**Educational Applications For 3D Printing: Human Anatomy**

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## Issue
Providing students with maximum laboratory time can be difficult for many universities. Laboratories are limited by the number of people they can hold, they are often in high demand by competing courses, and it can be difficult to obtain cadavers or specimens.

With this in mind, Victoria University wanted to extend students' access to anatomy classes beyond the laboratory sessions.

## Solution
To build human anatomical parts with the 3D printer.

Here we present two examples where 3D printed human anatomical parts enable teachers to extend anatomy classes outside of the laboratory, and students to gain additional hands-on experience with object-based learning activities.

### Osteopathy: Upper Limb Anatomical Models

1st year Osteopathy students learn the anatomy of the upper limb, memorising the individual anatomical terminology, structures, functions, how they interact, conditions which affect the corresponding parts, and what normal / abnormal anatomy looks like.

We printed the upper limb bones consisting of the Clavicle, Scapula, Humerus, Radius, Ulna, Carpus, Metacarpals, and the Phalanges.

The low cost for printing meant that we were able to build a complete set of bones for each of the 168 students to keep and take to classes, allowing students to maximize their time and experiences with the anatomical models.

### Psychology: Brain Puzzle

1st year Psychology students need to learn the different regions and functions of the human brain.

They do not gain access to human brains during their study. Previously students studied diagrams and images to memorise the different lobes and their functions.

We printed puzzle type models of the brain with each lobe a different colour.

### Extended Learning Activities

Students were provided with:
- Clay to model the muscles & ligaments on to the bones
- String to model the neurovascular system

Providing a more detailed hands-on experience.

Models which are damaged during the printing process were used in activities whereby students learn to recognise and discern the appearance of normal and abnormal bones.

### Learning Activities

The models provide the foundation for many in-class activities ranging from:
- Assembling the models correctly
- Labelling the lobes
- Exploration and discussion of the lobe functionalities
- Discussion combined with multimedia on how the lobes interact with each other

### Impact

Initial feedback from Psychology students suggests that designing these object-based learning activities with multi-colored pieces representing the different brain lobes, resulted in a more tangible and engaging learning experience than was previously provided by the activities based on textbook diagrams.

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