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# Engaging Dental Students in Technology using 3D Scanning and Printing.

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## Introduction and Aims:

Student engagement with new technology allows them to experience innovative uses of technology to study dental sciences. Integrating new technology into existing curricula is an ideal way to maintain current technological knowledge. Our aim was to use students' interest in new technologies to enhance learning of oral anatomy, tooth morphology and comparative odontology, simultaneously increasing their technological fluency in 3D imaging and printing.

A University of Melbourne Engagement Initiatives Grant provided funds for this project.

## Materials and Methods:

A Bruker MicroCT 1172 scanner (bruker.com) was used to create microCT scans of various small animal skulls and human teeth (fig. 1 and 2). A David SLS3 surface scanner (david-3d.com, fig. 3) was used to create surface scans of a variety of human dentitions, and a Zortrax 3D printer (zortrax.com, fig. 4) was used to create 3D prints of a number of scans (both from inhouse scans and downloaded from Thingiverse.com). Skyscan software was used to manipulate microCT scans and create 3D models. 3D Slicer (slicer.org) was used to create 3D models both from cone beam CT scans and MRI sample scans. Scans and models were used in the curriculum to demonstrate aspects of oral and comparative anatomy. Both the surface scanner and 3D printer were installed in a location visible to the students during their practical classes. Figure 5 shows first year Oral Structure and Function students inspecting the 3D printer at work (behind the window). Figure 6 shows an example of a tooth specimen (left) and the 3D print of a microCT scan of the tooth (right). The print was scaled up in size.



Fig. 1 3D reconstruction of a 4micrometre scan of the skull of a lesser bent-wing bat. Source: Mr. David Thomas, Melbourne Dental School

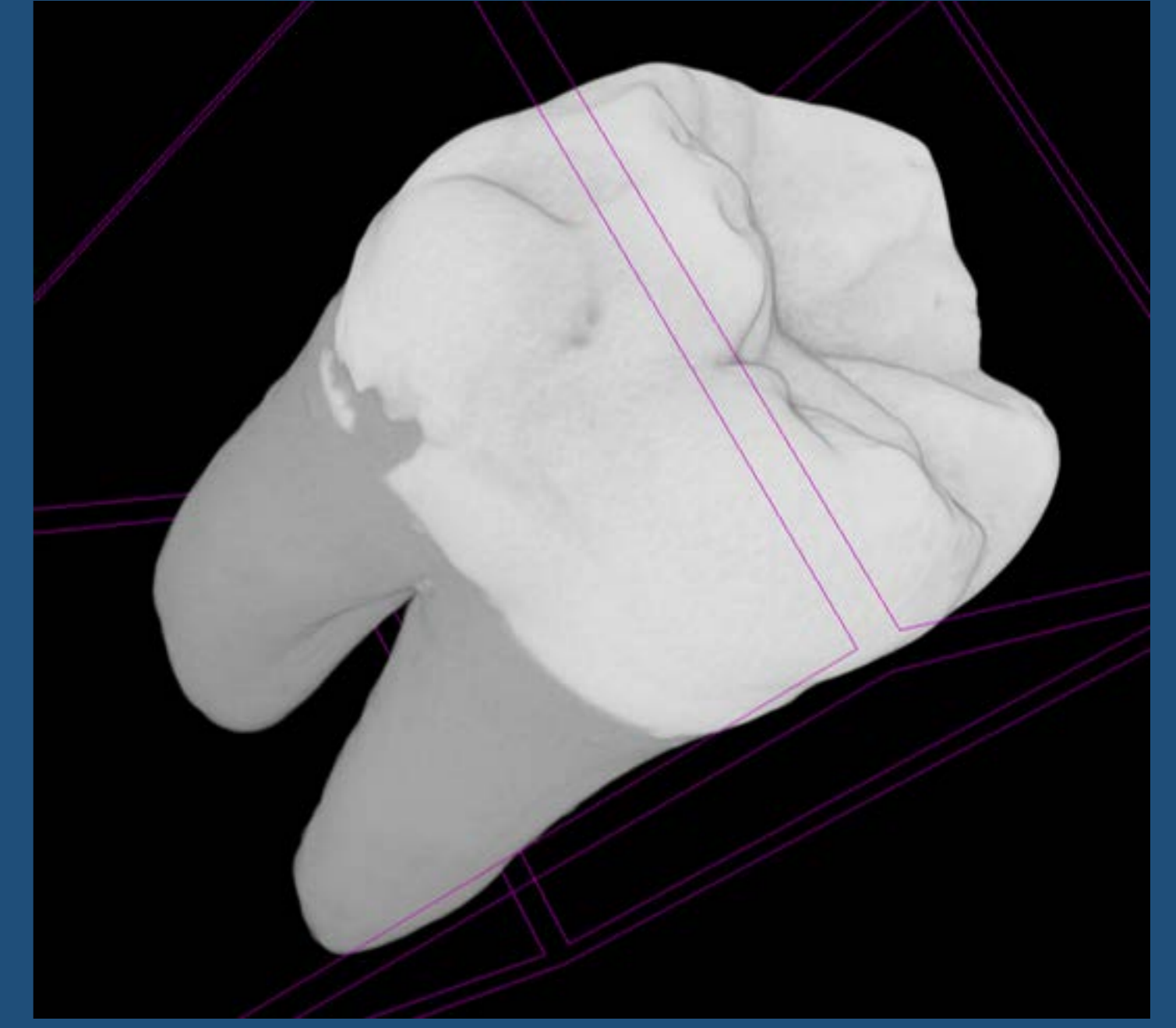


Fig. 2 3D reconstruction of a microCT scan of a human molar. Clipping box outlines are visible (pink). Dr. Rita Hardiman, Melbourne Dental School.



Fig. 3 DAVID SLS3 surface scanner with electronic turntable. Image source: aniwaa.com



Fig. 4. Zortrax 3D printer. Image source: thinglab.com

## Results:

3D scanning and printing was used to increase student engagement with the process, and the benefits of using this technology in future dental practice. This broadened students' knowledge of emerging technologies which are excellently suited to dentistry, and integrated into the curriculum an interest and engagement with this new technology. The project reinvigorated an appreciation of oral anatomy and comparative odontology. Increased engagement was measured using the Student Experience Survey (SES) distributed to students at the end of the subject. Results showed an increase in score from 2015 for questions on the Likert scale that incorporated resources, learning materials, the acquisition of skills and the translation of these skills to practice (Table 1). Positive comments mentioning 3D printing were also received.

Table 1. Comparison of relevant Student Experience Survey (SES) question scores for Oral Structure and Function 1 in 2015 (before 3D scanning and printing) and 2016 (during 3D scanning and printing).

Relevant SES question	2015 average score (n=51)	2016 average score (n=33)
Overall, this subject has been supported by useful learning resources	4.1	4.3
Focusing on my own learning in this subject, I have learnt new ideas, approaches and/or skills	3.9	4.0
Focusing on my own learning in this subject, I have learnt to apply knowledge to practice	3.7	4.0

## Discussion:

Results showed a moderate increase in the students' appreciation and acceptance of 3D scanning and printing techniques included in their curriculum. The next phase of the project will include the ability for the students to study 3D virtual models of teeth displaying a range of morphological variety in their practical classes. They will also be able to order some scans of teeth to be printed out for them to study outside of scheduled classes.

Limitations include the ability to alter the SES to truly reflect the students' attitude towards new technologies introduced into the curriculum, and may require a separate survey to target questions more directly.



Fig. 5 Students watching a 3D print being created.



Fig. 6 Tooth specimen (left) and a 3D print of a microCT scan of the same tooth. The print was of an enlarged version of the 3D model made with the scan.