Transactions on Additive Manufacturing Meets Medicine
Trans. AMMM, 2024, Vol. 6, No 1, Suppl. 1, Article ID 1802, 1 Page

Infinite Science Publishing

Abstract

Integration of 3D printed microscopes in biomedical education

C. Hanshans[1*] and F. Burkhardt[1]

[1] *Department of Applied Sciences and Mechatronics, Munich Universtiy of Applied Sciences, Munich, Germany*
[*] *Corresponding author, email: christian.hanshans@hm.edu*

Additive manufacturing has opened up new opportunities in many industries and has become an essential tool for rapid prototyping, small-scale production as well as in medical applications. It has, moreover, shown great potential in the education of engineers, especially in the biomedical field. This paper explores the integration of 3D printing in a didactic framework aimed at enhancing interdisciplinary and collaborative skills in medical engineering courses, focusing on the construction of open-source digital, brightfield, darkfield and holographic 3D microscopes.

The project consists of three core elements: theoretical lectures covering the foundational principles of 3D printing and its applications in medical technology, interactive seminars for discussing exercises and answering theoretical questions, and practical sessions where students build their own microscopes using 3D printing and other low-cost technologies such as microcontrollers, single-board computers, open-source software and electronics. The primary learning objective is to enable students to assemble and iterate functional biomedical devices, thereby transforming theoretical knowledge into practical skills.

The journey from conceptual design to the final 3D printed microscope involves several steps with different challenges, including material selection, print preparation, assembly of microscope stand and optics module as well as wiring, programming and testing of the microscope. Students learn to select appropriate materials based on mechanical properties, durability, and biocompatibility, crucial for creating reliable biobio devices. The use of open-source software, coupled with hands-on experience in 3D printing and mechanical assembly, enhances students' methodological competence and practical skills.

To stimulate motivation and deepen the learning effect, the project incorporates various didactic aspects and gamification elements. For example, students work in teams to overcome challenges such as dealing with material limitations or integrating alternative electronic components into their designs to improve the final resolution. This collaborative approach not only strengthens technical skills but also fosters teamwork and problem-solving abilities.

This educational model aims to encourage active learning, enhance interdisciplinary communication, and improve exam performance. The project's promising effects can be observed in the active participation of students in the practical sessions and positive student feedback. Participants recognize the relevance of the learning objectives and feel prepared for their future careers. The skills acquired in 3D printing of open-source hardware are transferable to other biomedical contexts, making this interdisciplinary approach a valuable addition to medical and technical education.

AUTHOR'S STATEMENT

Authors state no conflict of interest. Animal models: n./a. Informed consent has been obtained from all individuals included in this study. Ethical approval: n./a. The authors state no funding involved.

DOI: 10.18416/AMMM.2024.24091802