INNOVATION

Developing Medical Students as Educators: A Course Applying Teaching and Learning Theory to Question Writing

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Abstract

There is a need for formal students-as-teachers education with authentic application. We report on a course that teaches and models effective educational theory. Students applied theory by writing questions with answer explanations which were incorporated into an online educational platform used by first-year medical students.

Keywords Educational strategies · Undergraduate medical education · Question writing

Undergraduate medical training teaches medical students core competencies needed to become a physician. Teaching is an important skill for physicians and a required component of graduate medical training. Although medical schools are charged with preparing students for the practice of medicine, there is limited evidence that students graduate medical school with knowledge or skills in teaching, learning theory, or curriculum development [1, 2].

Medical students are often utilized as teachers and undergraduate medical education accrediting bodies view students as essential contributors to medical education [1]. However, a recent review of medical student teaching programs suggests that medical students commonly engage in teaching without formal preparation. Although medical educators recognize the value of involving learners in developing curricula and empowering students to lead curricular change, the literature proposes a need for formal training in medical education pedagogy and a need to develop opportunities for authentic engagement with existing curriculum [1–3]. We developed an innovative elective where students learn educational theory and principles of curricular design and apply their knowledge by developing content for an educational platform that uses gamification to engage learners in our pre-clinical curriculum.

Course Design

The course was co-developed by a medical education educational psychologist and a clinical educator. We leveraged adult learning principles and students' interest in learning through multiple choice questions to teach a semester-long elective for second-, third-, and fourth-year medical students. The course provided an overview of adult learning processes, cognitive science concepts, curriculum design elements, and the development and use of instructional materials (Table 1).

Students applied their learning and gained practical experience by writing at least two one-best answer immunology questions with robust answer explanations. Students drafted questions, developed clinical vignettes, provided peer feedback, and incorporated feedback into their own question development. We focused on principles of effective teaching through questions applicable to any topic and focused on M1 immunology due to faculty interest to develop questions for Kaizen, a gamification-infused online educational learning platform used in the M1 immunology course [4]. Feeding the educational output from our class into the curriculum allowed our learners to receive direct feedback on question performance in an authentic educational setting.

We modeled effective teaching principles utilizing small group and self-directed learning, interactive didactics, and direct application of learning principles. We emphasized

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Table 1 Course topics and learning objectives

Session	Objectives
Adult learning	• Discuss adult learning principles • Summarize foundational learning theories • Develop personal learning framework
Cognitive science	• Explain the metacognitive learning cycle • Reflect on active learning experiences • Describe testing effect, spacing and interleaving
Curricular development	• Explain curriculum design principles • Describe the domains of learning • Generate effective learning objectives
Learning-goals-driven design	• Reflect on advanced organizers used for learning • Summarize effective learning tools • Demonstrate alignment of graphic organizers to learning goals
Question development	• Demonstrate effective question writing principles • Apply question writing strategies • Assimilate feedback on question drafts
Feedback and writing workshop	• Summarize feedback components • Model feedback-driven metacognition principles • Provide effective feedback
Wrap-up	• Present final questions with explanation • Articulate learning principles for future application

students' active participation inside and outside of the classroom with faculty serving primarily as facilitators, consultants, and discussion leaders. In this way, we cultivated a community of learning and the co-creation of knowledge and teaching.

The first half of the course focused on developing a learning framework and scaffolding knowledge. Students engaged with foundational learning theory and learning science materials outside of class, and class-time was used to discuss and develop ideas. Educational strategies spanned short didactic teaching, co-developed knowledge, self-directed learning, and small group discussion. We overtly discussed the pedagogical approaches and learning modalities utilized in the course by purposefully pointing out or asking students to identify how our teaching reflected the principles covered.

The second half of the course was applied learning. To reinforce curriculum design principles, students created learning objectives for two immunology lectures before writing questions. During class, we compared student results to the faculty developed objectives. The activity offered a nice example of formative feedback to students, interim feedback to course directors on student learning, and was an example of building a community of learning. The course culminated with students presenting their questions and answer explanations to the course directors and an immunology content expert. Each question-and-answer set included an explanation of the correct answer which highlighted the teaching point, explanatory detail for each incorrect answer option, and additional text and images explaining core concepts. After feedback and revision students submitted final drafts.

With students' permission, questions were added to the immunology question database, and students receive longitudinal, post-course feedback on how their questions performed with first-year students.

The course was offered as a co-enrolled elective during the fall 2022 and spring 2023 semesters. Four students enrolled each semester. Our experience is limited by this small size, driven by school policy restricting enrollment in co-enrolled courses to only a subset of students. Co-enrolled courses are not required and occur concurrently with required coursework, thus selecting for students with high level of interest in gaining the skills and competencies taught. We believe our learning environment was enhanced by the intimacy and motivated individuals this selected for. Small sample size notwithstanding, course evaluations indicate students have a high level of interest in the theory and practice of learning and teaching. We learned that while students liked developing questions and answer explanations, they were drawn to educational theory and rated this component highly. This emphasizes the need to address gaps in medical students' development as educators and encourages us to incorporate educational theory and skill development within student teaching opportunities.

Declarations

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