Motivating And Engaging Lighting Students When Learning Remotely

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Abstract: To engage students remotely, industry-relevant material and authentic problem solving activities have been integrated into the lighting curriculum to inspire career goal setting, while EdTech has been used to chunk lectures and scaffold student learning.

1. Introduction and background

The recent sudden transition to online teaching due to the COVID-19 pandemic challenged educators to motivate and engage students in virtual learning environments. While it is uncommon for universities to offer intensive courses (i.e., those longer than three hours per class session), at the University of Sydney, some compulsory master's courses consist of eight-hour classes. These start at 9:00 am and finish at 5:00 pm on weekends. Before the pandemic, all lectures were delivered in person and multiple strategies were used to engage students, such as hands-on activities, lab tours, experiment demonstrations, question and answer sessions, and casual conversations during breaks. However, when remote teaching was implemented, it was extremely challenging to motivate and engage students, especially during long lectures, using the traditional strategies. A variety of approaches, developed from existing pedagogical literature, were used to improve students' motivation and engagement when teaching remotely.

2. Course background

The course discussed here is *Lighting Technologies*, which is compulsory for students in the Illumination Design professional graduate program. Students come from a diverse range of academic backgrounds, including electrical engineering, architecture, and interior design, as well as varied cultural backgrounds – approximately half of the students are international, and half are Australian. The course typically enrolls 50-60 students. This course provides fundamental knowledge of lighting technologies for designers, by introducing different types of lamps, including incandescent, fluorescent, metal halide and lighting emitting diodes (LEDs). Students are expected to understand the physical processes leading to the generation of light from electricity, select suitable lighting hardware, calculate energy consumption, etc. The relatively heavy physics and chemistry content sometimes intimidates or discourages students without science or engineering backgrounds.

3. Strategies

Causes of low student engagement were first analysed both from direct observations and the pedagogical literature. Two main causes were identified: a) a lack of goals and b) fatigue and cognitive overload during long remote lectures [1, 2]. Many remote students did not feel integrated into a learning community and lost sight of their goals in the virtual learning environment. Goal-setting theory contends that students will not perform well if they do not have a specific, challenging, but achievable, goal [3]. Inspiring students about their future career can motivate them, as they face considerable pressure when job-hunting. However, students usually have limited insights into the industry their career options. Providing students with industry insights and helping them set career goals can motivate them to take more responsibility for their learning, even in a relatively isolated environment.

Researchers have suggested ways of inciting proactive career planning and development, including developing skills connected with a specific career and building career networks [3]. A well-established approach to developing practical skills is problem-based experiential learning. The teaching material and assessments were situated within real-world contexts. When describing the principles and concepts underlying physical phenomena, real-world problems were always first introduced to engage students. Since many students were planning to pursue careers as lighting designers and illuminating engineers, they must understand the physical properties of different lighting products and evaluate their attributes. In recent years, when teaching face-to-face, students adjusted LED current and measured both temperature and light intensity in the lab to understand how the luminous efficacy of LEDs

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decreases as temperature increases. When teaching transitioned online, students were shown some commercially available LED lamps with interesting thermal management designs to inspire their curiosity. Then, students discussed the advantages and disadvantages of the different designs. Subsequently, the physical causes of problems, as well as their solutions, were explained. Ways to distinguish products of different quality were discussed. Problem-based learning helps students apply theoretical knowledge to real-life applications, and fosters deep learning. Their working memory is transferred into long term memory through real problem-based practise [4].

Integrating industry-related activities into the curriculum is another approach to inspire students to set career goals and help them build their networks. When all teaching and learning activities were delivered online, students were deprived of opportunities to become involved in the local lighting industry. Therefore, online workshops were organized, with alumni as guest speakers, who shared their insights into the industry. Students discussed potential career paths with the supportive and enthusiastic speakers, and considered a variety of career options.

Because of cognitive load limitations, it is challenging to engage students during long remote lectures. Students' attention in lectures declines after 10 to 15 minutes [5-7]. Fortunately, researchers have demonstrated that, despite cognitive load limitations, organizing content into a sequence of chunks can significantly extend or stretch one's ability to receive, process, and remember information [8]. Chunking and scaffolding techniques have been shown to improve learners' performance in online and blended education environments [9]. Therefore, long lectures were reconfigured into smaller 'chunks' of 20–30 minutes, connected by small in-class activities or/and multimedia-based material, such as animation and videos, since multimedia materials increase learners' cognitive capacity by using both verbal and visual channels [2].

Scaffolding techniques require educators to ask questions and provide immediate feedback to scaffold the learner's understanding of the desired concepts [9]. However, in the virtual environment, students are less inclined to answer questions. Therefore, in-class interactive activities were developed utilizing EdTech, such as Menti, Padlet and Socrative. Students were able to answer questions anonymously and see their peers' responses at the same time. For example, Socrative provides instant statistics, which allow both educators and learners to see overall percentages of correct answers of the class. This enables the educators to adjust the teaching based on the outcomes. Additionally, students can gauge their performance relative to their peers, without pressure or fear of embarrassment since individual student responses are not shown.

4. Results

These teaching approaches and curriculum adjustments were rated positively in the end-of-semester student survey administered by the university. Although a decreased score was expected due to the sudden online transition, the overall survey result (4.27/5) for remote teaching was slightly higher than the result (4.19/5) for the prior year (face-to-face teaching). In response to questions designed to address students' opinion of remote learning, 72 % of students agreed or strongly agreed that they have felt supported to learn in the online environment, while 64% agreed or strongly agreed that they felt part of a learning community.

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