The Benefits of Near-Peer Teaching Assistants in the Anatomy and Physiology Lab: An Instructor and a Student's Perspective on a Novel Experience

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Abstract
Near-peer teaching, in which students one or more years removed from a student within the same academic program, is utilized broadly in medical school curricula and increasingly in undergraduate anatomy and physiology courses. While the literature on near-peer teaching suggests that the practice is overwhelmingly positive, it is primarily from anatomy courses in a medical school setting. Therefore, instructors who implement near-peer programs at the undergraduate level should share their experiences and evaluate these programs on an ongoing basis. The purpose of this paper is to share a personal experience with utilizing undergraduates as teaching assistants in the anatomy and physiology laboratory setting. A detailed description of the near-peer experience is first provided, followed by the observed benefits for everyone involved from both the instructor and a near-peer's perspective. Finally, recommendations are made for implementing a near-peer program with future directions for research into evaluating outcomes of a near-peer program. http://doi.org/10.21692/haps.2020.003

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Introduction
Anatomy and Physiology is a traditionally challenging course, particularly for first year students. Reasons for difficulty in this course have been investigated (Anderton e*t al.* 2016; Gultice et al. 2015; Rompolski et al. 2016; Russell et al. 2016; Sturges et al. 2016). Students often overestimate their knowledge and preparedness and only realize they are not meeting their learning outcomes after a major assessment (Eagleton 2015; Sturges 2016). In response, increasing attention is being devoted to the importance of regular retrieval practice and low-stakes formative assessment with timely, regular feedback to close the gaps between student perceptions of their understanding and actual competency (Dobson 2013).

Due to the nature of the laboratory setting, laboratory sessions in Anatomy and Physiology present valuable opportunities for active learning and application of concepts being studied and presented in the classroom. While debate continues as to what laboratory experiences are the most valuable in meeting learning outcomes in Anatomy and Physiology, and how to structure and assess those outcomes, there is little debate that a greater faculty-to-student ratio increases the chance that students will receive valuable guidance and feedback. To meet the demands of increasing enrollment and lower faculty-to-student ratios in higher education, many instructors employ and rely on near-peer teachers to assist in their courses (Duran et al. 2012; Hopp et al. 2019).

Near-peer teaching is a type of peer teaching in which students who are one or more years senior in the same program as the more junior students, and have previously completed the same coursework or activities, teach some portion of the course (Bulte 2007). Near-peer teaching may occur in a variety of formats. Near-peers can act as assistants in the classroom for active learning exercises, function as laboratory instructors or assistants, or hold open lab hours (Hopp *et al*. 2019). Near-peer teaching is widely implemented in medical curricula, with evidence demonstrating that near-peers make effective facilitators, information resources, and role models for junior students (Bulte 2007; Reyes-Hernandez et al. 2015).

A recent systematic review of the literature on peer teaching in undergraduate medical education found that knowledge and skills outcomes do not differ between students taught by faculty and students taught by near-peers, and suggested that peer teaching continue to be supported for its power to increase the knowledge and teaching skills of the peer teachers (Rees et al. 2016). Traditionally, students engaged in graduate studies, usually labeled teaching assistants (TAs), assisted instructors in undergraduate courses, whether to fulfill an obligation for an assistantship, or to gain experience for a desired teaching career. However, TAs may not necessarily have gone through the same program, or even gone to the same school as the students they are assisting.

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Near-peer teachers are usually chosen for having been successful in the same course that their junior peers are taking and are highly motivated and enthusiastic about the subject matter. Both graduate assistants and undergraduate assistants are typically trained by the instructor of the course, or through some formal training program, and are carefully monitored, via direct observation by the instructor or student and near-peer feedback (Evans 2009; Hopp *et al*. 2019). A recent exploratory study by Hopp and colleagues into the use of TAs in Anatomy and Physiology found that nearly all participants surveyed reported utilizing TAs in some capacity in their Anatomy and Physiology curriculum. Of those institutions that did not utilize TAs, concerns such as lack of funding, small class sizes, and concerns about TA quality were the prevailing reasons. Of those that did utilize TAs, both undergraduate and graduate TAs were utilized, with graduate students dominating in the four-year public nonprofit universities and undergraduate being the most frequently used in four-year private institutions (Hopp *et al*. 2019).

This paper describes a novel near-peer laboratory teaching program that I, the instructor, piloted at my former institution. The paper is written from my perspective, with the exception of one section in which one of the near-peers, the second author, shares her experience. Prior to the development of this program, only faculty members taught the laboratory courses, and one graduate teaching assistant worked with the instructors in some of the labs as part of their assistantship requirements. Due to increasing admissions in the nursing and health sciences majors, the Anatomy and Physiology laboratory enrollments were increased to 40 students per lab, with a graduate teaching assistant and faculty member assigned to each lab. To further improve the ratio, I utilized both the independent study and senior research project electives in the Health Sciences major to personally mentor two students per quarter (winter and spring quarters of 2019) as near-peer teachers.

Here, I provide a detailed description of the activities that the near-peers were required to engage in for satisfactory completion, expectations I set for the near-peers, and myself, and the benefits of this program for everyone involved. I make recommendations for the successful implementation of a near-peer teaching program in the Anatomy and Physiology lab based on our personal experience and work done by other Anatomy and Physiology teachers. Finally, a personal perspective from the second author, who was one of the near-peers and was actively involved in the creation of the near-peer experience, is presented.

The Creation of the Near-Peer Experience

As near-peer teaching and mentoring had never been done in the department, I identified a few students who I felt would benefit greatly from the experience and would serve as positive role models for the students in the course. The invited students were successful in Anatomy and Physiology (B or better in the course series), expressed enthusiasm for the subject matter, were frequently observed assisting their fellow classmates in the understanding of concepts, had regularly reached out to me to review exams or confirm their understanding of course material, and expressed a desire to find ways to continually reinforce their Anatomy and Physiology knowledge prior to entering graduate school. Similar selection criteria have previously been applied to the identification and selection of near-peer teachers (Evans 2009). If the students were interested, they registered for either a two or three credit independent study option, or a three-credit senior project. The students that were seniors were expected, as part of their overall grading, to publicly disseminate their experience in some way. I was assigned to teach two labs each quarter; so one student was assigned to each lab with me, along with the graduate teaching assistant. The invitation sent to the potential near-peer students is provided in Appendix 1.

Time Commitment and Schedule for the Near-Peers and Instructors

The average weekly time commitment for all of the near-peers' activities was approximately ten hours. I met with the near-peers for one to two hours once per week to prepare for the upcoming lab. The near-peers were required to attend each Anatomy and Physiology lab, arrive a half hour early, and stay an additional half hour for clean-up and debriefing. This totaled three hours. The near-peers were also asked to critically appraise assigned online/virtual laboratory activities provided by the textbook publisher being used in the Anatomy and Physiology curriculum. Finally, the near-peers were required to submit three reflective portfolios of their experience, utilizing Kolb's cycle of learning (Kolb 1984). These activities totaled approximately nine hours of activities per week. I checked in weekly with the near-peers to monitor if the activities were taking up more time than expected and adjusted accordingly as to not over-burden the near-peers or distract from their other coursework. The senior students completed an additional activity, one in the form of a *HAPS Educator* publication, and the other a presentation about near-peer teaching at the university's day of undergraduate excellence.

Weekly Meetings - A Critical Component to the Success of Near-Peer Mentorship

In order to ensure that the near-peers and the graduate teaching assistant had prepared well for the lab experience and, just as importantly, felt confident in their ability to assist junior students, I met with the near-peers weekly to run through every step of the laboratory experience and monitor their progress. In my role as the director of the Anatomy and Physiology curriculum, I revised all of the laboratory handouts and exercises that year to be tied to HAPS Learning Outcomes, with numerous guided inquiry questions tied to their laboratory exercises.

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The near-peers were not provided with an instructor's key to the labs. They were expected to come to the weekly meeting with the pre-laboratory exercises completed, and then run through the lab as if they were a student taking the lab. Since the curriculum had only been revised in the current year, the near-peer students had not yet experienced these laboratories in the new format, eliminating previous exposure from influencing their performance.

The two near-peers met at the same time, and worked together to complete all the laboratory activities independently. I was present at all times to confirm findings and correct answers depending on the activities in question. I strongly emphasized to the near-peers that they should be honest if they did not understand a concept, or didn't feel confident in their understanding, so that I could support them and overcome these difficulties. It was very important that the students felt comfortable and safe expressing difficulty and embracing the vulnerability of having to overcome a barrier to learning. We consistently dialogued throughout the lab meeting about what it felt like to be learning the material for the first time, and how powerful and important modeling the beginner's mindset to their junior peers could be in helping them overcome their anxiety.

The near-peers were told that if they did not know the answer to a student's question during lab, that they should never improvise an answer and instead, ask me to come to the group and offer assistance. The laboratory students were also made aware that the near-peers were not subject matter experts, and were asked to defer to me when they were unsure. In this manner, the near-peers felt less anxiety about not having every answer, and the students could feel comfortable that they would not be misled or receive inaccurate information from the near-peers.

Once the near-peers completed all the laboratory activities and were sure that their answers to the laboratory prep handouts, I asked them to take the post-laboratory quiz, so that they knew what the students would be assessed on after lab. If the near-peers scored anything incorrectly, we reviewed that material again. The near-peers were strongly encouraged to tell me if they did not understand the phrasing of a question, felt that more than one answer could be accepted, or, felt that the laboratory activities and learning outcomes were not reflected in the quiz.

Weekly Lab Experiences

The near-peer laboratory teaching experiences occurred during the semesters in which Anatomy and Physiology II and III occurred. This university was on a quarter system, rather than semester system, and the Anatomy and Physiology series was split into three, ten-week sessions. This institution had a human anatomy lab with over 12 cadavers dissected by the Doctor of Physical Therapy students, as well as lab equipment for physiology experimentation. Laboratory experiences in Anatomy and Physiology II included study of the gross anatomy of the brain, spinal cord, peripheral nerves, digestive and endocrine systems, and physiology experimentation of the cranial nerves, spinal reflexes, blood glucose regulation, and the dive response. In Anatomy and Physiology III, students studied the gross anatomy of the heart and circulatory system, the respiratory system, the reproductive and urinary systems, and engaged in physiology laboratories that examined EKGs, heart sounds, ventilation/lung volumes and hormonal control of the ovarian cycle.

Approximately one week prior to the laboratory experience, I posted pre-lab preparatory activities and strategies for success in the learning management system for all students taking Anatomy and Physiology labs. On the first day of the labs, I introduced the lab students to the near-peer and explained their role. As previously described, I made it clear to the lab students that the near-peer students were instructed to always ask me if they were not sure of an answer and were not expected to be subject matter experts. The lab students were debriefed on what I expected of the near-peers in terms of student engagement. The near-peers were expected to:

1. Continuously engage with students by asking them questions to investigate understanding and practice recall.
2. Learn the names of students by the second lab.
3. Give all lab students equal attention, and particularly ask questions of students who seem to be idle.
4. Ask the instructor for help if they did not know how to help a lab student.
5. Be enthusiastic and relatable.

I explained the rationale for the near-peer experience to the Anatomy and Physiology lab students to encourage enthusiasm for the experience. As the labs are largely self-directed by the lab students, we circulated during the labs to provide assistance as needed and make sure that they were accomplishing all of their tasks. As each lab was filled with activities, I developed a number of supplemental activities to challenge lab students who claimed they were done earlier than expected, or to provide an extra level of challenge to

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those who wanted it. In the latter half of the quarter, I asked the near-peer students to try to develop these activities instead. These often revealed to the Anatomy and Physiology students that they did not, indeed, understand or retain the information and needed to spend more time engaging with the material prior to the laboratory quiz.

I instructed the near-peers not to immediately answer lab student's questions, as this might lead to reliance on the near-peers. Instead, we discussed strategies to guide the lab students through a critical thinking process to come to the correct answers or understanding of a concept. Additionally, we discussed how to do this in a supportive, inspiring manner to avoid the students feeling embarrassed or discouraged when answering questions.

Critique of Online Laboratories

As enrollments were projected to grow, the other Anatomy and Physiology instructors and I were considering the possibility of adding online laboratory experiences, or even developing an online Anatomy and Physiology course series. Recognizing that someone with expertise in a subject matter may have a limited ability to assess student perception and value of an online laboratory experience, I asked each near-peer to do a one to two-page write up about their experience completing three or four online labs that came with the digital platform being used at the time. To gain better insight into the potential mismatch between what an experienced instructor and a student who just completed Anatomy and Physiology would find valuable, I chose and completed all the labs on my own, prior to assigning them to the near peers for feedback. The labs that were ultimately chosen were ones that the near-peers felt were:

1. Straightforward to do.
2. Fun and engaging throughout.
3. Helpful in understanding a difficult concept.
4. Fit well into the curriculum.

If any of those criteria were not met by the near-peer, they were not chosen for future utilization, even if I had initially thought they would be useful online labs to assign.

Reflective Portfolios

To promote skills of self-reflection and self-monitoring, the near-peer students were required to submit three reflections throughout the quarter, once every three weeks. I believed that this would be an important part of the personal and professional development of the near-peers and would provide me with insight on how the peers were progressing through the experience (McLeod 2017).

To familiarize students with experiential learning, I sent students literature on the topic, as well as sample portfolios from my work in the Anatomical Society's Anatomy Training Program, in which trainees are required to keep monthly reflective portfolios (Fraher & Evans 2009). Experiential learning fit this scenario best as the near peers were actively engaged in activities that were concrete experiences that provided an opportunity for observation of the behavior of themselves and others, analysis of that experience, and hypothesis generation for future experiences. Also, as the near-peer experience is intended to help students think about how learning happens, both in themselves and their junior students, Kolb's theory that "learning is the process whereby knowledge is created through the transformation of experience" was very suitable. An example of Kolb's learning cycle theory applied to the near-peer experience is shown in Figure 1.

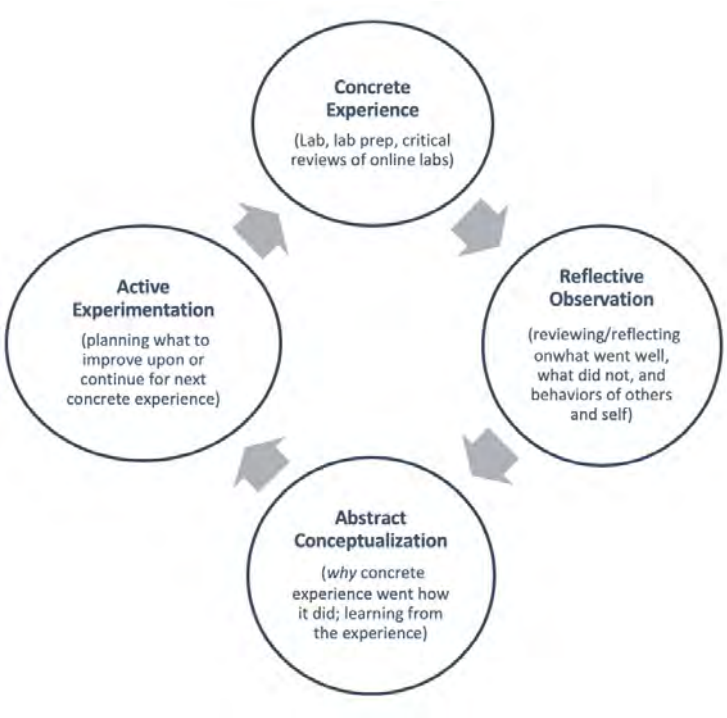

Figure 1. *Kolb's experiential learning cycle as a near-peer in the Anatomy and Physiology laboratory.*

Within 48 hours of the submission of a reflective portfolio, I provided the near peer with detailed feedback on their portfolios. Grading of the portfolios was based on timely completion and portfolio structure being a representation of a learning cycle, not on the specific content of that cycle. However, if they planned an activity in the 4th stage of the learning cycle, they were expected to carry that out for the next portfolio and reflect upon that. The near-peers were encouraged to be honest with themselves and take the time necessary to think carefully about their experiences. I prioritized building the near-peer's confidence and providing

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ideas and resources for them when they felt something didn't go as well as they would like. When they had ideas to overcome obstacles in the abstraction and experimentation sections, I encouraged them to carry them out.

I felt it was of crucial importance to express my own vulnerability when giving the near-peers feedback about teaching for the first time. I told the near-peers when I had a similar problem or expectation that did not go as planned at the beginning of my teaching career, and what areas I am still trying to improve in my teaching and learning. In this way, there are reciprocal models in place, by which the junior students felt supported and encouraged by knowing that the near-peers shared their struggles in learning, and the near-peers received the same feedback from me as the instructor. Example passages from a reflective portfolio by one of the near-peer students, the second author, are provided in the appendix.

The Benefits of Mentoring Near-Peer Teachers: The Instructor's Perspective

When this independent study was formed, my primary goal was to increase the faculty-to-student ratio, for a more structured, supported lab experience for the Anatomy and Physiology students at no additional cost to the department. At the same time, the experience could provide the near-peers with a unique method of earning credits while reinforcing their Anatomy and Physiology knowledge prior to entering their graduate programs. While the expected benefits were certainly achieved, there were a number of unexpected benefits and insights gained from the experience.

Benefits for the Anatomy and Physiology Students

As planned, having a near-peer join the instructor and graduate student in the lab decreased the student to faculty ratio from 18-1 to an average of 12-1. Informal feedback from the lab students and my own observations were that the lab students appreciated additional assistance, and were inspired by seeing someone one-two years older, who was successful in the course, now in a teaching role. The near-peers were transparent with the students in the amount of time they had to devote to Anatomy and Physiology, and were able to explain the significance of what they were learning in upper level courses.

Often, the lab students were required to prepare a short explanation or presentation for me in order to "check out" of lab, and they would frequently run their explanations by the near-peers first. In 2013, Anstey and colleagues published a reflection on a near-peer program developed for facilitation of guided inquiry projects in Anatomy and Physiology. They found that near-peers could be valuable facilitators of student inquiry due to their ability to relate to the junior students' feelings and needs for learning (Antsey et al. 2014). The Anatomy and Physiology students were able to see me interacting with the near-peers, and regularly asking the near-peers for feedback on how labs could potentially be improved.

A number of the Anatomy and Physiology students expressed interest in becoming a near-peer themselves in the following years. While they would not be the ones engaging with the new online laboratory options, the Anatomy and Physiology students were told that this critical review was part of the near-peers' role. Hopefully, this made it clear to the Anatomy and Physiology students that I was invested in their experience and open to feedback. Overall, the Anatomy and Physiology students were able to witness that mastery of the content they were learning was well within their grasp, and a model for how that can be achieved. This may be difficult to imagine when the only comparison a student has for their knowledge is the subject matter expertise of the instructor.

Benefits for the Near-Peers

Each of the four near-peers that signed up for the experience met all of the expectations that I set out for them. No one was late for a meeting, missed a day, or failed to submit their online laboratory reviews or reflective portfolios. Two of the near-peers, the senior students, were able to share their experiences in different formats. One near-peer did a presentation for the week of undergraduate excellence at the University, while another published the model he created for students to understand capillary exchange in the summer edition of the *HAPS Educator* in (Quinonez and Rompolski 2019). Through our conversations and content of their reflective portfolios, it was apparent that each near-peer greatly enjoyed the experience, felt that their understanding and recall of Anatomy and Physiology improved, and gained a perspective that they had not previously considered on the challenges of engaging with students and designing courses.

Every near-peer commented that having to figure out how to teach or explain a concept to others, especially when they are the authority in a setting, motivated them to better understand the material. The emotional charge of potentially seeming unprepared or unsure was a theme in all of their portfolios. A 2013 pilot program in which 4th year medical students in a senior radiology course were trained to instruct 1st year medical students in a series of anatomy sessions revealed that near-peers greatly enjoyed the experience and felt that their anatomical knowledge and teaching skills were improved by the experience (Naeger et al. 2013).

Perhaps most exciting to me as the instructor was that every near-peer was curious to find out how people go about becoming Anatomy and Physiology professors and thought that a clinical educator position could be part of their future career; something they had not previously considered. An interest in becoming teachers themselves is one of the benefits of near-peer teaching proposed by Neal Whitman in his 1988 piece "To Teach is to Learn Twice" (Whitman 1988).

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While there were common benefits seen for all four near-peers, each student had a unique goal, or area they wanted to improve upon, throughout the experience. One of these students described herself as being shy and afraid to speak publicly, so this was an opportunity for her to build her confidence in group settings before entering a clinical program in which she would have to teach her peers and educate patients. Another student had no difficulty in speaking with and engaging with the students but admitted to being easily distracted in school by social activities. The latter student's reflections frequently mentioned that the near-peer role was holding them accountable to me, the students and themselves in a way they had not experienced before in school, and how valuable that was for his professional growth. Two other students were preparing to attend medical school and a Physician Assistant Program and knew that gross anatomy and medical physiology would be rigorous courses within the first few months of their curricula. Thus, the reinforcement of material and new ways to learn and retain the material through teaching were valued preparatory experiences. While not related directly to the near-peer experience, working so closely with students over several months enabled me to provide strong letters of recommendation for all four of the students for graduate school.

Benefits to me as the instructor

Having an additional person to assist in the labs was a great benefit to me, since I sometimes felt that I could not support all the students to the degree that they deserved. Through this experience, I was able to closely mentor students for the first time on a consistent basis, which is an exciting career step for any educator. This mentoring experience required me to be open about my own struggles in teaching and learning, and receptive to both near-peer and Anatomy and Physiology student feedback. In fact, the idea for this experience was generated when one of the near-peers, the second author, requested to meet with the instructor while she was an Anatomy and Physiology student. From a place of curiosity, she asked me to explain why certain aspects of the course were designed the way that they were. This led to a productive conversation about the mismatch that can occur between instructor intentions and student perceptions, and the value of incorporating students into curriculum design.

Being a Near-Peer Teacher: The Near-Peer's Perspective

The following passage is told form the perspective of the second author, one of the near-peer students

"Dr. Rompolski's "near-peer" teaching experience allowed me the opportunity to not only observe and analyze how younger, undergraduate Anatomy and Physiology students learn, but also provided me a chance to further explore how I best learn in an education setting. I found it most effective to put myself in the students' shoes and complete the designed lab handout prior to my meetings with Dr. Rompolski. This provided me with a solid idea of what the students were expected to understand by the end of each lab. The first observation I made during my first lab experience was that most of them were reluctant to ask questions.

I soon realized that I needed to gain their trust and provide them with a sense of relatability in order for my time and theirs in the lab to be productive. I realized that this initial lack of trust in the beginning of the quarter was possibly due to the fact that I was an undergraduate student myself but was in a teaching position. I began to relate myself to them by making small remarks such as, "Oh, yes I remember this concept being very difficult to understand when I was in your year" in order for them to know that I once was exactly where they were. I then realized that so many professors at large education institutions miss this step. More often than not, gaining a student's trust is not very high on a professor's priority list. Dr. Rompolski ensures that students feel comfortable to ask them anything and this positively benefits their educational experience. Once students viewed me as a more seasoned version of "them", questions started to spill out in the cadaver lab and I was more than capable and eager to help.

In addition to providing the anatomy students with an older student they could trust, I believe that it was inspiring to them to see a professor have such confidence in an older student. Several different students towards the end of the quarter asked me how I earned this opportunity to aid Dr. Rompolski and if I had any advice for how they could achieve a similar experience. Having a near peer mentor in the lab created a strong incentive for students to further dive into their education.

It is evident that the near peer teaching experience was beneficial for the anatomy students, however it was equally (if not more) beneficial for me. Prior to this teaching experience, I was so accustomed to being in the student role and taking in all the information thrown at me and simply applying it to a quiz or test. In the beginning of the quarter, I noticed that when it came time for me to explain structures and

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their functions to Dr. Rompolski in our meetings, I initially experienced some difficulty. While I was sure that I knew concepts well, it was sometimes difficult for me to put them into easy-to-understand words. My objective when I explained things to students was to break the concepts down and hopefully make the anatomy easier to comprehend rather than confusing them even more.

I remember a specific example of this personal learning process when I was having a difficult time explaining Wiggers Diagram. Dr. Rompolski instructed me to draw my own diagram from the very beginning. She asked me to draw it piece by piece and attempt to explain each part along the way. I vividly remember the moment I realized that I did in fact know all the information; I just needed to show the students how to break down the concepts and reconnect them. I spent the entire cardiovascular lab circulating to different groups of students, asking them to break down the pieces of the diagram and explain them back to me. I was incredibly proud of myself. Furthermore, I learned that rather than talking *to* students, I needed to talk *with* them. The conversation needed to be interactive and two-sided to ensure they were connecting all the information and concepts. I learned that if I have really mastered the material, then I should be able to teach it. This is a lesson that I have steadily carried with me after my near peer experience came to a close, and is now the last step implemented into my study routine prior to exams.

This near-peer teaching experience was extremely beneficial to everyone involved. Learning to better understand student's perspectives and allowing them to feel a level of comfort when I was teaching was crucial for their learning experience. Learning how to verbally and visually teach students was crucial for my own personal learning experience. I believe that educational institutions would observe the increase in students' and professors' understanding of how students effectively learn and how professors effectively teach if near peer teaching experiences were routinely implemented."

Suggestions for Creating a Successful Undergraduate Near-Peer Program

At first glance, a near-peer program driven from elective course credit seems like a simple solution to problematic faculty-to-student ratios, or lack of funds or graduate TAs for additional laboratory support. However, implementation of a near-peer experience is not without careful planning and a significant time commitment for both the instructor and the near peers. General recommendations for creating and managing a near-peer program are presented next, which could easily be applied to any course or topics.

1. *Choose students who are genuinely excited to help other students.*
   This should be the first step, whether specific students are invited to consider a near-peer experience, or an application process is created. It will undoubtedly be difficult to accomplish any of the goals of the near-peer experience if the student is not eager to fulfill the role.
2. *Choose students who are enthusiastic about the subject matter.*
   As with #1, genuine interest in Anatomy and Physiology will be both a motivator for the near-peers to prepare for helping the students, and encouraging to students who are trying to understand the material. The near-peer teaching experience should only continue to increase the students' enthusiasm for the subject matter and motivate them to continue to learn Anatomy and Physiology in even greater depth.
3. *Choose students who were successful in the course with the closest social congruence.*
   While this criterion of having been successful in the course seems obvious, high grades do not suggest that the student would be an effective near-peer teacher, or are passionate about the subject matter. In fact, it may be beneficial to choose near-peers who initially struggled in the subject and overcame obstacles to learning, as they may be better able to relate to their junior peers. In addition, choosing students who are not too many years out from the course (ideally, one to two years) is important for social congruence (Loda *et al* 2019).
4. *Set goals and expectations that all near-peers must meet.*
   These can be unique to the institution or class in question, but a regular schedule of activities, and holding the students accountable for those activities, is vital to the success of near-peer teaching. Simply providing the near-peers with the lab materials in advance and expecting them to show up ready to teach is setting them up for failure and embarrassment, potentially leading to misinformation and anxiety in the students in lab, and creating more work for the instructor in the end; all of which are the opposite of the intent of near-peer teaching.

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It is strongly recommended that the instructor meet for a practice/mock run of the lab, during which time the near-peers must demonstrate mastery of the laboratory exercises and concepts to the instructor. The near-peers should also be required to take the same lab assessments and be trusted to not to share the content of those assessments with any junior students they may know outside of class. For example, one near-peer had a few junior sorority sisters in the A&P lab. The near-peer experience is also a great opportunity to develop professional behaviors such as timeliness of dress, professional boundaries, as well as effective communication skills.

5. *Set specific goals that are unique to what the near-peer hopes to achieve.*
   Each student will have a unique history that led them to becoming a near-peer, with various strengths and weaknesses. The strengths of the student should be highlighted and encouraged however possible during the near-peer experience, but should not determine the activities in which the student engages. For example, putting the more outgoing near-peer as a demo, while having a shyer student work on lab setup or curriculum review would be doing them a disservice. Students should be encouraged to identify at least one goal for personal and professional improvement and utilize some form of regular reflection to monitor their progress.
6. *Be willing and able to put in the time.*
   The time needed for this may vary significantly from student to student and lab to lab. Therefore, willingness and an ability to mentor the near-peer students until they are ready is vital to a positive atmosphere in the lab. Instructors need to be cognizant of the demands on their time, and realistic about the amount of time they would be willing to devote to near-peer mentoring and preparation for lab.

   Previous publications on near-peer teaching have stressed the importance of formal and structured training programs for the success of a near-peer program (Antsey et al. 2013, Evans et al. 2011, Border 2017). For me, the instructor, the near-peer mentoring was a non-compensated overload in my schedule. I spent approximately three hours per week helping to prepare the near-peers for lab, and another three hours reading and providing feedback on their reflective portfolios and critiques of virtual labs. While at times challenging, the experience was very personally rewarding and well worth the time commitment.

   Requiring near-peers to prepare thoroughly for lab, but not giving them the space to practice and receive feedback and correction prior to helping their junior peers, sets them up for anxiety, embarrassment and potential confusion in the lab. If near-peers are required to critically review curriculum material, the instructor should discuss this review with the students and solicit their suggestions.

   Finally, if reflective practice of some sort is required, thoughtful feedback should be provided in a timely manner to reward students for their hard work and give them an opportunity to adapt before their next experience.
7. *Involve the lab students in the process.*
   The junior students should be informed of the expectations set for the near-peer, and why the near-peer is a valuable resource in the lab. As mentioned previously, the students should be informed that the near-peers are not expected to know the answer to every question, and may have to come to the instructor for help. But, if they do answer a question or do not need instructor assistance, they can feel confident in the near-peer's response. This dynamic requires significant trust on the part of the instructor and students, and integrity and honesty in the near-peer, but with those dynamics in place, a very positive, collaborative environment is possible.
8. *Model the behaviors and attitudes expected***.**
   Having near-peers in the lab, with the instructor providing guidance and modeling interactions with students until near-peers find their own unique voice or style of teaching, promotes professional behavior and a higher degree of accountability. Instructors should strive to be relatable to the students. This means being willing to admit mistakes, or when they do not know the answer to a question, so that the near-peers and students all feel safe doing so as well. Instructors should regularly share their rationale for what they ask students and request and embrace student and near-peer feedback, so that both groups feel that they have rapport with the instructor and that their contributions are respected. While the idea of involving students in decision-making or providing rationales for activities may seem like instructors are inviting students to criticize or question their authority, they are in reality utilizing inclusive classroom practices that work well for the current generations of college students (Ruzycki *et al*. 2019).

Conclusions/Future Directions

A well-designed and closely monitored undergraduate near-peer teaching experience can have a number of expected and surprising benefits for students, near-peers and instructors. Leveraging electives such as independent studies or senior research projects into near-peer teaching experiences can provide students with college credit while eliminating the burden of additional funding for graduate teaching assistants or faculty time for laboratory instruction. However, caution should be taken in the implementation of the near-peer program, particularly if availability or willingness to devote

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time is in question, both on the instructor and near-peer side. Regular feedback between the near-peer and the instructor is vital to the program and will benefit the near-peer far beyond confidence in the classroom.

Numerous publications suggest that near-peer teaching is enjoyed by all students involved, is beneficial for knowledge gains and teaching skills of the near-peers, and helpful to the students being supported by near-peers. However, research on the influence of near-peer teaching on other aspects of the teaching and learning environment, as well as consistent terminology defining a "near-peer", is needed (Olaussen et al. 2016).

A 2016 systematic review investigating how near-peer programs are assessed in undergraduate health professional education suggested that future research examine the quality of learning outcomes and focus on affective behavior and metacognitive skills gains. At the moment, much of the research on near-peer teaching and learning in Anatomy and Physiology comes from medical school anatomy classes, limiting its applicability to the traditional freshman or sophomore Anatomy and Physiology class. As more and more institutions adopt near-peer teaching at the undergraduate level in Anatomy and Physiology, efforts to recruit students from diverse populations, departmental investment in the growth of a program, and buy-in from other instructors involved in the curriculum are important considerations for the growth of near-peer programs. In addition, continuous evaluation of the effect of near-peers on student learning outcomes should be incorporated.

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Appendix 1:

Invitation to the Near-Peer Teaching Applicants

"The purpose of this independent study is to provide students with teaching and mentoring experience in Anatomy and Physiology. It is well understood that being able to teach and learning how to teach a subject, is effective for long-term retention of material. Therefore, having a better understanding of how learning happens should benefit students, regardless of their future programs of study or teaching aspirations! Students in this independent study will participate in a weekly laboratory experience with current Anatomy and Physiology students and serve as a "near-peer" mentor during these experiences. It is expected that this independent study will increase the confidence, professionalism and interpersonal skills of the enrolled students, while simultaneously supporting the Anatomy and Physiology students. The outcomes of this independent study have the potential to benefit other Anatomy and Physiology instructors, particularly those with increasingly large class sizes. Ultimately, the successful implementation of this experience will depend upon clear, regular communication between us. I expect you to be fully prepared for the laboratory experiences and meet all deadlines. In turn, I will mentor and support you as much as you need until you feel confident to step into the laboratory experience with the students."

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Appendix 2:

Same Reflective Portfolio Written by the Second Author, a Near-Peer Student

Concrete Experience:
"I tried to let students settle in and find a cadaver or model first before making myself available for help. Once students began to find their rhythm I started to circle around and ask groups if they had any questions. Some groups quietly shook "no" while other groups bombarded me with five questions at once. Answering their questions gave me the opportunity to be really hands on in my explanation whether it was in a cadaver's body or comprehensively going through a diagram. Once the time in the lab was over, students returned back to the classroom to take their quiz. I, along with the TA, would cover up the bodies, put the models away, and rearrange the chairs so that the lab was left cleaner than it was when we first showed up."

Reflective Observation:
"Another thing I struggled with is that I definitely felt like there was nothing I could do for the groups of students who never had any questions and stuck to themselves. I know now that this is a great opportunity to say, "okay great, let me quiz you" and "do you want me to ask you practice questions?" Involving students that didn't necessarily want to be was difficult for me. I think that another thing I struggled with was for the second lab I tried re-learn the lab handout from a student's perspective when I really needed to be refreshing on the information from a teacher's perspective. For example, I really felt like I knew all of the technical information regarding the cardiac cycle (as detailed as each mV number for action potentials on an ECG) but then when it came time to explain this information to Dr. Rompolski in our pre-lab I was stuttering to find my words and I started to lose my confidence. While I thought that I had prepared well for the lab, I had missed the most important part. I needed to be able to teach and easily put into words what I knew. I am extremely grateful that Dr. Rompolski recommended I try to draw my own Wigger's diagram because once I did that I took the time to explain it piece by piece to someone out loud and it made me realize I knew the information all along it was just about connecting the concepts on the diagram and putting it all together. I was so happy with myself when I was able to confidently spend the majority of lab 2 for both weeks explaining the Wigger's diagram to a student."

Abstract Conceptualization:
"I believe my biggest strength in the past four weeks of this experience is making myself relatable to the students. I found that it really helped when I would say "oh my goodness I remember I found this particularly confusing too when I took this lab". Often times after I would say that they would reply with "that makes me feel so much better". I think they found a sense of familiarity with me and were able to identify with me when I said this especially because now, as a near peer, I am able to confidently teach them what I used to find confusing a year ago. I would always reassure them that a lot of it is just constant repetition of the concepts and material so that they aren't just trying to memorize specific information for a quiz or exam. This often led to them asking me how I would prepare and study for Anatomy.

I shared that I would always read and annotate the chapter prior to lecture so I was always a week ahead in my notes and that I would write down each question I would get wrong on my first quiz attempts and go back into the book and explain why (a big part of it for me is just writing everything down). They told me that they found that really helpful and would sometimes admit that they would just zoom through the quizzes. I would personally sometimes feel like I was babbling on or explaining things in complicated terms, however I found multiple times that I would start explaining something to a person and then by the time I was finished I would look up and five more students were crowding around me listening to what I was saying. One time I asked a student who was behind me "Do you have a question?" and they replied "No, you're just really good at explaining this so I decided to listen". The first time that happened was honestly a really incredible moment for me and every time it happens it leaves me with the best feeling."

Active Experimentation:
"For the future labs I would really like to improve on two main things: engaging the students who don't like to ask questions and then also preparing more applicable examples to what we're learning. As I already mentioned in my reflection portion, in both labs one and two it is always the same groups of students who like to keep to themselves and don't like to ask any questions. While it is so much fun (yes, fun!) to spend thirty minutes talking to the groups who have a million questions because they are so enthusiastic about learning; I need to spend more time focusing on the students who don't want my attention.

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Dr. Rompolski suggested that I offer to quiz them, which I started to do in the last lab and that worked out well, so I plan to continue to do this. I plan to come up with practice questions before the labs and write them down so that when I ask them to get involved, I have questions ready to fire off and ask. I know that this will provide an opportunity for these students to realize that they maybe don't know as much as they think they should, and this will open up a discussion for me to help explain concepts. I also want to improve by including real-life examples in my teaching experience in labs. A great example of this is when describing Wigger's diagram in Lab 2, she explained that the maximum and minimum aortic pressure are the same blood pressures clinicians measure! This was such a genius concept to mention because she was able to connect why hypertension is so dangerous for someone's cardiac health. Ventricular ejection cannot occur until the pressure in the ventricle is greater than the pressure in the aorta. Therefore, if someone has very high aortic pressure then their ventricle is going to work much harder in order to exceed that pressure to allow the semilunar valves to open and for blood to be ejected. Providing a clinical reference to why it is so important to know this information was really effective for the students and I plan to incorporate more of these explanations in my near peer teaching experience."

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