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A Multilingual Problem-Based Learning Environment for Awareness Promotion

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Abstract: Traditionally, Problem Based Learning (PBL) has attracted attention as a method for training in engineering design skills. However, PBL is constrained in that students have to gather in one location, so cooperation between several institutions is difficult. Constructing a multilingual PBL environment in a virtual space on the Web (*Second Life*) is one solution to this problem. In this paper, a summary is provided of one such multilingual PBL that has been constructed.

Keywords: Less than 6 words**.**

I. INTRODUCTION

Traditionally, Problem Based Learning (PBL) has attracted attention as a method for training in engineering design skills. PBL is a learning process by which learners communicate with each other about a certain issue and discuss methods of solution. It is often employed in fields such as medicine and engineering where importance is placed on solving technical problems on site. However, when carrying out PBL, the learners need to gather in one location and work together, making cooperation between widely scattered institutions difficult. Furthermore, due to the globalization of recent years, the nationalities of students are becoming diverse and the language barrier this causes is also a problem.

Use of a virtual space connected to via a network and equipped with multilingual functionality is one answer to this problem. By using it, students are not restricted by location and, as well as being able to communicate synchronously and remotely with other users, it is possible to promote constructive PBL amongst students of diverse nationalities. Also, by providing materials that exploit the characteristic features of the virtual space, the effectiveness of learning can be further enhanced. There are many reported cases, such, for example, as teaching materials which enable visualisation of a miniaturised world, or learning through Virtual Reality (VR) (XXX[1]); medical teaching materials using 3D computer graphics (XXX[2]); or, by adding simulation functionality in addition to these, a system which can provide insight into the variations in the various parameters and the relationships between phenomena. Using a virtual space can provide learners with experiences not possible in traditional e-learning or face-to-face lessons, making it possible to promote new discoveries by the learners.

For this paper, we investigated the requirements for multilingual PBL in a virtual space and implemented them.

II. DEVELOPPING MULTILINGUAL PBL SUPPORT SYSTEM

An overview of the multilingual PBL support environment and a configuration diagram of the multilingual PB L support system constructed are shown in Figures 1. In this paper, *Second Life* (*SL*) [4] was used as the virtual space. *SL* is a virtual space operated by the US company, Linden Lab. As well as being able to freely construct environments such as classrooms within the region possessed, by using the dedicated language, Linden Script (LSL), functionality such as HTTP communication with an external server can be implemented. The multilingual PBL support system used mainly this mechanism to implement various features. PHP+PostgreSQL and Ajax were used for system development. The multilingual PBL support system is composed of a client that the students operate and a university server that is able to connect to Lang, the Language Grid(LanG)[5] server that is required for the multilingual functionality provided within *SL*. Also, the SOAP protocol was used to communicate between the university server and the LanG server. In the section below, the multilingual communication functionality,

Figure 1 System View of Second Life

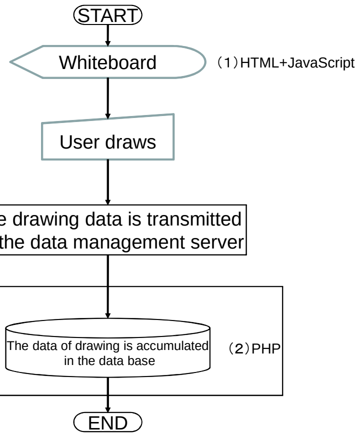

Figure 2. Flowchart of writing on whiteboard

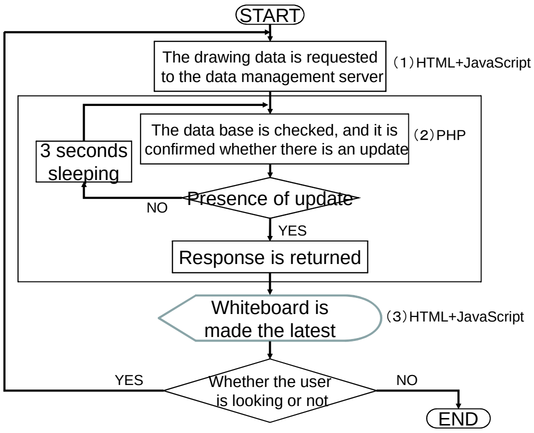

Figure 3. Flowchart for whiteboard update

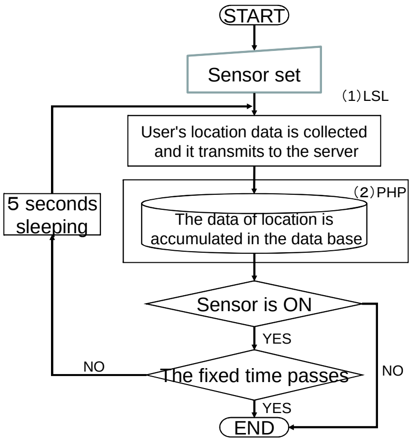

Figure 4. Process for gathering recorded learner behaviour

whiteboard system and learner monitoring functionality are explained.

1. Improving Multilingual Communication Function

The most difficult point in multilingual communication is the language used when communicating. Usually, in international conferences and the like, English is used as a common language to communicate; however this can be a high hurdle, particularly for students carrying out multilingual communication for the first time. Machine translation is provided within *SL* as a HUD [6]; however, as translation is supported only between Japanese and English, it cannot be used to interact with users whose mother tongue is a language besides these two. For this paper, the text-based multilingual communication functionality developed by Yoshino and Ikenobu [7] was used so that this language barrier did not inhibit lively discussion. This is achieved by connecting the chat feature implemented in *SL* with LanG. LanG is the service infrastructure enabling sharing of translation services and dictionaries over the internet. Currently, English, Japanese, Chinese, Korean, etc., are supported, but, by adding dictionaries, support of other languages is possible. For this paper, only Japanese, Chinese and Korean are used, but in the future, 11 languages will be provided in LanG starting with Malay, which is handled in the dictionary for engineering training at this university, and this will enable contributions to be made to engineering education.

2. Common White Board

Even with the multilingual communication functionality included, it is perfectly conceivable that students are not able to develop the discussion in the way they expected. In that kind of case, using diagrams to supplement text broadens the possibilities for students to communicate their ideas in greater depth. Consequently, a shared whiteboard was implemented, on which the students could freely write. As part of

Figure 5. Learner monitoring screen

understanding student behaviour, the shared whiteboard saves the drawing history, and a feature enabling browsing on an administrator Web page was implemented. Further, from this record of drawings, instructors should be able to comprehend more precisely such things as the content of the discussion and the students' levels of understanding. The processing flow of the shared whiteboard from drawing to recording is as shown in Figures 2 and 3.

Figure 2 shows the processing that occurs when a user writes something down on the whiteboard and the data written down is sent to the server and registered in the table that records the state of the whiteboard in the database. In addition, Figure 3 shows the processing when the whiteboard is checked for updates and updated to the latest state when someone has written something down. The whiteboard continues to function as long as the user displays it, but it is devised so as not to return a response until it has been updated, thus easing the communication load. Through these features, the students are able to share the same whiteboard, and are also able to keep the recorded drawings. This whiteboard is not only viewable from within SL, but also from a web browser.

3. Learner Monitoring Function

In PBL where the students are the main actors, when student evaluation is carried out, understanding the students' conversations and behaviour during the lesson is particularly important. Remarks by the students during the lesson are recorded, if able to be monitored, and the level of student contribution to the discussion can be understood. If information about the students' positions and directions in the metaverse can be recorded, it can be used to identify such things as the level of interest students have towards their studies, and which students did not take part in any discussion. Therefore, in order to achieve this, learner monitoring functionality was implemented that records and enables browsing of learners' behaviour.

After the user chat and behavioural records are collected using LSL within the metaverse, they are sent to the university server after passing through the *SL* server and are stored in the database. The flowchart for this functionality is shown in Figure 4.

Monitoring is not always ongoing: information gathering begins when the instructor turns on the sensor switch in the virtual space. If the switch is turned off or a set amount of time passes, there is a mechanism to halt information gathering.

It is possible to browse the gathered information on an administrator Web page. Figure 5 shows the administrator Web interface which enables browsing of the students' position information and the most recent conversations.

It is possible to browse the students' positional information and the most recent conversations at the time and date indicated by the upper timer. As well as being able to operate the timer manually using a button, it is also possible to advance it or move it backwards automatically. Also, the position information alone or the conversation information alone can be browsed. In addition, the whiteboard drawing history can also be displayed. This functionality is implemented in Ajax, and a request is sent to the server when the timer is operated, and information is acquired at the indicated time and date.

III. THE RELATION OF LEARNER MONITORING AND MULTILINGUAL PBL SUPPORT SYSTEM

Based on the above elements, it was possible to carry out PBL practice in the metaverse. Here we consider the relationship between the activities of learners that were acquired from the metaverse and the awareness triggered in the instructors.

The state of the individual learners in the metaverse classroom can be confirmed through 3 steps: confirmation of spatial participation status by checking the learner's avatar's position, confirmation of the status of the student's avatar's utterances, and confirmation of the content of the student's avatar's utterances. This confirmation is also carried out in the real world, but in the real world it is not possible to confirm down to the detailed content of the utterances. On the teacher's side, by using the learners, it is possible to provide guidance to stimulate utterances from learners' avatars that have been unable to contribute to group chat.

Next, the content of the group debate within the metaverse classroom can be confirmed, right down to the quality of conversation, by carrying out a bibliometric analysis of the chat between students in real time (Nakahira et. al., [8]).

Furthermore, in a PBL among people who are multilingual, i.e., possess diverse values, remarks about a given problem can also be expected to differ from those in a discussion involving only people of identical backgrounds. As stated by Kido[9], to carry out intercultural collaboration, besides language issues it is necessary to understand the differences and similarities due to differences in ways of thinking and values. Conversely, through learners' experiencing differences in values and ways of thinking, it is possible to obtain an extraordinary chance, even if it is just in the metaverse. It is conceivable that intellectual stimulation coming from the extraordinary will be a trigger to open new perspectives not only for the learners but also for the instructors.

However, from the educational point of view, there are limits to the intercultural collaboration possible with simple conversations alone. In particular, thinking about the elements of intercultural collaboration incorporated into the training of engineers, what is required is not only an understanding of the other party's culture, but also an understanding of the differences between one's own and the other party's way of thinking and values, and to develop the communicative ability to overcome differences and cooperate to accomplish a project. In that sense, in setting the scene, just setting up simple conversations is not sufficient. As with PBL, it is important that students be given some kind of problem by which they can gain experience in the process of working together to solve problems.

IV. CONCLUSION

For this paper, a multilingual PBL learning environment was set up and implemented in the metaverse, and an environment was provided to make records of various learning activities. Chiefly, 1) a classroom was constructed to acquire records of learning activities in the metaverse, and 2) improvements in multilingual communication functionality, construction of a shared whiteboard, and a learner monitoring system were developed as a support system to carry out livelier multilingual PBL. In addition to providing the above environment, by enabling the PBL to take place in the metaverse, there was mutual understanding of differences in ways of thinking and values, and it was possible to foster communication ability to overcome differences and cooperate together to accomplish a project.

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