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From artificial intelligence to 3D fabrication: Exploring VTL technologies to facilitate students' knowledge depth and creativity in sustainable energy through model design

Project Number: 6000857

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Grant Type: TDG

Abstract:

Design in experimental courses enables cognitive innovation, where students exercise their creativity and apply the knowledge gained in a course to improve their device design capabilities including design efficiency, and has thus become a pedagogical priority. The rapidly rising evolution of artificial intelligence (AI) represented by Chatgpt is gradually affecting and changing the way of teaching. Although utilization of AI has potential drawbacks, the role of AI in enhancing learning is evident. This project aims to make a rational use of advanced tools, such as AI and 3D fabrication technologies, to design sustainable energy models and conduct related experiments, so that students can gain a more intuitive understanding of relevant knowledge, while exercising their creativity.

Energy shortage and energy consumption-associated climate effects are pressing issues globally, and thus sustainable energy is witnessing growing widespread attention and is regarded as a fundamental strategy to address the energy crisis in the future. Every converted energy is derived from an energy transduction facility. However, because energy conversion components in plants, such as generator, are enormous and mostly unsafe to access, and hence it is challenging for students to fabricate and operate the real facility. To understand why and how energy is converted it is necessary to design, fabricate and operate such facilities by the students themselves based on the knowledge learnt. Therefore, in this project, we will select 10 representative sustainable energy transduction techniques and provide the tools of AI, CAD software, model design and 3D fabrication, and the guidance in a newly developed course, MNE2114 Experimental Sustainable Engineering Techniques.

Based on the scientific theories and working principles, students will be able to learn the concepts, collect information, prepare design drawings, and fabricate energy conversion models by themselves and utilize their models to record and assess input and output energies to calculate the conversion efficiency. Chatgpt and auxiliary drawing software, such as Midjourney and Stable Diffusion, will assist the students in generating design drafts. Firstly, students search for knowledge through Chatgpt, and integrate the knowledge generated by converting the text using AI drawing tools, Midjourney or Stable Diffusion, to generate sketch images. While students' thinking is usually immature, they will need to continuously debug their description of the model based on the generated sketch images until they are satisfied with the model. Then, based on this sketch model, they will use a CAD tool to prepare the

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drawing, and finally use a 3D printer to fabricated the model. In this pursuit, students will be encouraged to design and develop novel devices of high merits and submit related papers and/or file patents. To enhance students critical thinking, analytical, and communication skills, students will prepare reports and give presentations. To assess the knowledge depth and creativity of students, students will be asked to complete feedback questionnaires.