ABSTRACT

To safeguard the environment and satisfy the energy needs of the present, without compromising the ability of future generations to do the same, sustainable energy development is urgently needed. This complex task is riddled with social, political, scientific, technical, and environmental challenges. Education is essential if we are to meet the energy demands of the world in the most sustainable manner available to us. Langara College offers a first-year engineering course that is meant to introduce students to engineering design and case studies, in addition to providing a brief glance on the history, ethics, and the different disciplines of engineering (APSC 1010-Engineering and Technology in Society). Using a project-based learning approach that promotes teamwork and research, this course uses a variety of instructional methods including lectures, class discussions, and guest appearances by experts in their fields. Introductions to technical concepts, such as soldering, 3D printing, and microcontrollers, are also addressed in this course. This poster demonstrates how this, or similar courses, are optimized to raise awareness of the sustainability issues this planet is facing. Learning outcomes are evaluated using an anonymous student survey which demonstrates how the students’ project-management and presentation skills have improved.

PROJECT MANAGEMENT

Project management is one of the main core competencies in all disciplines of engineering. Therefore, project management education must be integrated into the engineering curriculum to complement the students’ technical training. In this course, we touch on the basics of project management principles, consider the challenges involved, and introduce the tools that can be used to facilitate the different objectives of the project. Subtopics discussed in this section include: project life-cycle (initiation, planning, execution, and closure), leadership and communication skills, risk management, managing cost/scope/quality/time, and basic project-management tools (work-breakdown structure, Gantt chart, project initiation sheet, and risk-assessment matrix).

Case studies and activities done during class are designed to encourage students to manage the different phases of the project life-cycle and use basic project-management tools. Students are encouraged to apply these techniques to their group projects. Some of the tools introduced in the course are shown in Fig. 1:

RESEARCH

Hands-on research used as an essential element of project-based learning can increase students’ retention and motivation in engineering courses [2]. To increase students’ understanding and awareness of the subject matter, a research component has been added to the course. However, since most undergraduate students have no prior training on how to do research and how to find resources, a lecture component has been devoted to this topic. Some of the subtopics discussed in this section are: formulating the research objectives, quantitative vs. qualitative research, inductive vs. deductive reasoning, literature review, academic databases, peer review, modeling and simulation tools, independent vs. dependent variables, accuracy vs. precision, and data analysis.

SUSTAINABILITY

Incorporating sustainability into engineering education is a vital necessity. To raise awareness of undergraduate engineering students about sustainability concepts, we have incorporated this topic into our lecture syllabus. In this course, some of the issues the planet is facing are introduced using evidence- and factual-based data. Students are encouraged to think about and research solutions for these problems in their individual research and group projects. The main topics discussed in lecture include: definition of sustainability, population (carrying capacity, Malthusian catastrophe, and tragedy of the commons), ecosystems and extinctions (global warming, climate change, and mass extinction), energy (fossil fuels, nuclear energy, hydro, wind, and solar energy), water crisis and virtual water. Fig. 2 shows some of the factual statistics used in course content related to sustainability issues such as population, climate change, energy, and water crises.

GROUP PROJECTS

Cooperative project-based learning (CPBL) is an effective inductive technique to teach complicated open-ended engineering problems [4]. CPBL not only improves students’ technical and design knowledge, but also enhances many soft skills, including independence, accountability, interpersonal and teamwork skills, project management, problem-solving, and self-assessment. Fig. 3 is a flowchart for the group project phases used in APSC 1010.

At the end of the term, groups deliver a final presentation in which a demo of their final prototype is shown to the class. Fig. 4 shows some of the project results delivered in 2016-2017.

CONCLUSION

This poster demonstrates how a first-year engineering-design course is optimized to raise awareness of sustainability issues through project-based learning and research components. Learning outcomes are evaluated using an anonymous student survey. Based on the results of group projects, individual presentations, and a student survey, the following course objectives have been achieved:

- Improving students’ project management skills and teamwork;
- Improving students’ communication and public-presentation skills;
- Raising awareness of sustainability issues;
- Introducing different fields of engineering.

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REFERENCES