International Comparison for Problem Based Learning in Metaverse

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Abstract

Problem Based Learning (PBL) is a powerful tool for Engineering Education. It can enhance creativity and has been used to successfully carry out many experiments in the real world. In order to survive and compete in the 21st Century, engineers must be prepared in engineering design and be able to creatively solve the new and challenging problems of our ever changing world. PBL is useful for creative engineering design courses in real classrooms. Would it be effective in a virtual world? Keep in mind that e-learning in a virtual space can make it possible for one to easily go beyond time and space. However, while using computer technology for instruction, certain problems relating to educational and technical issues may arise that need to be identified and addressed. In this study, two teams of students (one from Japan led by several Japanese researchers/educators and one from the United States led by a researcher/educator in the U.S.) separately pursued the same PBL project in virtual space. They were asked to solve the following problem. What will the ordinary (typical) house look like in the near future? The teams' progress and differences are presented and discussed in this paper. Their results will be used to determine the next step for global PBL in virtual space.

Introduction

Today's society, of advanced technology and information systems, is rapidly becoming a borderless one in regards to commercial activities. Therefore, the up and coming engineers need to be creative and active in order to compete in overseas markets. They must also be able to identify the needs and problems of our global community and to design ways for solving these problems and the challenges of our ever changing world.

Engineering design relates closely to problem solving and creativity. Problem Based Learning (PBL)(1),(2)is one of the powerful educational tools to enhance the capability of engineering design. It has been investigated and practiced at many Japanese higher education organizations during the past few years. Since PBL is very useful in real classrooms, would it also be effective in a virtual world? Internet technology has made such remarkable advances that individuals can now send rich content at a very high speed and communicate easily with other people by using visual interfaces. Also three dimensional virtual space services called Metaverse are becoming widespread throughout the world(3). A representative case for it is Second Life (SL), an online 3D-CG community, which started its service in 2003. Metaverse offers complementary activities between traditional face-to-face learning and e-learning. Also its cutting-edge technology can be utilized for experimental education. Japanese researchers, Drs. Fukumura and Kanematsu, decided to try a PBL project in Metaverse. They, along with their co-workers, have already set up virtual classrooms on the Japanese Island of Nagaoka University of Technology in SL. Here they are pursuing a PBL project for engineering design with their students from Japan (4). Drs. Fukumura and Kanematsu recently invited Dr. Barry and her group of students from the United States to join the project. Student teams from both Countries are independently carrying out the same PBL project. Even though this work is ongoing, some interesting results are presented and compared.

Virtual Classrooms

Fig.1. The virtual classroom buildings on the island of Nagaoka University of Technology.

The typical classroom usually has enough space for a group of students to meet and share ideas. It generally includes tables, chairs, blackboards, and various other items. The virtual classroom should be set up in a similar way. Fig.1 shows buildings containing virtual classrooms. They were made for this project and are on the island run by Nagaoka University of Technology (NUT). The two buildings, which are similar in structure, are separated by a short distance so that different group discussions for PBL could be ongoing simultaneously and independently. Each classroom includes two tables and seven red chairs per table. See Fig. 2. A sort of screen corresponding to blackboards in conventional classrooms might be required in the virtual classrooms. However for the purpose of this project, a screen is not necessary. In this PBL project, the group discussion and presentation are the main tasks. Therefore, another system was devised and introduced into the virtual classrooms to record chatting and strengthen communication.

Fig. 2.The U.S. team is having a lesson in the virtual classroom.

Fig.3 shows the auto-recording system for chatting in virtual classrooms. The object (shown as a blue box on the wall of the virtual classroom in Fig. 2) collects the chat dialogues. It was made by Linden Script Language for SL. The recorded dialogues are sent to a Web server through HTTP by using a Post Method. This data is stored there as a CSV-type file. Teachers and students can refer to the chatting records at any time, by using browsers such as Internet Explorer or FireFox, etc.

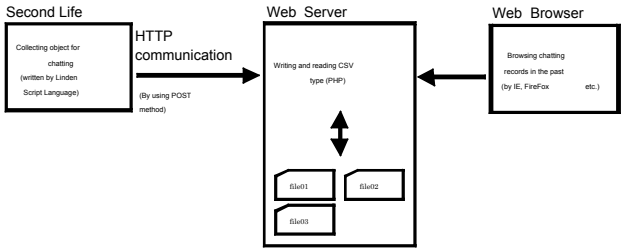

Fig.3 Auto -recording system in this project.

Since our virtual classes for PBL involve the designing of structures, NUT Island prepared a special place (Sandbox) for students to express their ideas and display their accomplished work. The Sandbox is available for the students to practice making virtual 3D structures called "prims" or for creating unique 3D objects. Eventually they will construct virtual buildings there.

PBL Class

PBL provides students with challenging, ill-structured problems that relate to their daily lives. The students receive guidance from their teachers and work cooperatively in a group to seek solutions to the problems. To start, a problem is presented to the group. The students have a brainstorming session about the topic. Then they collect resource materials and information to help solve the problem. Next they have another discussion to determine the best way (solution) for solving the problem. According to the concept of PBL, the current virtual classes were designed as shown in Fig.4. This figure also includes the procedure for a typical PBL project in real life.

(a) PBL class in real life

(b) PBL class in second life

Fig.4 PBL class plans in real life and second life.

To start the virtual project, the team of ten Japanese participants was divided into two groups of five members each. They included young male and female college students, who were either 20 or 21 years old. Several faculty members (referred to as teachers) were assigned to each group to provide guidance and serve as moderators during the discus-

sions. Then an ill-structured problem was clearly presented to the groups. Problems are always the key to successful PBL. In particular, this virtual project was a trial class to determine the applicability of Metaverse to engineering education from the viewpoints of both pedagogy and information technology. This class was composed of college students from different disciplines, so the selected problem did not require any detailed advanced knowledge in a certain subject area. In view of these facts a topic for creative education was selected, that relates to work previously carried out by two of the authors, Kanematsu and Barry(5). In their former educational project, they selected a space exploration problem and made it available to students of a wide age range. Their problem was the following question. "In the future, what will a greenhouse on the Moon look like?" Elementary school pupils as well as a high school PBL class for creative education successfully solved this problem in real life. Therefore, a similar topic was selected for our virtual PBL project. The problem is as follows. "What will the ordinary (typical) house look like in the near future?" This project requires the students to brainstorm about the function/purpose and structure for the ordinary house of the future through a virtual discussion. It also requires the students to build virtual 3D structures. In addition, the students and their teachers must complete two questionnaires (an interim and a final questionnaire).

Activities for PBL in SL

During the first session, the Japanese students were divided into two groups as previously described. Then the problem (What will the ordinary/typical house look like in the near future?) was presented to them. Before dealing with this problem, the students had practice discussions in SL to help them better exchange ideas by chatting in a virtual world. Their practice problem was the following question. "What is the difference between the similar words, 'Group' and 'Team'?" In Japanese, these two words have been used almost as synonyms. Therefore this question served as a good example for PBL. Most of the students were excited by this discussion.

During the first session, the U.S. students and their teacher traveled to the Japanese Island of Nagaoka University of Technology in SL and walked to the Japanese classroom. Once the students were seated, the problem was presented to them by the teacher. (It should be noted that both the Japanese and U.S. teams used the same classrooms and the same area of land to carry out the PBL project in Metaverse.) The U.S. team included three high school boys, who were either 16 or 17 years old. They did not have practice discussion sessions in SL, but instead immediately began to brainstorm for possible solutions to the problem by using local chat. The students mentioned that a typical house of the future should be energy efficient and maybe have solar panels. They also briefly chatted about the possible structure of such a house.

During the second session, the Japanese students and their teachers were taken to several islands in SL, to learn about this virtual world. Before starting the tour, the participants were connected to each other by the 'friend' function, so that they could exchange conversations and invite each other from other 'distant' islands at any time. The schedule for the virtual tour and each purpose for visiting the various islands are shown in Fig.5.

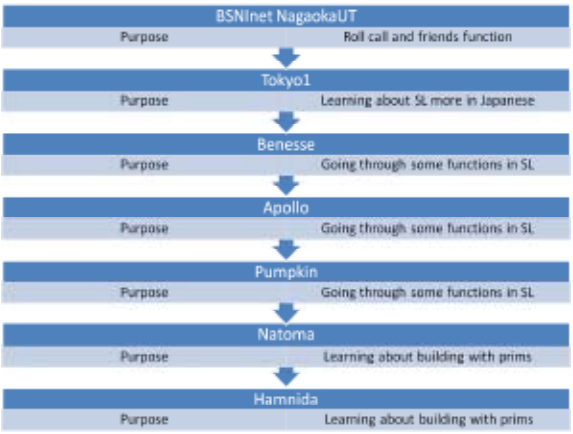

Fig.5 Visiting islands and the purposes for the virtual tour in SL

The U.S. students and their teacher met outside of the Japanese classroom for their second session. They had a short, simple lesson in making prims. Then the team agreed to individually visit Natoma and other islands in SL to learn about the virtual world and more about making and using prims.

Participants, from both Japan and the United States, practiced building different structures with prims during their third session. The work of the Japanese students can be seen in Fig. 6. Perfecting the building technique is very important because it is used by the teams to display their final solution to the problem in the form of a building. During this session, both teams were reminded to obtain additional resources needed to solve the problem.

Fig. 6.The Japanese team makes structures with prims.

During the fourth session, both teams began serious discussions about the problem. They considered various functions and structures for the typical house of the future. This step is still in progress.

Interim Questionnaire

The Interim Questionnaire includes six questions. All participants from both Countries and their teachers answered these questions after the first session in SL. This class served as the initial discussion stage of the PBL project. The six questions are provided.

#1: Are you interested in this PBL class of SL? 1. very much 2. rather 3. neutral 4. not so much 5. not at all
#2: How do you feel about this PBL class in comparison with a conventional face-to-face learning class? 1. very enjoyable 2. rather enjoyable 3. neutral 4. not so enjoyable 5. not enjoyable at all
#3: How do you feel about the communication in SL in comparison with that in real life? 1. very easy 2. rather easy 3. neutral 4. not so easy 5. very hard
#4: How do you feel about the communication in SL in comparison with chatting by instant messenger (IM)? 1. very easy 2. rather easy 3. neutral 4. not so easy 5. very hard
#5: How do you feel about the operability of Second Life? 1. very easy 2. rather easy 3. neutral 4. not so easy 5. very hard
#6: Mention your most problematic operation in Second Life.

Figure 7 compares the answers to question # 1 (Are you interested in the PBL class so far?) for both Countries. The results show that the students in the United States and in Japan are enjoying the PBL class.

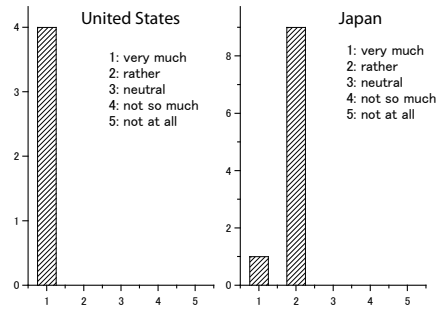

Fig. 7. Questionnaire result for #1: Are you interested in PBL class so far?

Figure 8 compares the answers to question # 5 (How do you feel about the operability of SL?) for both Countries. The results show that the students in the United States find the operability easy in SL, while those in Japan find it to be somewhat difficult.

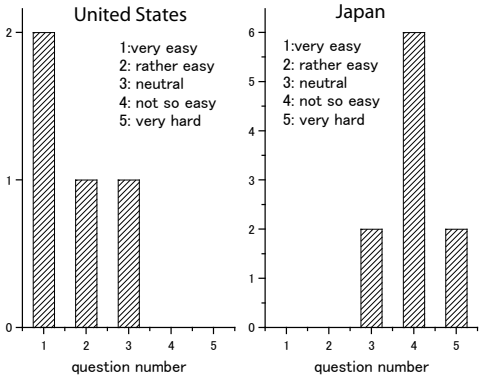

Fig.8 Questionnaire result for #5: How do you feel about the operability of SL?

In addition, the Japanese students' answers to questions #3 and #4 indicate that communication in SL is difficult for them. On the other hand, the U.S. students' answers to these same questions show that communication in SL is somewhat easy for them.

Keep in mind that the questionnaire was completed at the start of this PBL project. Therefore, the results are the students' initial reactions to it. Their answers may change when they complete the final questionnaire after the project is finished. I feel that the students in the U.S. found the operability easy in SL, because they only carried out simple operations at the start of the program. They walked their avatars, teleported them to several locations and had them communicate by using the local chat function. The students from the U.S. may believe that communicating in SL is somewhat easy, because the local chat function is a simple operation. An individual types his or her message and then clicks on the word "SAY." This function may be harder for the Japanese students because their language is more difficult than English.

The differences in the results for the two Countries may be attributed to their difference in culture and language, their interpretation of the survey questions, or to other variables. This PBL project is still in progress, so the authors feel that the participants will become more comfortable with the operations in SL as their experiences and time spent there increase.

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