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Virtual STEM activity for renewable energy

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Abstract

A project about renewable energy was successfully carried out in Second Life **(S**L) by a team of Japanese students with a U.S. instructor who used English to communicate. This was a challenging task, especially since the students' first language is Japanese. To improve the learning environment, a teaching assistant was available to translate information from English to Japanese when necessary. This paper describes the successful STEM (science, technology, engineering, mathematics) activity in SL where the Japanese students designed and built a special airplane for wind energy. It also mentions other contributions of our work, such as the incorporation of an Engineering Design Process into the lesson and the advantages we found by carrying out the renewable energy project in a virtual reality environment.

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Keywords: STEM education; virtual class; Second Life; energy sources; engineering education

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1. Introduction

There is great concern about the decreasing supply of fossil fuels. These fuels are made from buried, dead organisms like prehistoric plants and animals. The organisms and their resulting fuels are generally millions of years old. Different types of fossil fuels form depending on the organic matter present, the amount of time it was buried, and the temperature and pressure conditions that existed during that time period. These fuels are non-renewable and include oil, coal, and natural gas.

Fossil fuel industries generally drill or mine to obtain these energy sources, which are burned to produce electricity. These fossil fuels are used to heat houses and provide energy for various types of transportation. What can be done to offset the decreasing supply of fossil fuels? From the viewpoint of STEM and engineering education, our present and future engineers must be prepared to address and answer questions like this. Engineers should know ways to conserve energy and to promote the use of renewable energy sources. Also they should inform the general public about this information. Engineering education is very important because we depend on engineers to detect and creatively solve the challenging problems of our ever changing world. Engineering is a component of STEM education, an interdisciplinary teaching approach where STEM refers to science, technology, engineering, and mathematics. [1, 2]

In this study (carried out in Second Life: SL), Japanese students use English to perform an activity for renewable energy that incorporates all of the STEM topics. They rely on science for information about energy sources (solar, wind, etc.). As for technology, the participants use computers and software to solve a problem in the virtual world. Engineering and mathematics are important for this project too. The solution to the proposed problem is an item that must be designed using mathematics and built with prims (primitives) in Second Life (SL). In addition, an Engineering Design Process is incorporated into the lesson.

2. Background information for the renewable energy project

This project took place in Second Life on an island owned by Nagaoka University of Technology (NUT) in Japan. Researchers at the university made virtual buildings containing virtual classrooms for e-learning activities. The authors have already carried out some projects there.[3, 4, 5] For example, they successfully used the virtual classrooms to teach lessons about nuclear safety and to hold multilingual discussions (for problem-based learning) with U.S., Korean, and Japanese students. Each student sat in a chair that had a specific pigment of coloration, which corresponded to his/her country. (The U.S. participants sat on green chairs.) The international students communicated with each other by speaking in their own language. The special chairs contained language translation software which allowed all of their conversations to be simultaneously available (as chat: text messages) in three languages (English, Korean, and Japanese).

The virtual classroom for our energy project contains red chairs, tables, a podium, and a whiteboard. These items allow the classroom to simulate a real life learning environment. A team of Japanese students was set up to carry out the renewable energy activity. This team included three, sixteen year old, female students at the National Institute of Technology, Suzuka College in Japan. To start, the girls registered and named an avatar to perform duties on behalf of them. They made their avatars move by using tasks such as walking and flying. The avatars were transported to different locations in SL by applying the teleport function.

The U.S. instructor met the students in a virtual classroom on the Japanese island. She presented a forty-five minute lesson about energy sources. The lecture and discussions were carried out in English using the chat function, which is similar to a text message. Since the students' first language is Japanese, a teaching assistant was available to provide translation tips when necessary.

A poster was used to provide general information about energy sources and to present the renewable energy problem. Fig. 2 shows students taking a close look at the poster.

3. The lesson

The instructor began the lesson by describing fossil fuels and emphasizing that these energy sources are decreasing. These fuels are non-renewable and include oil, coal, and natural gas. Fossil fuels are used for heating