree (11)
- ☐ Disagree (12)
- ☐ Neutral (13)
- ☐ Agree (14)
- ☐ Strongly Agree (15)

I feel that my avatar is an extension of myself in Second Life™.

- ☐ Strongly Disagree (16)
- ☐ Disagree (17)
- ☐ Neutral (18)
- ☐ Agree (19)
- ☐ Strongly Agree (20)

Section 2: The following are questions involving your participation in discussion sessions and the nature of your group interactions. Please rate the following statements according to your level of agreement.

I prefer face-to-face interaction in a classroom setting as opposed to virtual interaction in Second Life™.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I am more likely to ASK my PROFESSOR questions during a discussion in Second Life™ than in a regular classroom.

- ☐ Strongly Disagree (6)
- ☐ Disagree (7)
- ☐ Neutral (8)
- ☐ Agree (9)
- ☐ Strongly Agree (10)

I am more likely to ANSWER questions from my PROFESSOR during a discussion in Second Life™ than in a regular classroom.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I am more likely to ASK my PEERS questions during a discussion in Second Life™ than in a regular classroom.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I am more likely to ANSWER questions from my PEERS during a discussion in Second Life™ than in a regular classroom.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I feel comfortable expressing my ideas in Second Life™ discussions.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Explain why you did/did not feel comfortable expressing your ideas in Second Life™:

How important is your anonymity as an avatar in your comfort level in asking and answering questions in Second Life™. (10=very important, 1=not at all important)

- ☐ 1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)
- ☐ 10 (10)

I feel that I can rely on others in this course.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I feel uneasy exposing gaps in my understanding.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I feel that other students do not help me.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

This course has improved my ability to communicate.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Rate your comfort level in your group (10= very comfortable, 1= very uncomfortable).

- ☐ 1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)
- ☐ 10 (10)

My team worked well together.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

My experiences in Second Life™ have improved my ability to work as a team.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

There was mutual respect for other teammates' viewpoints during Second Life™ discussion sessions.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Section 3: The following are questions involving the value of discussion sessions with regard to your mastery of the material. Please rate the following statements according to your level of agreement.

The discussion sessions for this course were more helpful than discussion sessions I have had for other courses.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

The discussion sessions helped me prepare for course examinations.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Using Second Life™ for discussion sessions is not effective.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

The GRAT group discussions allowed me to correct my mistakes and improve understanding of anatomical concepts.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Discussions of the clinical examples/(TBL learning issues) improved my understanding of basic anatomy content.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Individual readiness assurance tests (IRAT) improved my understanding of basic anatomy content.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

IRAT helped me prepare for discussion sessions.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I feel that my educational needs are not being met.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

The ability to collaborate with my peers will be necessary if I am to be successful as a student.

- ☐ Strongly Disagree (6)
- ☐ Disagree (7)
- ☐ Neutral (8)
- ☐ Agree (9)
- ☐ Strongly Agree (10)

It is a waste of time to work in groups.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I have a positive attitude about working with my peers.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

The ability to work with my peers is a valuable skill.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

In my career, I can be as successful working alone as working with others.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Collaborating with my peers will help me be a better student.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Collaborating with my peers will help me in my career.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Solving problems in a group is an effective way to practice what I have learned.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Solving problems in a group is an effective way to learn.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Working in teams in class is productive and efficient.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Group decisions are often better than individual decisions.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Solving problems in groups leads to better decisions than solving problems alone.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Survey 3

Spring 2014

Section 1: The following are questions involving your perceptions of Second Life™ and your avatar as it relates to yourself.

Avatar name:

Rate your comfort level in using Second Life™ technology on a scale of 1-10 (10=very comfortable, 1=very uncomfortable)

- ☐ 1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)
- ☐ 10 (10)

What do you like about your experience thus far with Second Life™?

What do you dislike about your experience thus far with Second Life™?

Please rate the following statements according to your level of agreement.

I feel a sense of anonymity as my avatar.

- ☐ Strongly Disagree (9)
- ☐ Disagree (10)
- ☐ Neutral (11)
- ☐ Agree (12)
- ☐ Strongly Agree (13)

If something embarrassing happened to my avatar, I would feel embarrassed.

- ☐ Strongly Disagree (11)
- ☐ Disagree (12)
- ☐ Neutral (13)
- ☐ Agree (14)
- ☐ Strongly Agree (15)

I feel that my avatar is an extension of myself in Second Life™.

- ☐ Strongly Disagree (16)
- ☐ Disagree (17)
- ☐ Neutral (18)
- ☐ Agree (19)
- ☐ Strongly Agree (20)

Section 2: The following are questions involving your participation in discussion sessions and the nature of your group interactions. Please rate the following statements according to your level of agreement.

I prefer face-to-face interaction in a classroom setting as opposed to virtual interaction in Second Life™.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I am more likely to ASK my PROFESSOR questions during a discussion in Second Life™ than in a regular classroom.

- ☐ Strongly Disagree (6)
- ☐ Disagree (7)
- ☐ Neutral (8)
- ☐ Agree (9)
- ☐ Strongly Agree (10)

I am more likely to ANSWER questions from my PROFESSOR during a discussion in Second Life™ than in a regular classroom.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I am more likely to ASK my PEERS questions during a discussion in Second Life™ than in a regular classroom.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I am more likely to ANSWER questions from my PEERS during a discussion in Second Life™ than in a regular classroom.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I feel comfortable expressing my ideas in Second Life™ discussions.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Explain why you did/did not feel comfortable expressing your ideas in Second Life™:

How important is your anonymity as an avatar in your comfort level in asking and answering questions in Second Life™. (10=very important, 1=not at all important)

- ☐ 1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)
- ☐ 10 (10)

I feel that I can rely on others in this course.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I feel uneasy exposing gaps in my understanding.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I feel that other students do not help me.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

This course has improved my ability to communicate.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Rate your comfort level in your group (10= very comfortable, 1= very uncomfortable).

- ☐ 1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)
- ☐ 10 (10)

My team worked well together.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

My experiences in Second Life™ have improved my ability to work as a team.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

There was mutual respect for other teammates' viewpoints during Second Life™ discussion sessions.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Section 3: The following are questions involving the value of discussion sessions with regard to your mastery of the material. Please rate the following statements according to your level of agreement.

The discussion sessions for this course were more helpful than discussion sessions I have had for other courses.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

The discussion sessions helped me prepare for course examinations.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Using Second Life™ for discussion sessions is not effective.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

The GRAT group discussions allowed me to correct my mistakes and improve understanding of anatomical concepts.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Discussions of the clinical examples/(TBL learning issues) improved my understanding of basic anatomy content.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Individual readiness assurance tests (IRAT) improved my understanding of basic anatomy content.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

IRAT helped me prepare for discussion sessions.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I feel that my educational needs are not being met.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

The ability to collaborate with my peers will be necessary if I am to be successful as a student.

- ☐ Strongly Disagree (6)
- ☐ Disagree (7)
- ☐ Neutral (8)
- ☐ Agree (9)
- ☐ Strongly Agree (10)

It is a waste of time to work in groups.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

I have a positive attitude about working with my peers.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

The ability to work with my peers is a valuable skill.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

In my career, I can be as successful working alone as working with others.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Collaborating with my peers will help me be a better student.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Collaborating with my peers will help me in my career.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Solving problems in a group is an effective way to practice what I have learned.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Solving problems in a group is an effective way to learn.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Working in teams in class is productive and efficient.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Group decisions are often better than individual decisions.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Solving problems in groups leads to better decisions than solving problems alone.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Section 4: The following are questions involving your participation and your overall evaluation of this course.

On average, how many hours did you study to master the regional content covered in the weekly team-based learning questions?

- ☐ 1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ >8 (8)

What grade do you expect to get in this course?

- ☐ D (1)
- ☐ C (2)
- ☐ B (3)
- ☐ A (4)

Did you access Second Life™ from a campus computer lab?

- ☐ Never (1)
- ☐ Sometimes (2)
- ☐ Always (3)

If not, where did you access Second Life™?

How do you think this course will help you with your future educational and career goals?

What was the most valuable component of ANA 309?

Rate how engaging Second Life™ discussions were for you (10= highly engaging, 1= not engaging).

- ☐ 1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)
- ☐ 10 (10)

What do you attribute your engagement to in Second Life™?

Would you take another course that involved discussion groups in Second Life™ in the future?

- ☐ No (1)
- ☐ Maybe (2)
- ☐ Yes (3)

Having been through this experience, would you take this course again?

- ☐ No (1)
- ☐ Maybe (2)
- ☐ Yes (3)

Explain your reasoning:

How could we improve this course?

I think this was a worthwhile experience.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neutral (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

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Teaching Assistant (Microbiology, Anatomy), 2011 to 2015
Lab Assistant/Undergraduate Research, 2008 to 2009

FAYETTE COUNTY SCHOOLS – CASSIDY – Lexington, KY
Spec. Ed. Paraeducator, 2010 to 2011

UK MEDICAL CENTER – GOOD SAMARITAN – Lexington, KY
Medical Records Clerk, 2007 to 2008

UNIVERSITY CAMPUS STORE – Salt Lake City, UT
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Scholastic & Professional Honors

Human Anatomy & Physiology Society Membership – 2014
Department of Biology Teaching Assistantship – 2012
Golden Key International Honour Society Membership – 2012
Departmental Honors - 2009
Dean's List – 2009
Tri-Beta National Biological Honor Society Membership – 2009
Ribble Scholar – 2008
Geology Department Scholarship Recipient - 2005

Dean's List – 2002

Disabled American Veteran Scholarship Recipient – 2002

TOPS (Tuition Opportunity Program for Students) Recipient – 2002

National Honor Roll – 2002

Professional Publications

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4/18/2016