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3D Printing: A New Dimension for Anatomy Education

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Learning objectives

Purpose The purpose of this pedagogical practice was to evaluate the feasibility, cost-effectiveness, and educational value of three-dimensional (3D) printed anatomical models in the teaching of human anatomy. Advances in medical imaging and 3D printing have enabled the conversion of CT and MRI data into physical models, offering new opportunities to enhance spatial understanding, tactile learning, and student engagement beyond traditional two-dimensional resources [1–4]. This study aimed to assess whether low-cost, in-house 3D printed models could effectively complement conventional anatomy teaching, improve student motivation, and...

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Background

Background The teaching of human anatomy has traditionally relied on two-dimensional atlases, cadaveric dissection, and commercial anatomical models, which may present logistical, financial, and accessibility limitations. Recent advances in medical imaging and three-dimensional (3D) printing technologies have enabled the transformation of CT and MRI data into tangible anatomical models, offering enhanced spatial visualization and tactile learning opportunities [1–3]. These models support active and multisensory learning, facilitating the understanding of complex anatomical relationships and pathological variations that are often difficult to grasp using conventional resources alone...

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Findings and procedure details

The implementation of three-dimensional (3D) printed anatomical models in practical anatomy classes yielded positive educational, technical, and economic outcomes. A total of 30 students participated in the learning activities, interacting with both normal and pathological anatomical models produced using low-cost FDM printing.Quantitative analysis of student questionnaires revealed high overall satisfaction with the use of 3D printed models, with a mean global evaluation score of 4.4/5. Anatomical fidelity was rated as excellent (4.6 ± 0.07), indicating strong structural accuracy and proportional correspondence. Pedagogical utility (4.4 ±...

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Conclusion

The findings of this study demonstrate that three-dimensional (3D) printed anatomical models constitute an effective and innovative pedagogical tool for teaching human anatomy in higher education. The integration of low-cost, in-house 3D printing into practical classes enhanced student engagement, spatial understanding, and anatomical comprehension, while promoting active and collaborative learning.Beyond the educational benefits, the use of 3D printed models proved to be economically advantageous, achieving substantial cost reductions compared with commercial anatomical models and allowing a high degree of customization, including the representation of pathological...

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Personal information and conflict of interest

J. Pinheiro: Nothing to disclose L. P. V. Ribeiro: Nothing to disclose A. D. M. Ribeiro: Nothing to disclose R. Gonçalves: Nothing to disclose L. Luz: Nothing to disclose E. Seiça: Nothing to disclose M. Gonçalves: Nothing to disclose J. Paulo Sousa: Nothing to disclose L. Silva: Nothing to disclose

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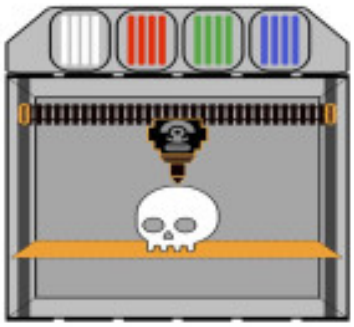

Fig 1: 3D Printer Illustration

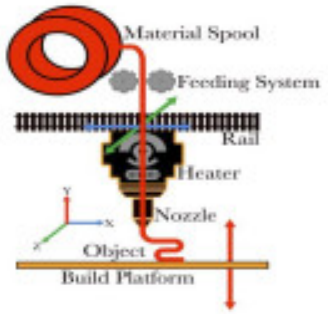

Fig 2: 3D Printer scheme mechanics

Fig 3: Process from image acquisition to printing

Evaluation Criterion	Mean (± SD)	Interpretation
Anatomical fidelity	4.6 ± 0.07	Excellent structural accuracy and realism
Tactile and visual realism	4.3 ± 0.09	Convincing physical feel and visual appearance
Structural clarity	4.2 ± 0.10	Good legibility and ease of anatomical identification
Pedagogical utility	4.4 ± 0.09	Strong contribution to the learning process
Motivation and engagement	4.5 ± 0.08	Increased participation and classroom interest
Overall evaluation	4.4 ± 0.06	High satisfaction with the educational experience

Table 1: Evaluation Criteria and Interpretation

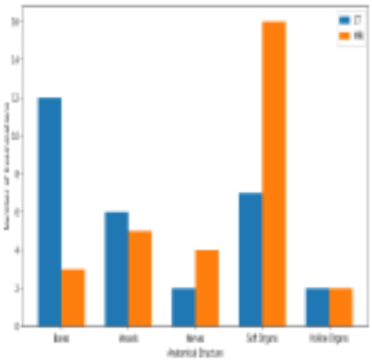

Fig 4: Distribution of CT and MRI Examinations by Anatomical Structure

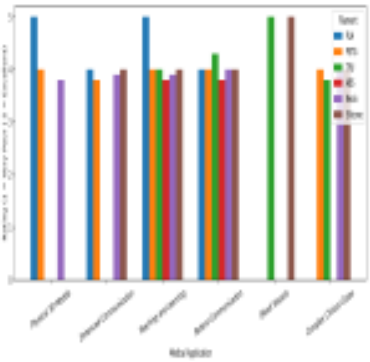

Fig 5: Mean ratings of filaments (PLA, PETG, TPU, ABS, Resin, and Silicone) across...