Improving Accessibility to Human Anatomical Museum Specimens for Teaching, Through Use of Modern Digitisation Techniques

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Introduction

Anatomical specimens provide an invaluable resource for teaching, however, many of these specimens are fragile and irreplaceable. Modern visualisation techniques may aid in the preservation and safekeeping of such delicate materials while also facilitating wider access for teaching.

This project aimed to digitise human juvenile skulls from the University of Glasgow's, Museum of Anatomy, with a view to creating an interactive 3D application (app) to aid student learning of the growth and development of the juvenile craniofacial skeleton.

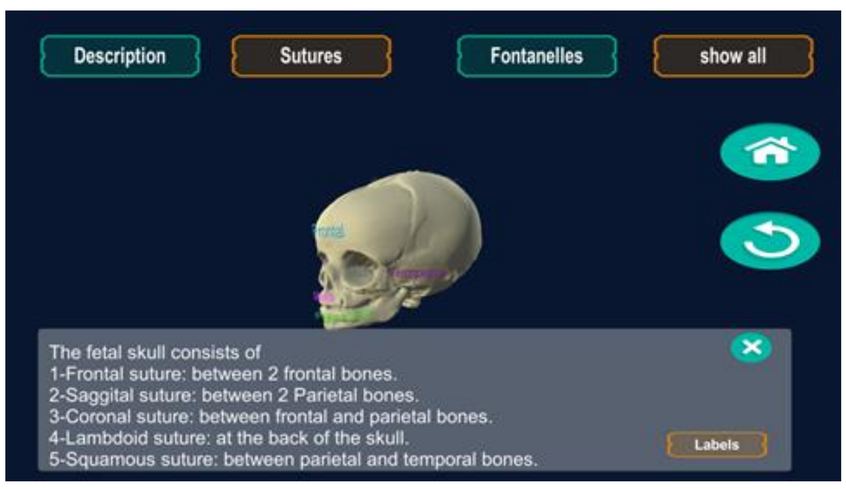
Museum Specimens

Two fetal skeletons aged 16 and 40 weeks *in utero* respectively (Figure 1) were selected for digitisation. A Canon E0S 5D camera was used to take > 50 photos of each specimen in 360 degrees, to capture the full skull. into 3D models using Agisoft Photoscan software.

Figure 1. Museum specimens – 16 week (left) and 40 week (right) fetal skulls. 16 week fetal skull is scaled up in size

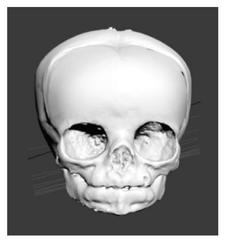
Creating the Application

Step 1: Photogrammetry – generating 3D models from digital photos. Multiple photos aligned and stitched together.



Step 2: Retopologizing – reducing polygon count & optimising model performance within app.

Step 3: Application development in Unity. Addition of scenes, labels and anatomical information.



Testing the App

A cohort of anatomy summer school students (n=12), trialled the juvenile skull app. Feedback was collected through an anonymous questionnaire, using a 5-point Likert scale and open text comments.

Results

Overall, feedback was positive. Participants found the app easy to use and did not feel that they would require technical support or prior knowledge to use it (Figure 2).

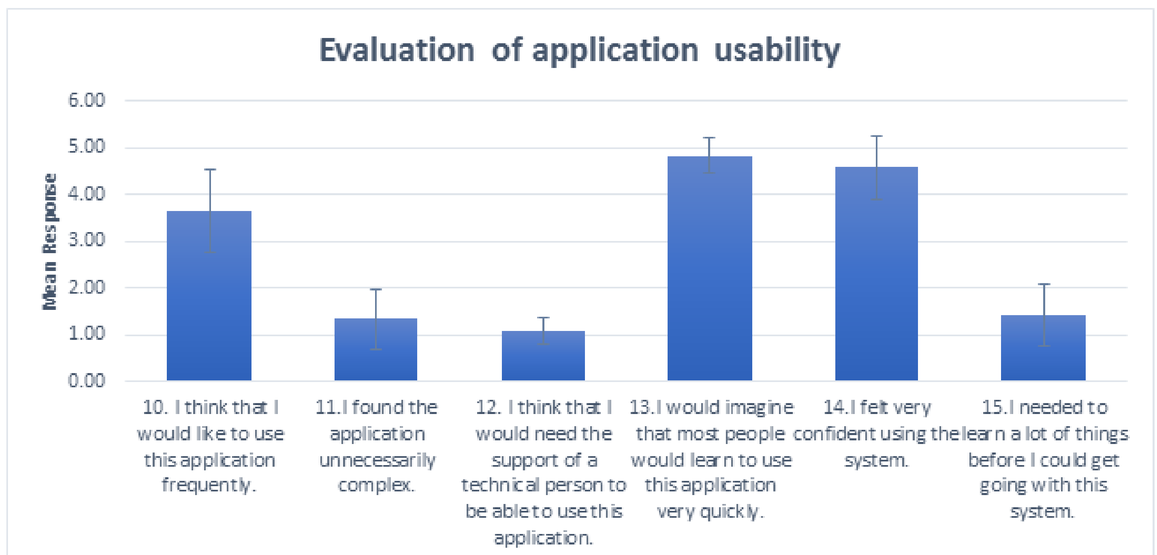


Figure 2. Responses to questions on app usability

The majority of students (n=11) indicated that the application helped them to learn more about the human skull ($\bar{x}$ = 4.58, σ = 0.67) and most participants (n=10) positively rated the use of 3D models in understanding the position and structure of anatomical features on the juvenile skull (Figure 3; $\bar{x}$ = 4.33, σ = 0.78).

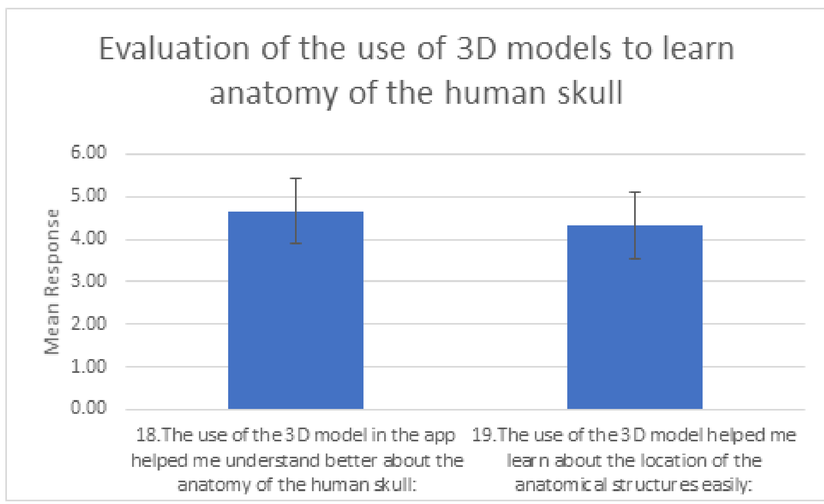


Figure 3. Responses to questions on learning anatomy from 3D skull models

Participants appreciated the ability to show or hide labels on individual bones to test their learning, but also requested labels for sutures and fontanelles to be added.

Discussion & Conclusion

Advances in technology mean that it is now possible to digitise and create accurate models of anatomical museum specimens. Moreover, specimens can be enhanced for teaching, by the creation of interactive applications including features such as identifying labels and markers, which may improve student learning.

This application is a first positive step in providing an alternative method for accessing anatomy specimens. However, further research is required to assess if this type of application is a suitable substitute for physical specimens in teaching anatomy, or if it is merely a supplemental tool.

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