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People, Partnerships and Pedagogies

Developing a digital anatomy lab for rural medical students

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This paper follows the genesis and development of a digital anatomy lab for geographically isolated students in a postgraduate Doctor of Medicine programme in rural New South Wales and represents a work in progress. Students studying their degree at the rural clinical school do so without an in-situ cadaver-centred anatomy laboratory. This represents a pivotal shift away from the fundamental learning pedagogies implicit in academic Medicine, and therefore a challenge for situating the digital anatomy lab; its contents and explicit pedagogical needs, inside an already saturated curriculum. The Digital Anatomy space under development represents an intersection of scholarship on whether nascent digital tools (VR/AR) can develop fast enough to provide haptic and spatial feedback, how such digital spaces sit pedagogically amidst the accepted didactic teaching frameworks of Medicine, and whether creating virtual spaces improves student learning of Anatomy. This work-in-progress reflects the conference themes of people, partnerships and pedagogies.

Keywords: Digital, Anatomy, Medicine, Pedagogy, Doctor of Medicine, people, partnerships, VR, Rural

A digital anatomy lab – Background

The story of the *Dubbo Digital Anatomy Lab Project* brings together diverse people working across educational design, educational and medical technologies and Gross Anatomy, and represents a work in progress of innovative practice in technology supported teaching and learning. It is a project aiming to negotiate the liminal space between old-school medical pedagogy, and new ways of thinking, being and doing.

The physical anatomy learning space available to students at the School of Rural Health is not like a traditional anatomy laboratory, in that there is no access to cadaveric specimens for study and dissection, and no library of human specimens for observation and use as study tools, standard practice for Australian tertiary medical programmes. There is instead, a large space full of high-quality plastic medical models representing each human system.

Figure 1: Renal Block Anatomy learning with plastic models.

The shift away from tradition

There is ongoing debate about whether students really need exposure to human specimens to be adequately prepared as medical practitioners, with some research focusing on lost sensory perception from digital anatomy

education, with “changes in learners’ practice, behaviour, and skills.” (Sveistrup et al, 2023. P765) This, and research like it, posits that without getting your hands inside real human flesh and organs, your sensory perception (haptic and spatial) is not advanced enough by the time your medical training ends, to be truly considered adequately trained. There is speculative discussion around whether the haptic and spatial feedback of VR/AR technology might change at such a rate to make these arguments redundant, parallel to published work illustrating advanced remote computer-assisted head trauma surgery (Lu et al, 2023), which is to say the scholarship is not settled.

There is little argument resources supporting anatomy education, including digital simulation and VR/AR will move medical education further away from its conservative roots, (Adnan & Xiao, 2023. p471.) and “the majority of literature supports the notion that digital technologies enhance anatomical education”. (Adnan & Xiao, 2023. P472.) It is also the case, a digital learning space provides unlimited access and practice opportunities, which overcomes both time and distance for students who are already some way away from metropolitan learning hubs. This project began with the founding principle of providing equity for our rural cohort, so this aspect isn’t easily dismissed.

While the practice is not widespread, it is becoming more acceptable for medical students to learn about anatomy from resources such as high-quality plastic models, detailed digital encyclopaedias, specialist enterprise software and modern teaching tools like the Sectra virtual dissection table. (Abuvatfa et al, 2021) Collectively, these are being seen as more efficient and a higher value proposition than the infrastructure, expertise and ethical oversight required to maintain a morgue and cadaveric specimens for learning.

Ongoing questions

How then do we situate the development of a digital library of existing plastic models, into this developing paradigm of teaching and learning? After all, this cohort of rural students can already access the plastic models in the learning space, so this work poses a number of questions:

- How can digital files of existing models add value to the learning programme?
- What role do Anatomy educators want the digital models to fulfil in their praxis?
- How will we know if the project is successful?

Support from the accrediting body

The Australian Medical Council are the accrediting body for medical education in Australia, with a purpose to ensure the standards of education, training and assessment of the medical profession promote and protect the health of the Australian community. (AMC, 2023) A presentation detailing the work on digitizing the Dubbo Anatomy Lab was made by the presenting author in October, 2022 to the Australian Medical Council accreditation group, during their site visit to Dubbo. The digital lab concept and its development was considered an asset to the Dubbo stream of the Sydney Medical School and the Council team encouraged the project group to continue with what they saw as innovative work.

Work undertaken

The Educational Designer led a Design Thinking workshop with the Anatomy Lecturer and other members of academic teaching staff in the medical programme, to determine if a digital lab was a concept worth pursuing, and what form it might take. Funding was sought and obtained. This resulted in a range of iterative conceptual frameworks.

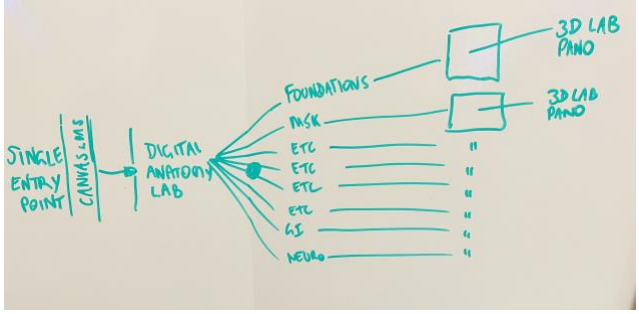

Figure 2: Hand drawn design iteration

All models in the physical laboratory were scanned by media technologists, using 3D scanning equipment over a 2-day period. Models were scanned with an Artec Spider device and processed With Artec16 software. The panoramic 3D Laboratory framework was created with 3D Vista, Adobe Photoshop and Canvas. Access is via VR Headset array and all screen systems.

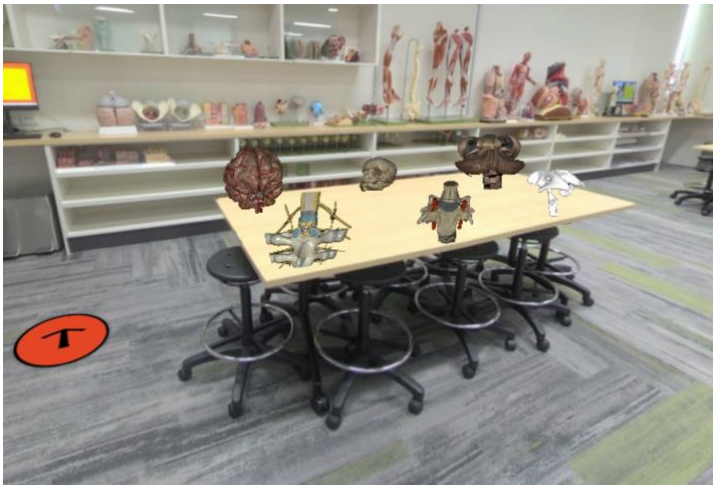

Figure 3: 3D Panoramic view with neuroanatomy rendered models on display.

Results

Each Anatomical model was loaded into a page in Canvas, linked via URL from 3D vista and loaded into the learning management system as SQUORM package. The system of models follows the existing didactic curriculum presentation of human body systems in a 'block' pattern across the weeks of study. E.g., Models of the brain are listed under 'Neuroanatomy Block.

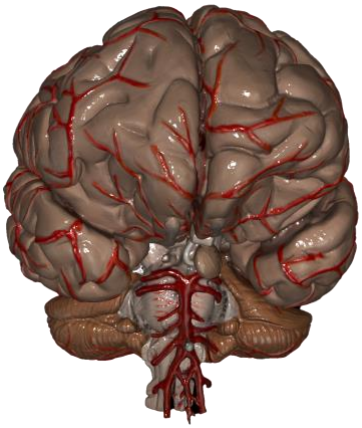

Figure 4: 3D rendering of plastic model of the human brain.

Users access the learning management system (LMS) providing access to a rendered version of the physical anatomy learning space, available at any time. Each model is available for close study within the LMS or via manipulation, capture, annotation and animation for further study and revision using smartphone apps and tools. The repertoire of available digital tools is expanding and users are able to remix the digitized files to create study tools to suit them, by utilising a range of systems from simple screenshot annotation and labelling, through to more technical solutions utilising LiDAR (Light Detection and Ranging) such as Scaniverse.

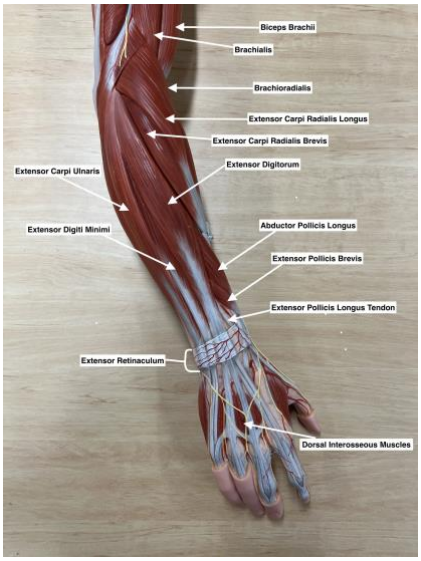

Figure 5: Annotated plastic model

Figure 6: Scaniverse LiDAR scan patella

The idea is the original digital models serve as a springboard for co-created assets for learning, giving agency and autonomy to use the digital anatomy lab as inspiration for wider learning. This idea reflects the values of 'self-determination theory', expressed by Lyness et al (2013) as a basic human need for "autonomy, competence and relatedness", and that where these exist in academic medicine, learners are more successful.

Ongoing challenges

The challenges of creating a digital Anatomy Lab using 3D scans of plastic models, embedded into a learning management system using a 3rd party tool (3D Vista) are numerous and include:

- Digital learning requires an explicit pedagogical framework to work effectively in this hybrid learning space, "digital anatomy education should not be viewed as a simple technical conversion and needs an explicit pedagogical framework." (Wickramasinghe et al. 2022.p1) At present, the Digital Lab is seen as a 'bonus' resource, not as independently significant.
- There is potential for embedding ELearning into each 3D model, including labelling and hidden sub-menus, requiring more technical acumen in web-based systems.
- There is a chasm between pedagogical skill and understanding, and knowledge of Anatomy, and it would be beneficial to bring together people with expertise across both areas.

- Distance between human resources at main campus is considerable and presents a physical barrier
- There is no measure in place to learn if this is effective

References

Abuvatfa, S. I., Bolilyi, V. O., Lunhol, O. M., & Sukhovirska, L. P. (2021). Use of sectra virtual dissection table in the educational process. Information Technologies and Learning Tools, 83(3), 49–59. https://doi.org/10.33407/itlt.v83i3.3798

Adnan, S., & Xiao, J. (2023). A scoping review on the trends of digital anatomy education. Clinical Anatomy (New York, N.Y.), 36(3), 471–491. https://doi.org/10.1002/ca.23995

Australian Medical Council. (2023) Our Purpose. https://www.amc.org.au/about-the-amc/purpose/

Lu, J., Leng, A., Zhou, Y., Zhou, W., Luo, J., Chen, X., & Qi, X. (2023). An innovative virtual reality training tool for the pre-hospital treatment of cranialmaxillofacial trauma. Computer Assisted Surgery (Abingdon, England), 28(1), 2189047–2189047. https://doi.org/10.1080/24699322.2023.2189047

Lyness, J. M., Lurie, S. J., Ward, D. S., Mooney, C. J., & Lambert, D. R. (2013). Engaging students and faculty: implications of self-determination theory for teachers and leaders in academic medicine. BMC Medical Education, 13(1), 151–151. https://doi.org/10.1186/1472-6920-13-151

Sveistrup, M. A., Langlois, J., Wilson, T. D. (2023). Do our hands see what our eyes see? Investigating spatial and haptic abilities. Anatomical Sciences Education, 16(4), 756–767. https://doi.org/10.1002/ase.2247

Scaniverse (Version 2.1.8) [Mobile Application Software]. Toolbox AI. Apple Application Store.

Wickramasinghe, N., Thompson, B. R., & Xiao, J. (2022). The Opportunities and Challenges of Digital Anatomy for Medical Sciences: Narrative Review. JMIR Medical Education, 8(2), e34687–e34687. https://doi.org/10.2196/34687

Hampshire, L., Havellas, W., Corvalan-Diaz, C., Beverdam, A., Kariyappa J. T. & Whittaker, M. (2023). Developing a digital anatomy lab for rural medical students. In T. Cochrane, V. Narayan, C. Brown, K. MacCallum, E. Bone, C. Deneen, R. Vanderburg, & B. Hurren (Eds.), *People, partnerships and pedagogies*. Proceedings ASCILITE 2023. Christchurch (pp. 425 - 429). https://doi.org/10.14742/apubs.2023.673