



Assessing 3D Learning Resource Preference and Performance in Embryology Education

Angelique Dueñas, BS¹; Jennifer Stratford, PhD²; Ernesto Salcedo, PhD^{1,3}; Lisa M.J. Lee, PhD^{1,3}

¹University of Colorado Anschutz Medical Campus, Modern Human Anatomy Program, Aurora, CO USA

²University of Colorado Boulder, Department of Psychology and Neuroscience, Boulder, CO USA

³University of Colorado Anschutz Medical Campus, Department of Cell and Developmental Biology, Aurora, CO USA



Modern Human Anatomy Program

UNIVERSITY OF COLORADO
ANSCHUTZ MEDICAL CAMPUS

Introduction

- Embryology, the study of development, is one of the fundamental anatomical sciences subjects
- Mastery of embryology can aid understanding of gross anatomy and is critical in understanding of congenital anomalies
- A body of literature illustrates access to 3D learning resources can yield better learning outcome in Gross Anatomy education (Smith et al., 2017; Khot et al., 2013)
- Currently, there are few 3D visual resources for embryology education, and most students still rely heavily on 2D illustrations [Figure 1]
- There is a paucity of research on the effectiveness of 2D or 3D visual resources, or students perceptions
- Project Aim:** Assess educational value of 3D visual resources in embryology education

Figure 1

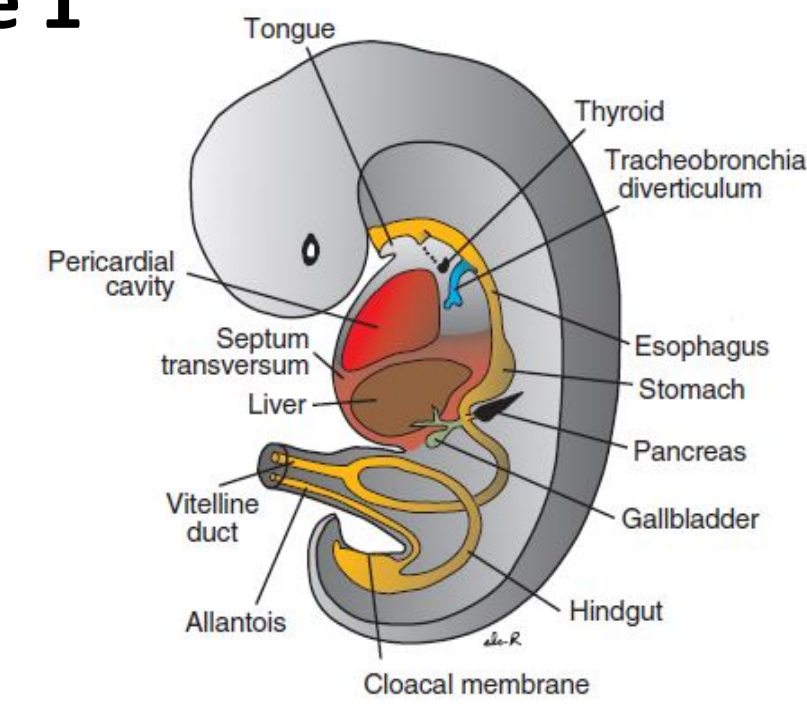


Figure 1: Image displaying major organogenesis at the 6th week of development (Langman, 2012)

Models and Methods

- Subjects: 1st year medical, dental, and graduate students
- Study design: A pamphlet with figures was provided to students alone (A), with a 3D virtual model (B), or with a 3D printed model (C) (Blezinski & Lee, 2017) [Figure 2]

Figure 2

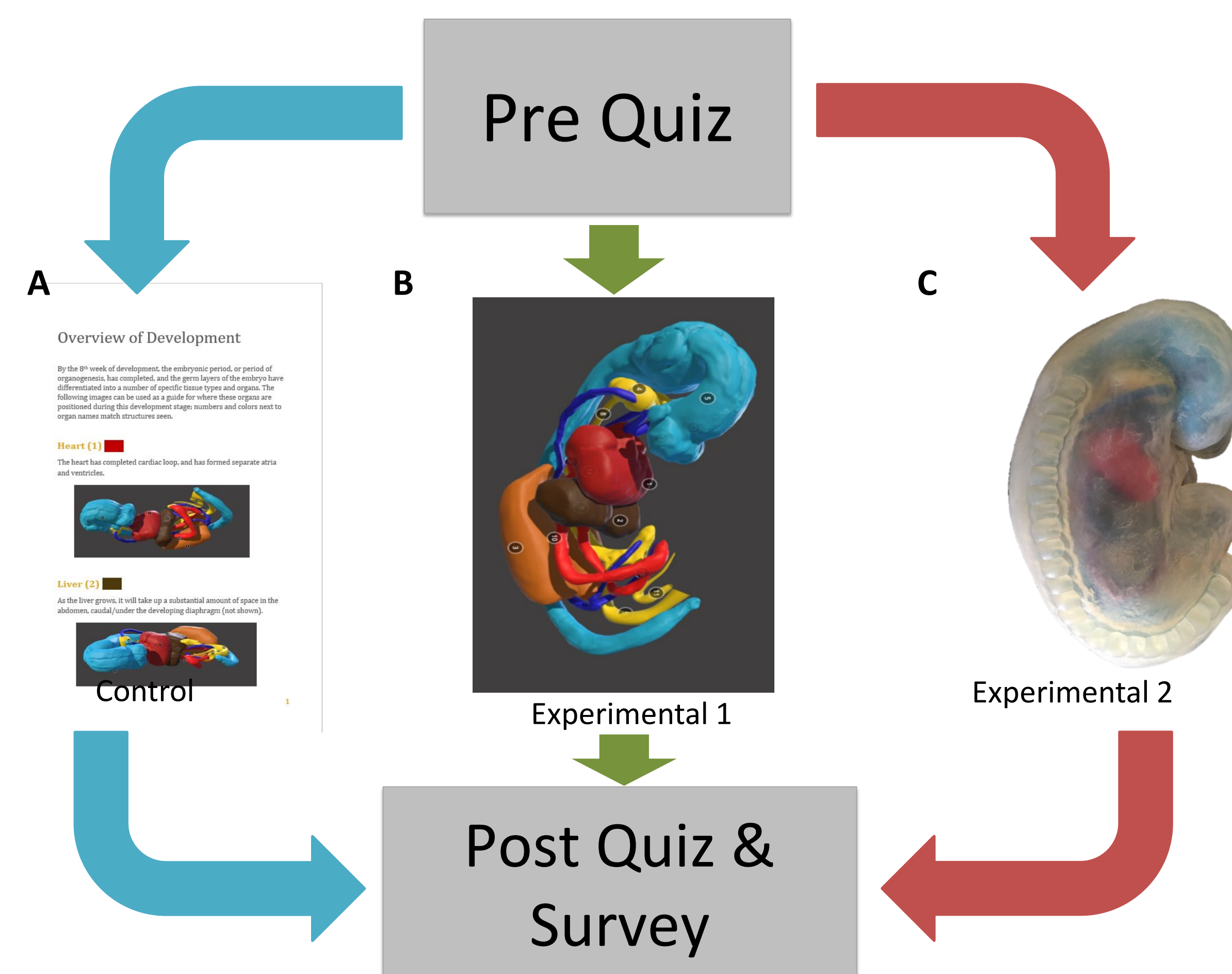


Figure 2: Part 2 Methods; Study subjects were randomized to access the pamphlet alone (A) or with a 3D virtual model (B) or with a 3D printed model (C)

- Statistical Analyses: Pre vs post quiz data were analyzed with MATLAB and Statistica. An Anderson-Darling test was performed to assess normality. All pre and post quiz data were found to be non-parametric. Kruskal-Wallis tests were then performed for significance, and Multiple Comparisons post-hoc tests was conducted for subsequent significant data

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Models Have Positive Impact on Learning

- Total of 162 students completed the study (56 medical, 80 dental, 26 graduate)
- Finding 1:** Interacting with 3D virtual and printed embryo models yields a significant increase in post quiz performance compared to prequiz [Figure 3]
- Comparison of the amount of post quiz increase in the 3 experimental groups, however, was not statistically significant

Figure 3

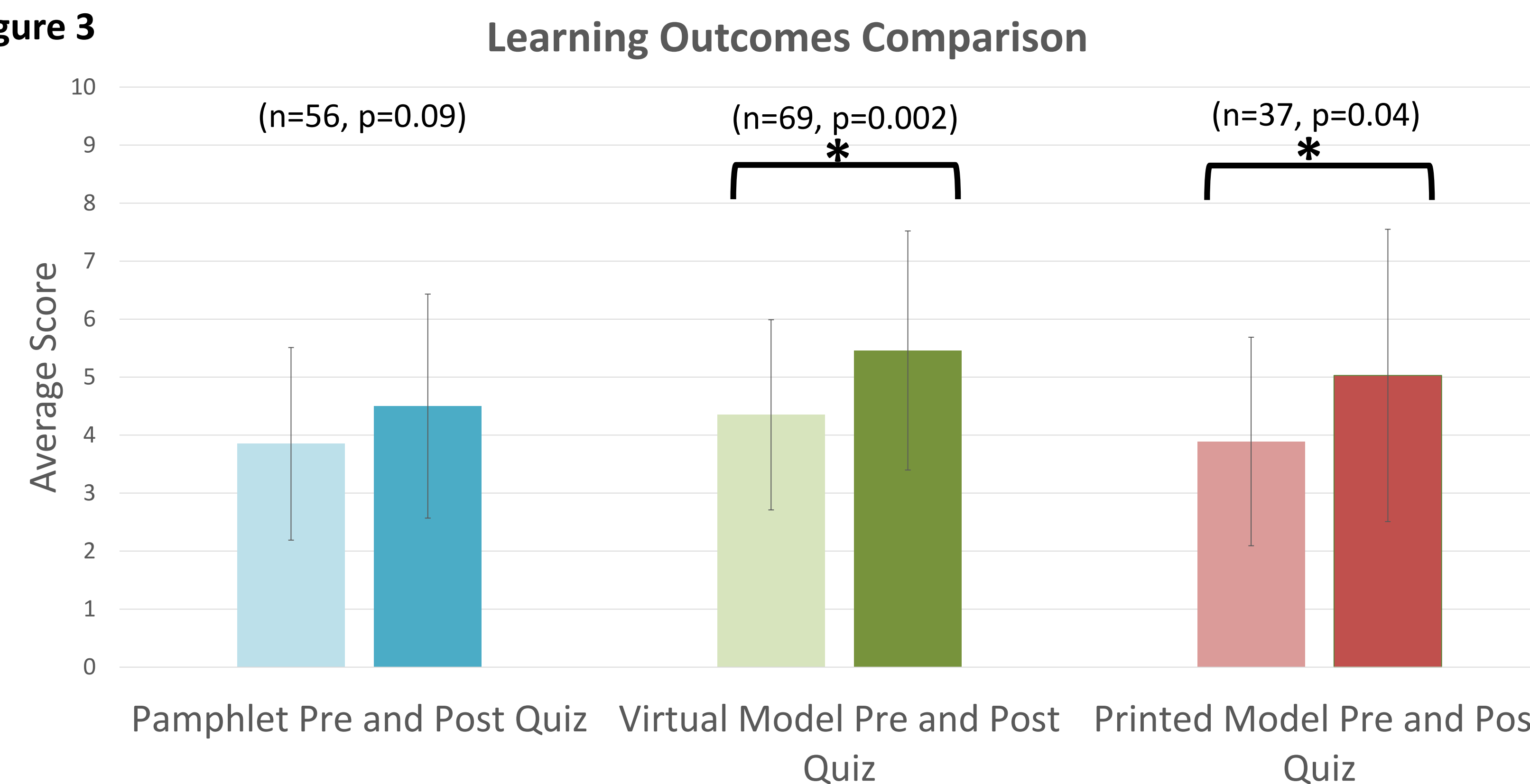


Figure 3: Pre and Post quiz comparison between the control (handout with 2D figures) vs the experimental (handout with 3D figures) groups. Compared to the prequiz performance, both group performed better on the postquiz, and the improvement was significant for the experimental group. The amount of postquiz increase between the two groups however was not statistically significant (n=104, p=0.21).

Students Highly Rate Interactive Resources

- Finding 2:** Students rated the 3D virtual and printed embryo models more favorably than the pamphlet [Figure 4]
- Virtual model was rated slightly higher than the 3D printed model

Figure 4

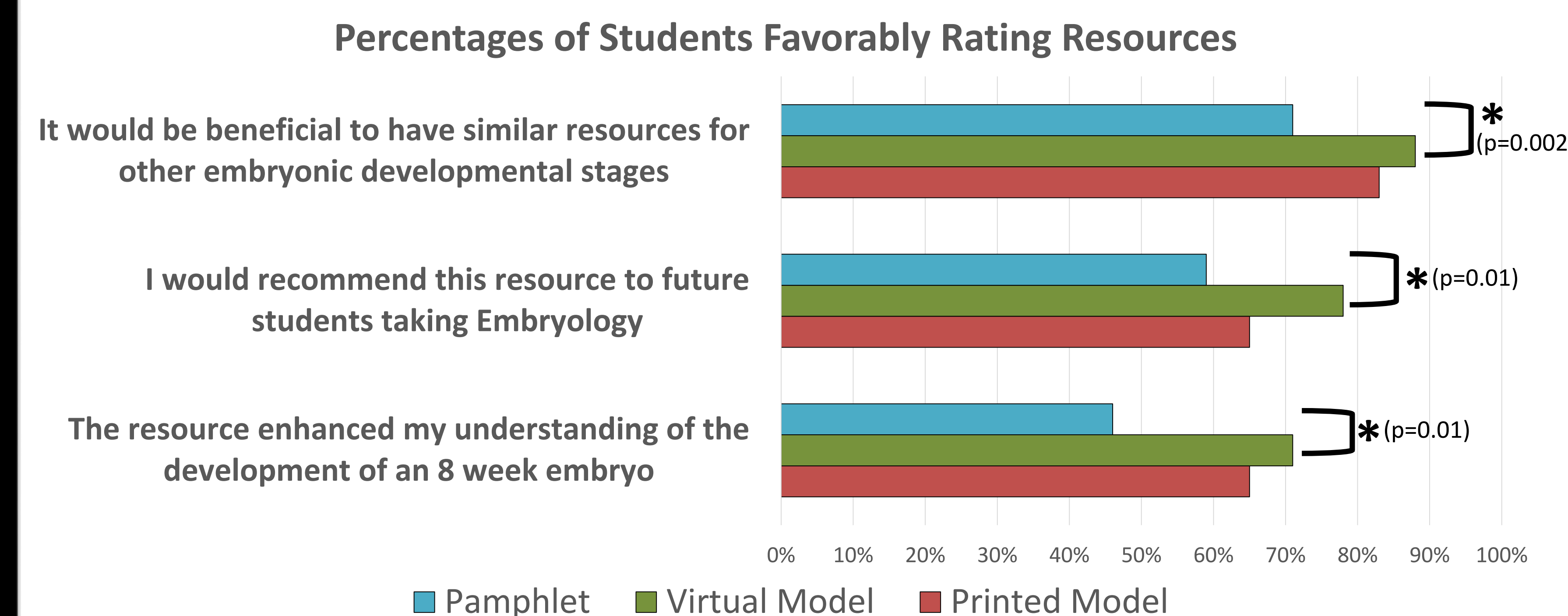
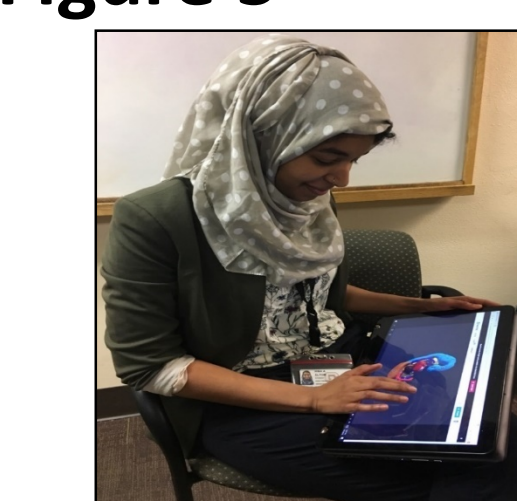


Figure 4: Percentage of subjects agreeing to the Likert survey items measuring students perceptions of educational value of the resources. There was statistically significant preference for the virtual model to the pamphlet for these prompts.

Student Feedback & Future Resources

- Finding 3:** Overall, the 3D virtual and printed embryo models were perceived to be highly effective for learning [Figure 5]
- Addition of text content and the sturdiness of the virtual and printed models were identified as areas of improvement respectively [Table 1]

Figure 5



"I love this idea and really feel it would benefit students studying embryology. I hope to see resources like this available in the future." -Virtual model comment

"A more pliable, durable model would be awesome. I'd buy it, especially if further developed." -Printed Model Comment



Figure 5: Example of student support statements from surveys, and images showing graduate students outside of the study examining the resources

Table 1

	Pamphlet	Virtual Model	Printed Model
Areas for Resource Improvement	"I wish I could spin the model to see better, but not possible in a pamphlet... would look better on glossy paper "	"Virtual tool could have incorporated the facts from the paper, I barely used the tool and more so looked at the paper"	"I was afraid that by handling it, I might break it... felt very fragile"

Table 1: Representative student comments regarding areas for improvement of the resources, bold terms appearing frequently in student feedback

Figure 6

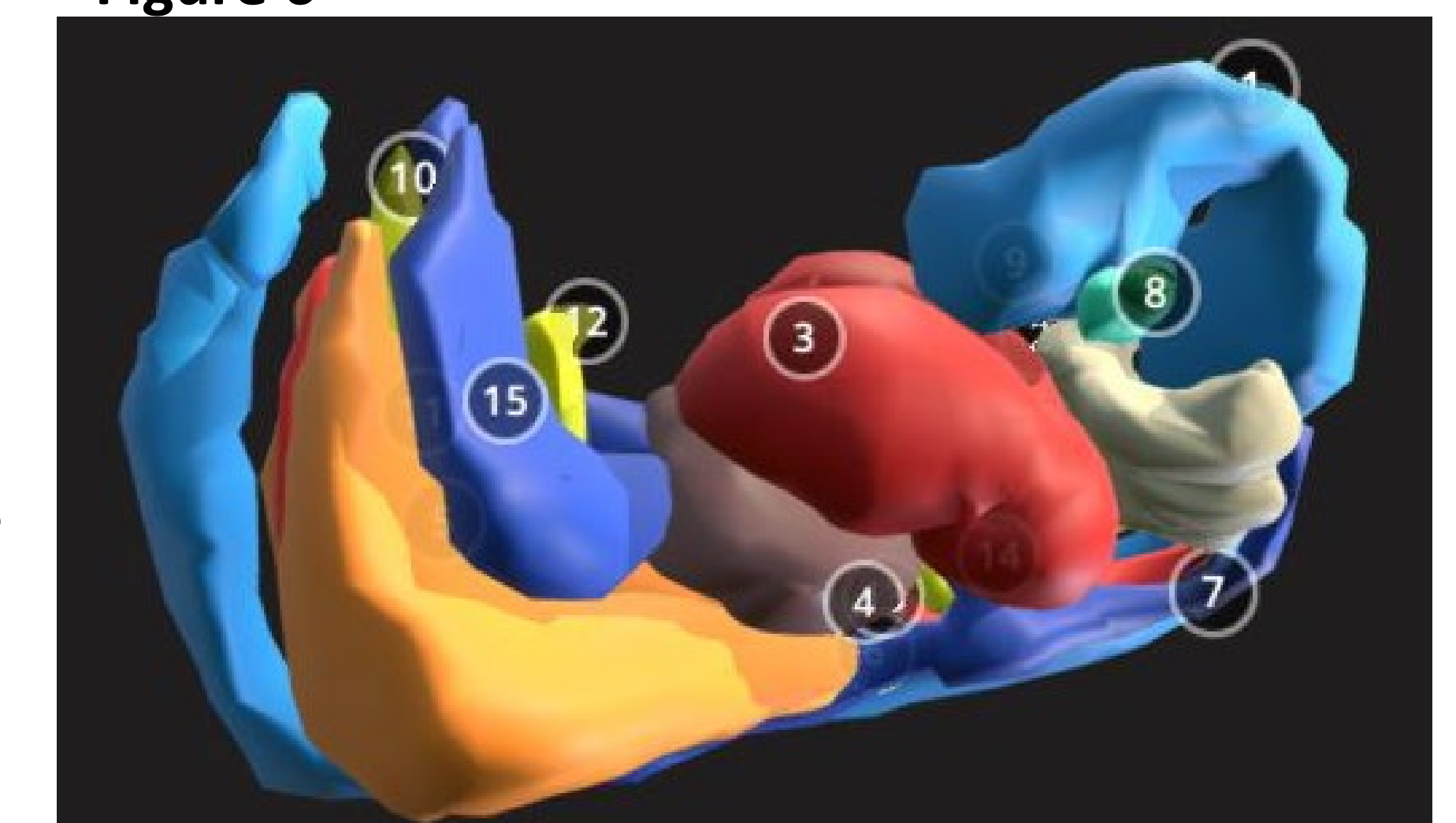


Figure 6: Image of new virtual model displaying organs at the 6th week of development

Conclusions and Discussion

- Interactive 3D virtual and printed models promote higher learning outcome and are rated highly by students in educational value
- Students favor making improvements on current resources, and creation of more visual and physical resources for embryology
- The study demonstrates the value of and the demand for more educational resources in embryology that can effectively convey the complex developmental events
- User and learning outcomes assessments on educational resources are integral for evidence based production and implementation of learning aids

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