

Design of an Innovative Congenital Heart Disease Curriculum Using 3D Visualization Technologies

Trina Bloemen^a, Cody Wesley^a, Patrick von Hauff^a, Thomas Jeffery^a, Tegan McGraw^d, Kumaradevan Punithakumar^b, Michelle Noga^{b,d}, Sylvie Cormier^{c,d}, Lyn Sonnenberg^{a,c}, Charles Larson^{c,d}

a. Academic Technologies, Faculty of Medicine and Dentistry, U of A
b. Department of Radiology and Diagnostic Imaging, FoMD, U of A

c. Department of Pediatrics, FoMD, U of A
d. Stollery Children's Hospital



INTRODUCTION

- Congenital heart defects (CHD) affect 1% of live births.
- CHDs are notoriously difficult to understand in their 3-dimensional (3D) form.
- There is a paucity of literature on best practice in teaching CHD anatomy.^{1,2}
- Curricula including 3D objects for CHD is limited.^{1,2}
- **Objective: To design a congenital heart disease curriculum for residents to better visualize the anatomy of CHDs.**

METHODS

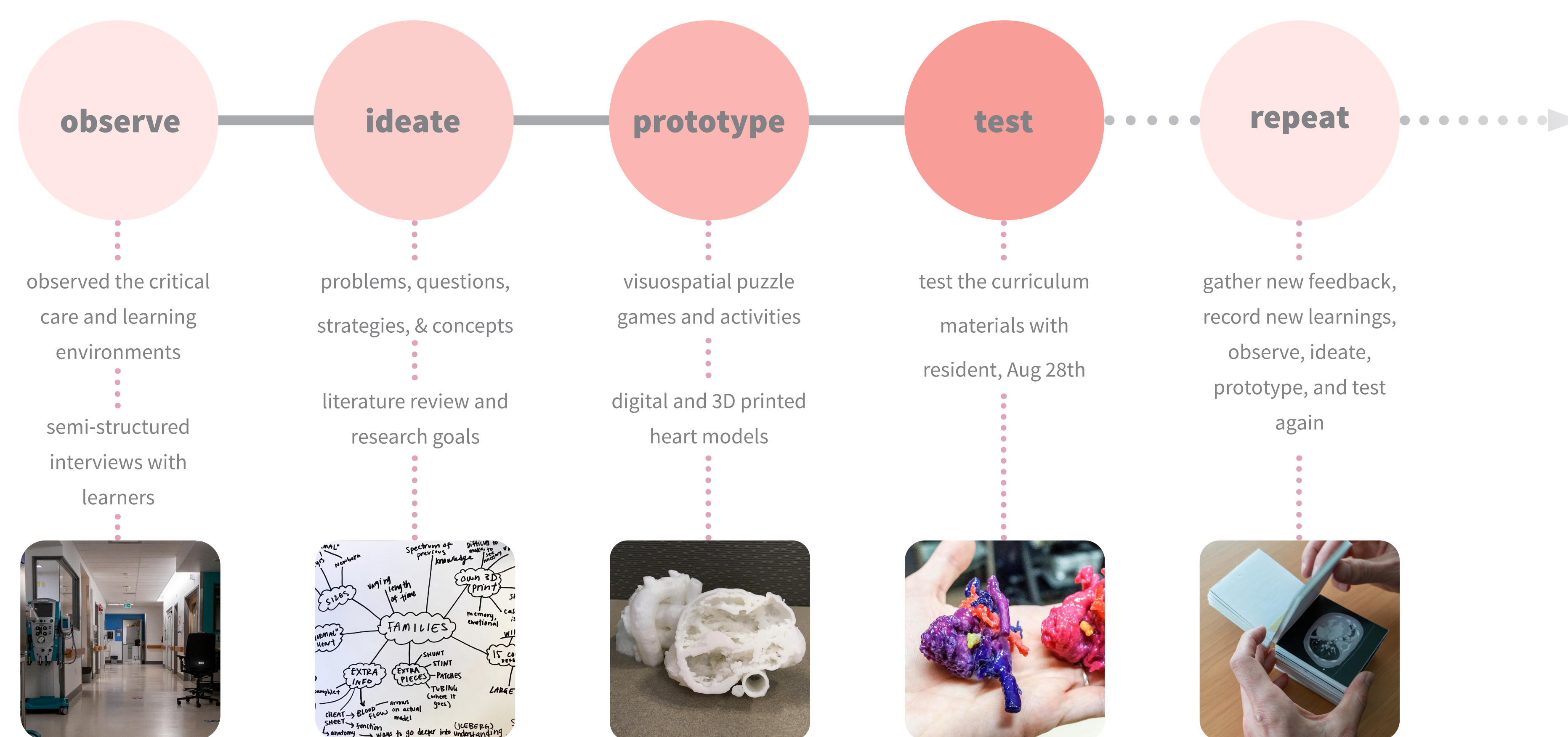
1 Literature review

- Physical/digital technologies in anatomy education
- 3D printing for CHD
- Theories applicable to anatomical knowledge

2 Iterative design process

- Observed critical care and learning environments
- Conducted semi-structured interviews with learners
- Identified challenges and opportunities,
- Generated and refined concepts based on observation and feedback from learners and clinical teachers

Iterative design process



We created patient-specific 3D printed hearts, stereoscopic and 2D models, and spatial anatomy learning tools.

Designed materials:

1. 3D printed hearts (replicas)
2. Spatial ability cubes
3. 3D CT Scan flipbook
4. Information sheets for common lesions

RESULTS

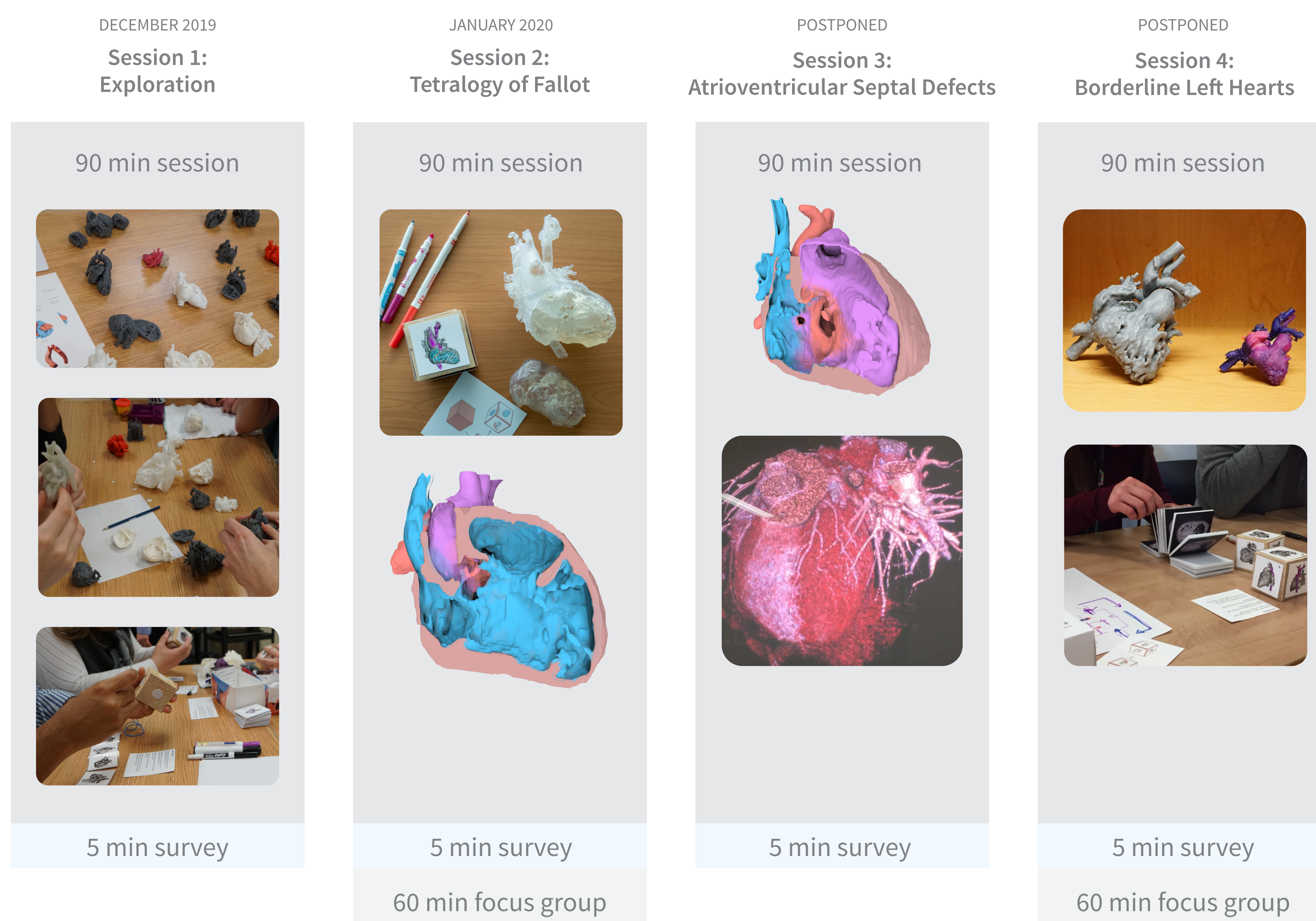
Key findings:

- Traditional clinical imaging is unfamiliar & not taught.
- Learners have little ability to understand specific patient lesions, in comparison to standard digrammatic abstract representations.
- Patient-specific 3D printed models create opportunity for concrete representation of CHD.
- Providing learners with activities to perform mental gymnastics, such as assigning images of a digital model to 6 sides of a cube, are useful to learning.
- The curriculum needs to make connections between 3D models, diagrammatic representations, and imaging seen in everyday clinical practice.

NEXT STEPS

- 2 out of the 4 CHD sessions have already taken place. We plan to complete the data collection once university restrictions allow for group learning.
- We have begun to see the 3D models' impact in counseling/educating patients and families, giving us ideas for new design projects.
- We are now collaborating on 3D projects within anesthesia, oncology, and medical simulation.

Curriculum Implementation and Evaluation



The work completed on this project was funded by a Health Professions Education Summer Studentship Grant, TLEF Grant, and a donation from Ila & Cody Will through the Stollery Foundation.

1. Smerling J, Marboe CC, Lefkowitz JH, et al. Utility of 3D Printed Cardiac Models for Medical Student Education in Congenital Heart Disease: Across a Spectrum of Disease Severity. *Pediatr Cardiol.* 2019;40(6):1258-1265.

2. Lim KHA, Loo ZY, Goldie SJ, Adams JW, McMenamin PG. Use of 3D printed models in medical education: A randomized control trial comparing 3D prints versus cadaveric materials for learning external cardiac anatomy. *American Association of Anatomists.* 2015;9(3):213-221.

