Development and Evaluation of Prototype Transdisciplinary Biophysical 3D Visualisation Resources for Enhancing Medical and Physics Interprofessional Student Learning

Ong Paul Sherng[1], Lim Xin Yan[1], Professor Iain Keenan[2], Dr Aleksey Kozikov[2]
1: Newcastle University Medicine Malaysia, Johor Bahru, Malaysia
2: Newcastle University, Newcastle upon Tyne, UK
P.S.Ong2@newcastle.edu.my; X.Y.Lim4@newcastle.edu.my

RATIONALE

- Healthcare is collaborative, but students in medicine and physics often lack the opportunities to connect their knowledge in clinical contexts
- Interprofessional learning connects these disciplines where students learn with, from, and about each other to build shared understanding and teamwork
- We developed 3D printed models simulating ligament injuries and bone density scans, allowing physics students to apply mechanical principles and medical students to explore anatomy and diagnostics
- This cost-effective, and tactile approach enhances engagement, deepens understanding, and prepares future professionals for team-based healthcare

LITERATURE REVIEW METHOD

- The PRISMA protocol was used to conduct the literature review (Figure 1)
- The papers were searched for using the terms 'Anatomy Education + 3D printing' and 'Anatomical Education + 3D printing' on PubMed

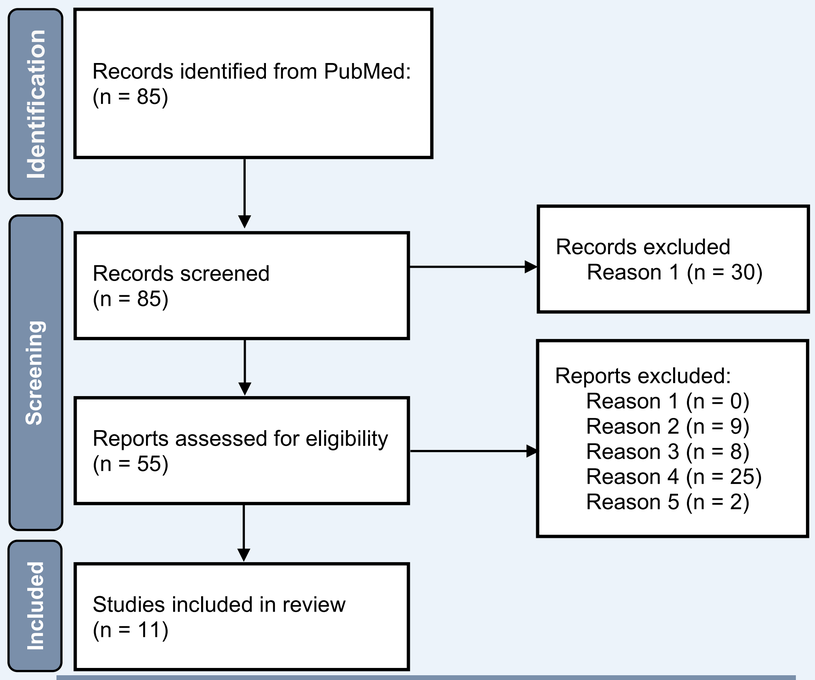

Figure 1: PRISMA protocol

QUANTITATIVE SYNTHESIS

1. Students using 3D printed models showed significant gains in post-test scores and spatial reasoning, especially in lung and skull anatomy studies [1,2]
2. In studies comparing 2D images vs. 3D models, students tested with 3D printed tools performed better in identification tasks [3,4]

QUALITATIVE SYNTHESIS

1. Students reported increased motivation, confidence, and enjoyment when using 3D printed models compared to traditional methods [5,6,7,8]
2. Learners valued the physical realism and texture of models, which helped them distinguish anatomical features and retain information better [2,4,5,8]
3. Physical 3D models encouraged authentic group discussion and fostering authentic interprofessional dialogue [7,9]

PROTOTYPE DEVELOPMENT

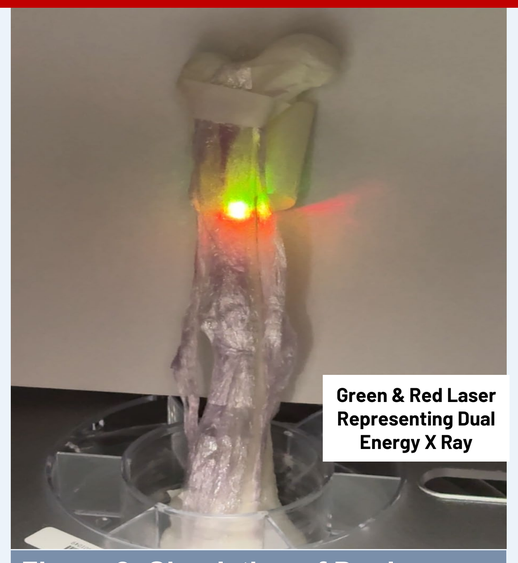

Figure 2: Simulation of Dual-energy X-ray Absorptiometry

- The 3D-printed femur is illuminated using red and green laser sources to simulate dual-energy X-ray absorption
- The differing laser interactions with bone material mimic how bone density is assessed in medical imaging, helping students visualise and quantify energy attenuation principles


Figure 3: Simulation of Knee Joint and Ligament Mechanics

- Using 3D-printed femur, tibia, and fibula connected with Blu tack as ligaments, the model demonstrates joint articulation and ligament tension
- Physics students analyse mechanical forces, while medical students correlate motion with anatomical landmarks and injury mechanisms

DISCUSSION / LEARNING OUTCOMES

Year 1 Physics Students	Year 1-2 Medical Students
Understand how X-Ray energy is used to measure bone density with principle of the electromagnetic spectrum	Learn how DEXA scan works and its' usage in diagnosing osteoporosis
Explore how X Ray emitter affects penetration depth based on various muscle layers from different anatomical view	Link bone scan results to patient risk factors like aging or nutrition
	Discuss how collaboration with physics improves understanding of medical imaging

- Reflect on the ethical implications of radiation exposure in medical diagnostic imaging, especially in vulnerable populations
- Understanding the biological impact of ionising radiation

Year 1 Physics Students	Year 1-2 Medical Students
Evaluate and apply ligament's stress-strain principles, including ligament elasticity and failure thresholds	Describe the anatomical structures that forms the knee joint
Discuss the benefits of physics in healthcare settings	Apply biomechanical principles and explain the anatomical basis of cruciate ligaments injuries
	Discuss how collaboration with physics improve understanding of injury, diagnosis and management of musculoskeletal injuries

CONCLUSIONS

- This project showed that 3D printed simulation models can effectively link physics and medical concepts through hands-on, team-based learning
- Students have greater engagement, clearer understanding of biomechanics and imaging principles, and appreciate meaningful collaboration across disciplines
- Overall, this model highlights how simple, tactile tools can strengthen interprofessional learning and prepare students for real-world teamwork in healthcare

REFERENCES

1. Drevet, Gabrielle et al. "Contribution of 3D visualization and printing in teaching lung segments anatomy." 3D printing in medicine vol. 11,1 25. 9 Jun. 2025, doi:10.1186/s41205-025-00272-z
2. Yang, Mao-Yi et al. "Effects of the individual three-dimensional printed craniofacial bones with a quick response code on the skull spatial knowledge of undergraduate medical students." Anatomical sciences education vol. 16,5 (2023): 858-869. doi:10.1002/ase.2269
3. Myles, Christian et al. "3D printing variation: Teaching and assessing hepatobiliary variants in human anatomy." Anatomical sciences education, 10.1002/ase.70073. 19 Jun. 2025, doi:10.1002/ase.70073
4. Cheung, Rocky Chun Chung et al. "Show them what they can't see! An evaluation of the use of customized 3D printed models in head and neck anatomy." Anatomical sciences education vol. 17,2 (2024): 379-395. doi:10.1002/ase.2361
5. Chandrasekaran, Ramya et al. "A validated instrument measuring students' perceptions on plastinated and three-dimensional printed anatomy tools." Anatomical sciences education vol. 15,5 (2022): 850-862. doi:10.1002/ase.2147
6. Miao, Huachun et al. "Application of 3D-printed pulmonary segment specimens in experimental teaching of sectional anatomy." BMC surgery vol. 23,1 109. 4 May. 2023, doi:10.1186/s12893-023-02022-6
7. Tripodi, Nicholas et al. "The Impact of Three-Dimensional Printed Anatomical Models on First-Year Student Engagement in a Block Mode Delivery." Anatomical sciences education vol. 13,6 (2020): 769-777. doi:10.1002/ase.1958
8. Radzi, Shairah et al. "Development of a three-dimensional printed heart from computed tomography images of a plastinated specimen for learning anatomy." Anatomy & cell biology vol. 53,1 (2020): 48-57. doi:10.5115/acb.19.153
9. Lee, Jason Wen Yau et al. "An activity theory approach to analysing student learning of human anatomy using a 3D-printed model and a digital resource." BMC medical education vol. 25,1 553. 16 Apr. 2025, doi:10.1186/s12909-025-07172-0