



Using the art of medical illustration to enhance anatomy education

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Abstract

The pairing of science and art represents a practical approach to simplify the complexity of anatomical education. Medical drawing allows learners to develop a deeper understanding of the body's functions, thus optimizing quality of learning in the health sciences. During the first half of the semester, the central learning objective was two-fold: becoming acquainted with the field of medical illustration and its many facets and learning the fundamentals of drawing. Discussions focused on decision-making in the composition design process as well as in the effectiveness of artistic elements. During the second half of the semester, necessitated by COVID-19, the course transitioned to online synchronous meetings via Zoom. All the students continued to draw, collaborate, and share feedback of their progress. The students found that their learning by drawing was therapeutic, especially while self-isolating. Student feedback was 100% positive. Indirectly, we aimed to nurture the students' problem solving and investigative skills. This learner-centered elective course represented a unique experience for scientifically minded students to use skills other than the traditional modalities for their academic learning. Collectively, these principles support self-directed, life-long learning. In summary, this multi-disciplinary learner-centered approach to teaching anatomy motivates and reinforces student learning within the health sciences.

Keywords: Medical illustration, Anatomy and physiology; Health science; Medical education

Introduction

Even prior to COVID-19, educators in universities have been tasked with the pedagogical challenges to integrate learner-centered approaches to teaching (Rapanta et al., 2020). Diversity in intrinsic motivation, prior knowledge, and aptitude have affected student achievement and retention rates, as well as the preparation for admission into a vast array of competitive health science programs (Davies et al., 2020). Making anatomical instruction relevant and enduring is now more important than ever. To date, many of the instructional design techniques employed to impact learning have fallen short in the utility needed to enhance medical and anatomical education, reform pedagogical efforts, and receive positive learner feedback (Kind, 2009). However, if medical illustration can be viewed as a conceptual crossroads between arts and science in the context of health science education, the pedagogical challenge and enhanced anatomical education can be traversed concurrently.

Focusing on a learner-centered initiative, the pairing of science and art, represents a practical approach to developing curricula in the health sciences. Medical drawing allows learners to develop a deeper understanding of the body's functions, thus optimizing quality of learning in the health sciences. When the student takes ownership and pride in a scientific drawing, the experience becomes more relevant and builds many cognitive connections for life.

The History of Combining Science with Art

The origin of medical drawings can be traced back to Galen, a famous physician of the 3rd century who wrote *Artis Medica* or "The Art of Medicine." His rudimentary knowledge of medicine was gained from renderings of animal dissections on papyrus. Many years passed before more progress was made: with the Renaissance period of the 1400-1700s promoting the rebirth of knowledge, medicine, literature, and art. Leonardo da Vinci, sometimes referred to as the father of anatomic art, is famous for his Vitruvian man, which highlights the proportions of the

human body. Da Vinci thoroughly examined art and anatomy by dissecting and drawing more than 10 human bodies under the secrecy of candlelight because of the Church's decree that forbade human dissections.

Following the progress established by the Renaissance artists, the Flemish physician Andreas Vesalius continued the art of medicine. Considered by some a quintessential physician/artist, he created the first definite anatomy textbook of his time. Vesalius named his book *De humani corporis fabrica libri septem* or *The Seven Books on the Fabric of the Human Body*—commonly known as the *Fabrica*. In 1894, Max Brödel's unique ability to synthesize art and medicine facilitated the integration of cross-sectional anatomy and an aerial viewpoint, resulting in illustrations that continue to be invaluable in medicine. Brödel developed a famous technique using carbon dust and sable brushes to delineate lights and shadows. Although we still emphasize developing lights, mid-tones, and shadows in our drawings, we have replaced those antiquated supplies with pencils, styluses, and software like Photoshop. Today, medical illustration is as present as ever, despite the use of videography and photography. Medical illustrators seek to highlight the important parts of a process or structure, simplifying images where appropriate without doing harm to the scientific purpose of the presentation.

Integrating the Past with the Present: An Elective Course in Medical Illustration

Collectively, these illustration techniques were integrated into the instructional design and development of a medical illustration course offered through the Honors College at Florida Gulf Coast University. This novel, elective course aims to promote student creativity, problem solving, and a deeper understanding of Anatomy & Physiology.

While in class, with instructor guidance, the students practiced using illustrations instead of text-based applications to comprehend the human body. This learner-centered environment allowed for active comprehension and engagement, helping to breakdown the complexity and obscurity of the body and its organs.

Each student was provided with artist-quality drawing paper, sketching pencils, kneaded erasers, blending stumps and tortillions, Faber-Castell pen & ink sets, watercolor pencils, and paintbrush sets. Assignments are displayed in Box 1.

During the first half of the semester, the central learning objective was two-fold: becoming acquainted with the field of medical illustration and its many facets as well as learning the fundamentals of drawing. Each class started with mini critiques in which the students displayed their drawings. The students would share feedback with each other, enhancing their skills by demonstrating various solutions to the same assignment. Discussions focused on decision-making in the composition design process as well as in the effectiveness of artistic elements. Above all, the students became engaged in this interactive and safe environment in which learning was relevant and hands-on.

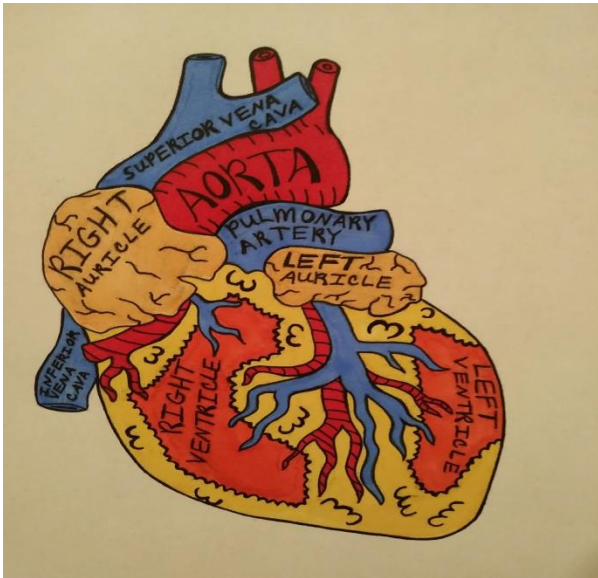
Box 1. Assignments

- Bones: including the cranium and a choice of one other complex bone
- Skin Histology: Epidermis, dermis, and hypodermis
- Three-dimensional Vessels: Arteries, veins, and capillaries
- The Heart: Chambers and superficial landmarks
- The Brain: Gyri, sulci and functional lobes

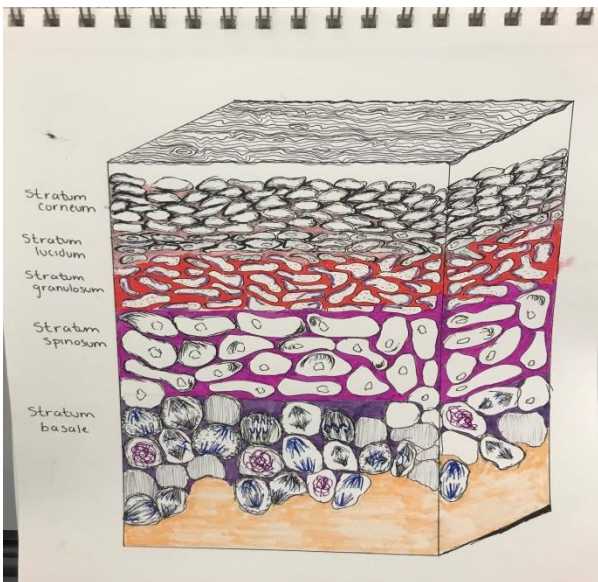
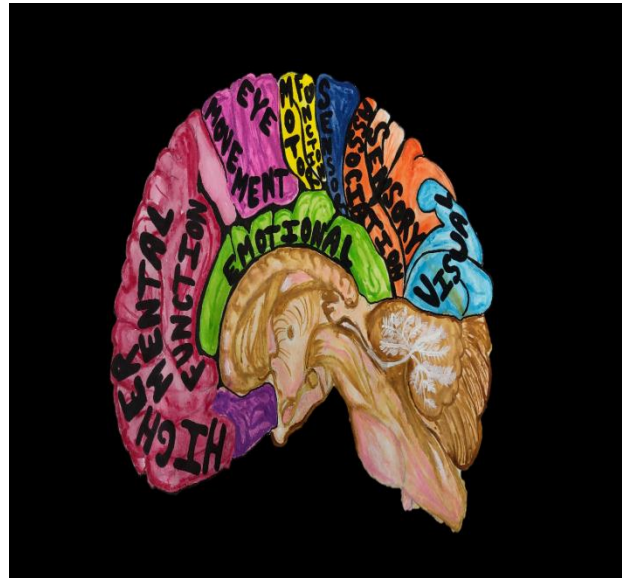
During the second half of the semester, necessitated by COVID-19, the course transitioned to online synchronous meetings via Zoom. All the students continued to draw, collaborate, and share feedback of their progress. The students found that their learning by drawing was therapeutic, especially while self-isolating.

Figure 1 highlights a few student pieces. The heart in Figure 1a incorporates a myriad of techniques discussed such as pen & ink work and color blocking. The student demonstrates mastery of the anatomy in a whimsical manner. After learning about the cerebral cortex with its various functions that make human beings unique, the student created the work displayed in Figure 1b. This depiction of the lobes and gyri of the brain successfully conveys the myriad of functions of the cerebral cortex. With exploration of the skin, we learned about the five stratum of the epidermis with its unique cell shapes and sizes. In this next project, as shown in Figure 1cd, the student incorporates new knowledge about skin histology by creating textures with pen and ink work and thus, the epidermis is brought to life in the student's world. Finally, we discussed the complexity of the bones and their intricacies as depicted in Figure 1d. This student has captured the cranium by drawing its contours and sketching its lights and shadows.

a.



b.



c.



d.

Student Feedback of Course

The Student Perception of Instruction (SPOI) allowed for evaluation of the extent to which conveying the passion for arts and sciences was a viable strategy of learner-centered instruction. The class included ten students. One student wrote, “This was my favorite class ever. I received so much encouragement, and I learned so much about my art and myself. I would recommend this class to everybody who has any interest in art or anatomy (or both :)).” Another wrote, “I learned sooooo much patience in this class and I think I've really grown as an artist through this class.” Asked whether or not they would recommend this new class (IDH 1930) to others, one student wrote, “YES! {the instructor} is someone that everyone should meet. She is so kind, generous, and supportive. She is an amazing person to be around, especially for women.” Asked which assignments supported their learning the most, one student answered, “The drawings themselves supported my learning because you take concepts of anatomy/physiology and recreate them on paper. The interpretation through your own eyes has to be anatomically correct and be physiologically logical, but also presented in your own creative way.” Another responded, “All of the projects gave me a new way to explore art and medical illustrations. I loved them all.”

Discussion

Learning about the human body can be daunting. Typically, Anatomy and Physiology is taught as a content driven course, prompting the need for memorization of complex details with very little understanding of its relevance. It

has become increasingly evident that there is no one correct way to teach anatomy (Johnson et al, 2012). The skills necessary for academic success, as well as lifelong learning, are cultivated by piquing intellectual curiosity. In this manner, visual images may play a role in how we learn, teach, and practice science.

Key anatomical concepts from Human Anatomy & Physiology I and II can be reviewed when actively drawing the body. Teaching anatomy via drawing unites the creative “right-brain” with the more analytic “left-brain,” engaging both hemispheres. Analogously, non-traditional routes to medical school, which may be fortuitous and unplanned, have a unique capacity to generate intellectual curiosity that can be applied across all disciplines. To that end, an artistically minded individual may end up as a scientist and vis a versa.

Drawing encourages emerging health science professionals to accumulate knowledge in multiple disciplines and to approach the same anatomical subject in various ways—including visual images created by the student. Thus, by integrating learning styles, anatomical learning can be optimized. By offering an elective in medical illustration, we sought to inculcate basic drawing skills to a group of students in the health-related disciplines. Ten interdisciplinary health science students with different artistic backgrounds participated in our medical illustration workshop as part of an elective within the honors college curriculum. Illustration may be a tool used in clarifying student’s understanding of anatomy.

Conclusion

By integrating a visual approach to learning, the goal is clear—to simplify the complexity of anatomical education. Indirectly, we aimed to nurture the students’ problem solving and investigative skills. Anatomical drawing demands observation, problem-solving and comprehension. This learner-centered elective course represented a unique experience for scientifically minded students to use skills other than the traditional modalities for their academic learning. Collectively, these principles support self-directed, life-long learning. In summary, this multi-disciplinary learner-centered approach to teaching anatomy motivates and reinforces student learning within the health sciences.

Practice Points

- Drawing encourages emerging health science professionals to accumulate knowledge in multiple disciplines and to approach the same anatomical subject in various ways—including visual images created by the student.
- Non-traditional routes to medical school, which may be fortuitous and unplanned, have a unique capacity to generate intellectual curiosity that can be applied across all disciplines.
- The Student Perception of Instruction (SPoI) allowed for evaluation of the extent to which conveying the passion for arts and sciences was a viable strategy of learner-centered instruction.
- It has become increasingly evident that there is no one correct way to teach anatomy. Visual images may play a role in how we learn, teach, and practice science.

Notes on Contributors

VALERIE WEISS, MD, MS is an Assistant Professor in the Department of Rehabilitation Sciences at Florida Gulf Coast University, Fort Myers, Florida, teaching undergraduate Anatomy and Physiology to students in the pre-health professions. She is also a medical illustrator, contributing to the course companion and lab workbook used in the course. Her research interest is in using the art of medical illustration to enhance anatomy education.

KRISTA CASAZZA PhD, RDN is the Assistant Director for Research and Outreach in the Water School at FGCU. She has two decades experience teaching anatomy and physiology in secondary and post-secondary education. She also maintains an active extramurally funded research program.

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