A Trial of Interactive Remote Teaching by Shared Virtual Spaces between Two Universities

Michiko Ohkura
Shibaura Institute of Technology
ohkura@sic.shibaura-it.ac.jp

Hiroyuki Sakurai
Rissho University
sakurai@ris.ac.jp

Tetsuro Aoto
Shibaura Institute of Technology
m706101@sic.shibaura-it.ac.jp

Abstract

An interactive remote teaching trial was performed by shared virtual space between two universities. Its features included the interactivity of teaching by faculty members of both universities, collaboration between information engineering and psychology, and the utilization of shared virtual space in education. This new and fruitful attempt received favorable evaluations from participating students.

1. Introduction

In 1999 the first author began both a lecture course and an exercise course on the design and development of information systems for third year students of the Department of Information Science and Engineering of the Shibaura Institute of Technology (SIT). These courses, which continue today, were designed based on *An Undergraduate and Professional Curriculum "J97" in Computer Science* [1] published by IPSJ. The special exercise course, which was intended to be practical from the beginning, has been revised by referencing curriculum guidelines by ACM/IEEE (ex. [2] [3]) [4].

In 2006, another exercise course entitled the "Design and Implementation of Virtual Space" also began at SIT [5]. Although various courses have attempted to utilize virtual reality such as [6] [7], teaching design and implementation of virtual space *en masse* is not so common.

On the other hand, the second author, who belongs to the Faculty of Psychology at Rissho University (RU), continues to research the "Psychology of Virtual Reality" aiming at power assist of kansei and/or intelligent activities. He has employed virtual reality for "Utilizing plan of research activities" of the "Rissho University Cyber Campus Network Project."

Since both universities have facilities for real-time transfer of images and sounds and for remote VR transfers, we performed the following interactive remote teaching trial by shared virtual spaces:

(1) The Faculty of Engineering students taking the exercise course entitled the "Design and Implementation of Virtual Space" showed and explained their own virtual space navigations.
(2) The Faculty of Psychology students listened to the explanations while viewing the virtual space stereoscopically and evaluated the virtual spaces by questionnaires.
(3) The above processes were repeated for other virtual spaces one by one.
(4) The questionnaire results were analyzed at RU and explained in remote-teaching lectures.

This is the report of the remote teaching trial.

2. Outline of exercise course

Before describing the remote teaching trial, the outline of the exercise course entitled the "Design and Implementation of Virtual Space" will be described.

This exercise is held in conjunction with other exercises by two another professors for juniors in fall semester. The students choose two out of three exercises for the first half and the latter half. The curriculum shown in Table 1, which is designed for two periods/week of half the semester, assumes that the students have taken exercise courses in programming and algorithms using C language.

Table 1. Curriculum outline

Class	Content
1	Explanation of VRML and exercises
2	Presentation of VRML products
3	Explanation of software to construct virtual spaces and deciding target spaces to generate for each group
4	Exercises to construct virtual spaces
5	Exercises to construct virtual spaces
6	Presentation of constructed virtual spaces

Virtual Reality Modeling Language (VRML) generates objects in virtual spaces. Since VRML description is text-based using tags, it is relatively easy to learn for students familiar with C language and html.

From the third class, students worked in groups and used VRML to generate objects and other software to construct virtual spaces. As software to construct virtual space, OmegaSpace of Solidray Co., Ltd. was employed.

At the 6th class, the students of each group introduced their constructed virtual spaces, which were displayed stereoscopically using a 100-inch screen and polarized glasses [8]. Moreover, students answered questionnaires to evaluate the exercise course, including the following question to get keywords used for later remote teaching: "Please list as many suitable adjectives and onomatopoeia as possible to evaluate the generated virtual spaces by yourselves or other students such as stiff or fuzzy."

Figures 1 and 2 show examples of virtual objects made by VRML and examples of virtual worlds constructed using OmegaSpace, respectively.

The following are the main features of this exercise course:

- Project-based learning
- Manufacturing
- Visualization

This exercise course was also introduced as an example of the OmegaSpace e-version, developed for educational usage [9].

3. Conducting remote teaching

The interactive remote teaching trial using shared virtual spaces was conducted on January 9th, in 2008.

3.1. Equipment

The following equipment was used at SIT:

(1) TV meeting system (Polycom)
- Communication rate: 1024kbps
- Image sources: PC and camera images
- Displays: 2 100-inch screens (one for PC images and another for camera images)

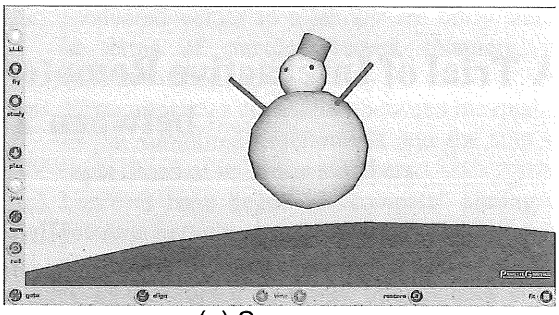
(2) Software to share virtual space: OmegaSpace to shared spaces for many people

The RU equipment was almost identical.

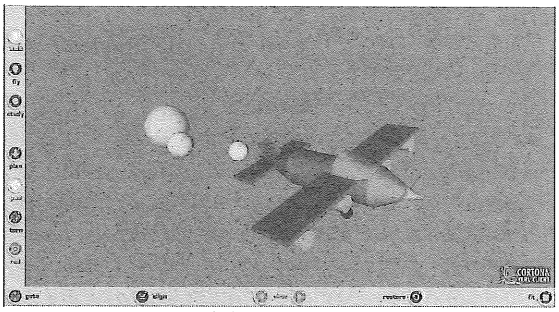
3.2. Content of remote teaching

(1) Introduction of virtual spaces and their evaluations

Beforehand, the files of the virtual spaces constructed by the SIT students were sent to RU and installed on a PC. During remote teaching, after the same virtual space file was simultaneously boosted on OmegaSpace in both universities, the students/

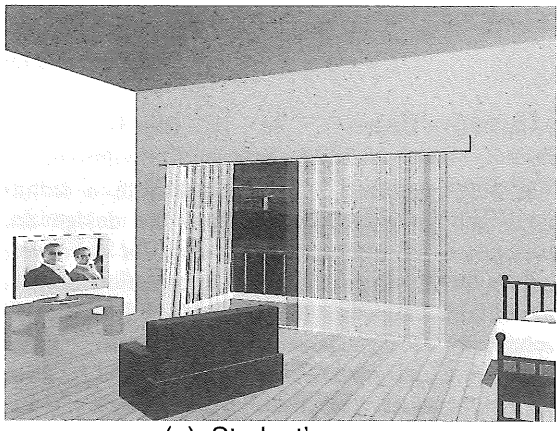


(a) Snowman

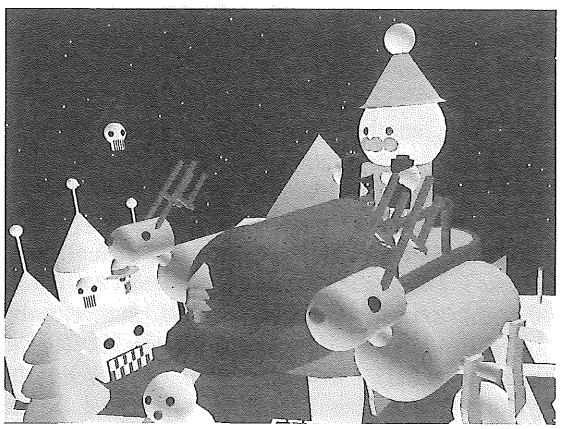


(b) Airplane

Figure 1. Examples of objects made by VRML



(a) Student's room



(b) Christmas in Toyland

Figure 2. Examples of virtual spaces constructed using OmegaSpace

creators of the virtual space operated a mouse and introduced the space. The mouse operations reflected the synchronized movements of the virtual space at RU: the realization of shared virtual space.

RU students with polarizing glasses watched the virtual space stereoscopically while listening to the introduction by the SIT students. After the introduction, they removed the polarizing glasses and answered questionnaires to evaluate the virtual space. Table 2 shows the employed evaluation items, which are based on an evaluation used by the second author to which he added the keywords selected and modified from the questionnaire results answered by SIT students beforehand. Each item was evaluated on a 7-point Likert scale, where 7 implies "very" and 1 implies "not at all."

The above introduction and evaluation process was repeated for seven different virtual spaces. Figure 3 shows remote teaching at an RU classroom, where students are watching a virtual space with polarizing glasses, and Figure 4 shows a SIT classroom when the RU students answered questionnaires. The right screen showed a virtual space and the left screen showed the RU camera image.

(2) Explanation of evaluation results

The questionnaire results were analyzed immediately by the second author. The analytical methods and results were explained during the remote teaching. First, the averaged scores were shown for each virtual space evaluated by five RU students. Then, all the results were shown, and the scores of items with relatively large differences between spaces were compared.

During lectures, the RU students explained their reasons of impression scores and the SIT students commented on them. Figure 5 shows all the results of the impression evaluations. Content (6) has relatively higher scores for items 20# (Cool) and 25# (Stylish), for example.

4. Discussion

By focusing on the information stream in interactive remote teaching this time, the information mainly traveled from SIT to RU by operating the virtual spaces in the first half of the lectures. On the other hand, in the later half, it mainly traveled from RU to SIT by explaining the data analysis. In general remote teaching, interactive questions and answers between a teacher and students at remote locations are common. However, the following features of our interactive remote teaching trial are not:

- Interactivity of main information stream to students of both universities
- Collaboration between information engineering and psychology
- Utilization of shared virtual space in education

Table 2. Items for impression evaluation

Number	Keyword	Number	Keyword
1	Immersive	20	Cool
2	Easily viewable	21	Simple
3	Interactive	22	Intimate
4	Familiar	23	Nostalgic
5	Useful	24	Stick
6	Enjoyable	25	Stylish
7	Intelligent	26	Cut-and-try
8	Free	27	Quick
9	Relieved	28	Comical
10	New	29	Smooth
11	Interesting	30	Laid-back
12	Unique	31	Magical
13	Motivational	32	Careful
14	Warm	33	Invigorating
15	Funny	34	Exciting
16	Avant-garde	35	Kawaii
17	Dynamic	36	Dreamy
18	Mechanistic	37	Extraordinary
19	Beautiful	38	Soothing
		39	Totally Preferable

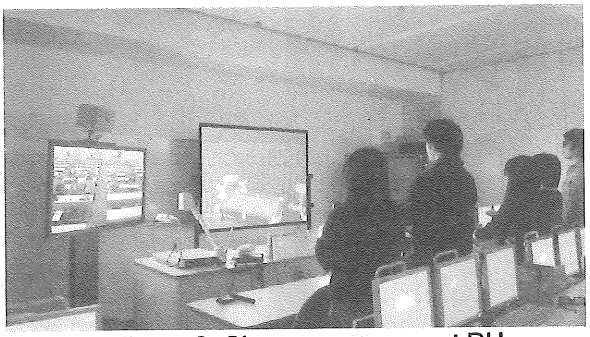


Figure 3. Classroom scene at RU

Figure 4. Classroom scene at SIT

Participating SIT students made the following comments:

- It was very interesting that the keywords I wrote were employed for impression evaluation and analysis.
- I was very happy that the sales points of our virtual space could be fully understood by students with different backgrounds.
- The analytical method lecture and the analysis results of the impression evaluations were very useful and interesting.

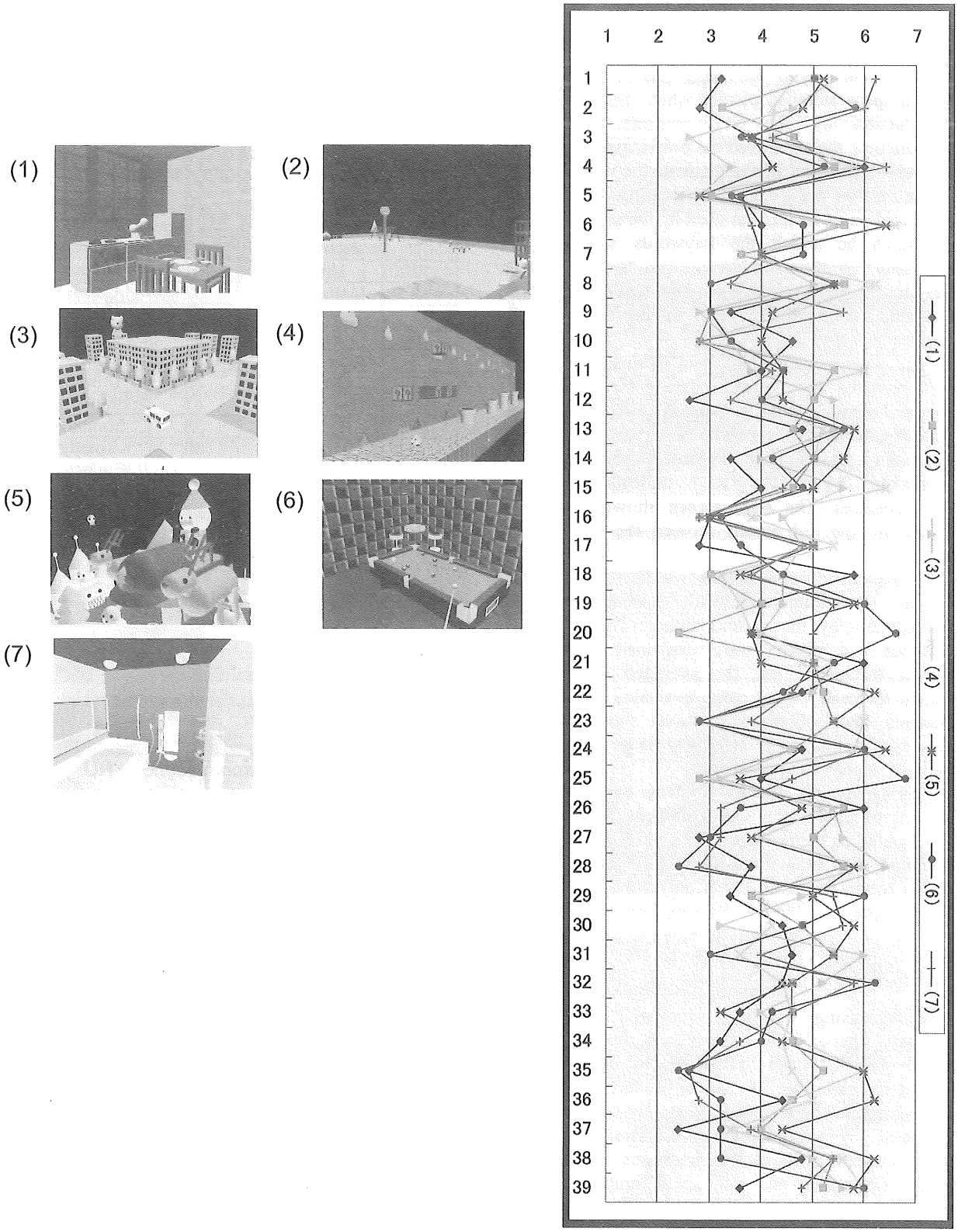


Figure 5. Impression evaluation results

Moreover, participating RU students made the following comments:

- It was very interesting that the evaluation of the same content was different between its creator and observers.
- I thought it was very meaningful that our impressions were sent immediately and that we could get the reactions of the creators at once.

Based on such comments from both universities, through this remote teaching using shared virtual spaces, we successfully gave students of both universities a chance to communicate with students of different fields and to increase their awareness of the value of collaboration.

5. Conclusion

An interactive remote teaching trial was performed with shared virtual spaces between the Shibaura Institute of Technology and Rissho University. Its features included the interactivity of teaching by the faculty members of both universities, collaboration between information engineering and psychology, and the utilization of shared virtual space in education. This attempt received favorable evaluations from the participating students, suggesting that this remote teaching using shared virtual space is useful to promote communication between the students of different research fields. In other words, it effectively utilized shared virtual space to offer an important opportunity to exchange views for impression evaluations with other students with different research fields.

In this trial, the number of evaluators at Rissho University was only five, which is too few for detailed analysis. Greater detailed analysis based on another trial with a sufficient number of evaluators remains future work.

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