Background and Rationale

- Embryology is a foundational subject for understanding the adult anatomy, anatomical variations and congenital conditions.
- Many effective teaching tools include detailed visual aids, but embryology is limited by the availability of 4D visual resources.
- Currently, most resources are limited to 2D illustrations in textbook figures.
- This project aims to develop a 4D virtual folding embryo model (VFE) and assess its educational value and effect on student perception.

Hypothesis

- Interaction with the VFE will improve student learning outcomes regarding body cavity formation compared to the control group, and will result in a positive perception and confidence in the material.

Materials and Methods

Resource Development

- Histological sections obtained from the Carnegie Collection of Embryology were segmented and rendered to create a series of 3D virtual models.
- VFE interface was built on a web browser for student interaction (Figure 2).

Study Design

- Randomized single-blind study with first-year medical students (n=155) conducted (Figure 3).

Data Analyses

- One-way repeated measure ANOVA performed to determine educational effect before and after VFE interaction and between control and VFE groups.
- Likert scale survey data analyzed on 1-5 scale (1=Strongly disagree, 5=Strongly agree). Thematic analysis preformed on open ended response items.

Learning Outcomes Not Influenced by VFE

- Whole class learning outcomes (Figure 4).
- Control vs VFE group post quiz scores (Figure 5).

Student Perception of VFE Rated Highly

- Analysis of Likert scale survey items show high perceived educational value of VFE, but low confidence in material.

Student Feedback and Thematic Analysis

- Thematic analysis of survey comments revealed that the spatial and temporal relationships of changing embryonic anatomy, demonstrated by the VFE, was perceived as the strength of the resource (Table 1).
- Faster interface response emerged as a theme for VFE improvement (Table 1).
- Multiple student responses indicate the time of interaction with the VFE was too short to "digest" material (Table 1).

Confounds and Limitations

- Timing of the active learning session and student fatigue.
- Short VFE interaction time during active learning session.
- Active learning session held on the Zoom platform.
- Effects of VFE interaction in small breakout sessions not explored in this study.

Conclusions and Discussion

- Student perception of the VFE was very positive, but performance on quiz score did not improve as a direct result of the VFE.
- Further examination of VFE impact in different educational circumstances is warranted to definitively determine efficacy of this 4D visual resource.
- Future iterations of VFE, including animations, may yield additional insight to efficacy of similar resources.

Acknowledgements

- Special thanks to the Modern Human Anatomy Program, Jennifer Thurston as program administrator, and Yuna Park for assistance on module creation.