BUILDING VIRTUAL LEARNING COMMUNITY WITH AUTHENTIC PROBLEM-BASED LEARNING ACTIVITIES
For Exploring Emerging Science and Technology

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Abstract: The authors have worked with developing and evaluating educational programs dealing with emerging scientific and technological. The programs promote collaborative learning activities that research and examine emerging science and technology through interfacing between middle and high school students with volunteers via websites. Upon abstracting empirical knowledge from the actual experiences of high school club activities and evaluating the effectiveness of the information system, the learners took the initiative in uploading what they had learned from their club activities to the websites, received necessary information from the explanations and queries of the waiting online volunteers, and were ultimately able to translate that into such activities as presentations on that basis.

1 INTRODUCTION

Existing science museums have been introducing the world of science and innovation to learners, educators, and general visitors, through many aggressive educational program practices (Hooper-Greenhill, 1999). But then again, trials of up-to-date science and technology topics are widely besought (Bell, 2004). Though professionals' works are very challenging and absorbing, high disciplinary and the lack of information inhibit people from understanding science and technology researches.

The aim of this study was to develop and evaluate educational programs about such emerging science and technology. The programs promote collaborative learning activities that research and examine emerging science and technology through interfacing between middle and high school students with volunteers via websites. In these programs high school students with a curiosity and interest in emerging science and technology and involved in related school club activities engaged in such activities as studying the latest trends though resource materials, produced ideas through research activities including theoretical and laboratory experimentation, and considered the significance of emerging science and technology and its various problems. The goal was a high level of authenticity in the learning experience derived from developmental and pragmatic sources of knowledge attained through the medium of an online collaborative learning environment. This study discusses more appropriate educational content and recommendations in teaching methodology. Such activities can be understood as an aspect of science communication (Stocklmayer et al., 2001).

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2 DEVELOPMENT OF WEB SITE FOR VIRTUAL LEARNING COMMUNITY

2.1 The Aims of this Study and Prior Research

In recent years, the need for developing social educational facilities such as science museums and school educational activities that proactively incorporate contributions from industry has been underscored (Ministry of Education, 2002). There are a great number of studies on ideal collaborative educational activities between science museums with schools, and the educational effectiveness of such (Fujitani et al., 2005). Some have underscored the existence and significance of science museum personnel tasked with interactive duties vis-à-vis visitors.

Existing science museums have been introducing the world of science and innovation to learners, educators, and general visitors. Educational program in the museum (Ambrose, 1993) is a popular way to offer learning resources for deeper understandings of learning resources at the museum. Especially for museums of science and technology, many aggressive practices are going on to make sense of exhibits more effective (Cité des Sciences et de l'industrie, On-line; The National Museum of Emerging Science and Innovatio, On-line). Trials of up-to-date science and technology topics are widely besought (Bell, 2004). But none have thus far either engaged in or studied the actual dialog or communication itself that museum personnel can provide, particularly in terms of teaching materials in concert with schools.

Communication in science museums has been mentioned, but what does that actually mean? Science museums play a major role in enriching the opportunities to come into contact with science. The present study has as its purpose an enrichment of awareness towards science and technology, and furthermore a facilitation of an understanding of core science. Not limited to museum exhibits, this is achieved with the cooperation of persons long involved in technological innovation and scientific fields—volunteers willing to explain various aspects of science and technology to students—and the participation of students in that specialized community.

What is intended is not simply the imparting of some set of knowledge or technical skills, but an all-around participation, assessment, and understanding of science and technology through the two approaches of narrative and exposition—including peripheral knowledge, ordinary experiences and solutions, along with culture—to provide an alternative viewpoint towards science. The psychologist S. Bruner has called this "narrative knowing."(Bruner, 1986) Narrative has an impact on our paradigmatic knowing of others, and with such a paradigm in the background it is easy to construct reality and understand others (Harlow and Johnson, 1998). Explanations in a scientific format have a complementary function, and the role that narrative plays in scientific awareness and understanding should be noted (Bruner, 1986; Roberts, 1997).

In particular, the present study concerns learning activities using a collaborative learning environment deployed through a network to high school students. The digitized learning activities employing information devices and a network environment were designed to teach problem solving methods by: (1) pursuing authentic questions holding the real world as the knowledge source, not limited to the school in which the knowledge sources are teachers and textbooks; (2) engaging in activities that transcend such barriers as school and age; (3) pooling knowledge through collaborative activities not subject to the restrictions of time and place; and (4) handling issues that do not easily lend themselves to formulation (Akahori, 2002).

2.2 Design of Educational Program and a Website

From this viewpoint on the subject of science education, we conduct a project that sets a final target on developing a new way of management of the educational program in science museum for stimulating learning activities (Figure 1).

We administer a website (Musedu.jp) for the program. Using the web, science museum volunteers provide learning resources related to current topics on science and technology, and learners comprehend current situation and find their interesting topics to look into by further online collaborations with volunteers as experts.

"Science Topics" and "Topics from Newspaper" deliver topics of choice by each volunteer. Each volunteer takes advantage of their knowledge and interests about up-to-date discussing events and findings on their chosen field and writes down an article with photos. These supplementary readers enable support learners to approach read source materials. "Discussion Area" supports activities such as further discussion and continuing study for learners and volunteers. Some learners should associate their experiences with another learning activities or classroom studies. Learners explore discussion bulletin boards and additional information web pages for expansive studies.

2.3 Constructing Human Networks

Figure 1: Musedu.jp: virtual learning community website.It consists of three parts: “Science Topics” for introduction and commentary of new technology trends; “Bulletin Board” for a place of on-line intensive studies building scientific knowledge together; “Space for Presentation” for making simple website.

This study mainly concerns improving the understanding of emerging science and technology through science museums. First, a group of volunteers was formed to interface with students. We held lectures and discussions to exchange opinions for the sake of those technical specialists with limited pedagogical experience. The science museum volunteers from specialized emerging technological and scientific fields formed the community that interfaced with high school students as scientists and technicians.

3 EFFECTIVENESS ASSESSMENT

In order to engage in collaborative learning activities between learners and volunteers, to abstract empirical knowledge, and to evaluate the

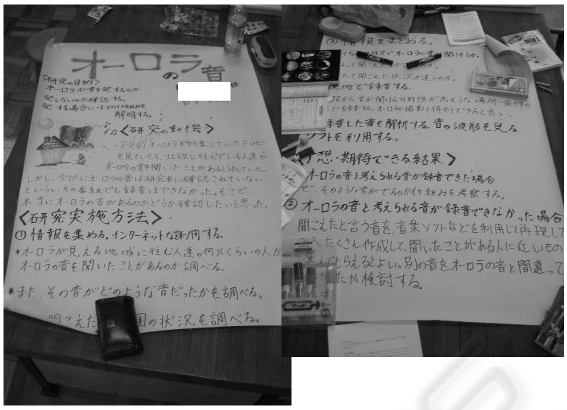

Figure 2: Poster Presentation of their Research for an event of National Institute of Polar Research.

effectiveness of the information system, an effectiveness assessment in which learners and volunteers engaged in coordinated studies and reviews was conducted. An example follows.

3.1 Outline of the Effectiveness Assessment

The pilot assessment is proceeded at a high school student, 11th graders, in Tokyo in December 2004.

Here shows our procedure about building learning activity content and assessment methods:

- National Institute of Polar Research in Japan proposes events and related activities for polar observation by middle and high school students.
- Volunteers provide comments, opinions, and information regarding the research activities of the students.
- Students organize their results using posters or other formats and written explanations, and participate in the presentation of the National Institute of Polar Research.
- After the learning program is concluded, students create and display a poster of their findings including the collected comments of the students, teachers, and volunteers (Figure 2).

3.2 BBS Messages from Participants

This project involved information exchanges beginning with “questions [the students] wanted answered.” Unique BBS messages were observed within the learning environment of this study. The discussion will proceed with quotations of a portion of the BBS messages below. The entire transcript is written only in Japanese, hence this is English translation.

(1) Clarifying the purpose of the questions, and corresponding responses from the students
Questions by the volunteers to clarify the purpose of questions originating from the students were then answered by the students with explanatory remarks. Dialog between the students and volunteers on open-ended questions was observed.

Volunteer Alex

>>(Student's quote) Although I have seen a website that **auroras make sound on the air along with the movement of auroras, but I don't think that**.

Well, actually I don't think so either when I have read your comment, "auroras make sound on the air along with the movement of auroras." I wonder we have reached a same reason for that. **Could you tell me your reason why the sound does not hear?**

Student Betty

Sorry for late. Even auroras might make sounds, **I think the sound takes a long time to arrive to the ground than the lighting** of the auroras to come. ;(That's why the sound from auroras along with the sound is impossible.

(2) Provision of information related to the questions by the volunteers, and responses from the students
The volunteers not only answered questions on content as yet not covered in school classes concerning matters that arose along with the questions (or treating answers to those questions as a given), they also provided additional related information. For matters that were "basically not fully understood," the students did not immediately understand fully or else misunderstood—this also appearing in the BBS messages. Such BBS messages are only natural given that the students were collecting scientific knowledge in fields for which they lacked a full conceptual understanding. Knowledge impartation and information exchanges that did not aim at a full and immediate comprehension were observed. Such deficiencies could be subsequently corrected.

Volunteer Alex

Here I will try to explain characteristics of "Microwave."

Betty said observing microwave helps us understanding about auroras. Talking about the observation of microwave for understanding natural phenomena, **there are many proposition about the relationships between microwave and earthquake**. (snip) **Unlike audible sound, microwave can get through to a long distance without damping, and it speeds more than sound. Thus, the microwave may influence distant places**.

Student Betty

Hmm… It sounds difficult for me to deal with microwave… I will let our science teacher explain about the thing.
Even though, **I have easily understand microwave runs faster than sound!**

(3) Innovations arising from information supplied collaboratively among the volunteers
Situations were observed in which a volunteer would provide more detailed explanations regarding the information given by another volunteer in answering a question, with the volunteers discussing among themselves. There were no BBS messages from the students touching on this, but the students did notice the discussions among the volunteers. There is the possibility of further increasing the related information gained.

Volunteer Charlie

I've found! Finally!
http:// [A website with an introduction of aurora reflection propagation for amateur ham radio]

Volunteer Alex

I will **add some information** for that.

The auroras appear very high above the ground, right? When we make a big voice to the auroras, it indeed doesn't make echo among the auroras. But when we hit microwave, not voice, to the auroras, we may hear of the echo of that.

(4) Impressions and opinions from non-participant science museum volunteers
There were volunteers who voiced appraisals of the students activities following the interaction

between the students and volunteers. By receiving evaluations regarding their activities from persons outside the interactive process, there is the possibility that the students will engage in more proactive future activities.

3.3 Empirical Knowledge Based on the Effectiveness Assessment

In this program students were able to speak without trepidation to science museum volunteers they had never met before. Rather, the adults were the ones who were worried that they "would not be able to adequately transmit the information."

Beginning with the prepared questions based on what the learners had researched through club activities, information was exchanged using the limited tool of a web BBS. The explanations and counter questions of the volunteers waiting online provided them with needed information, which was ultimately employed in such activities as presentation making.

From interviews with the appraising teachers, however, it was noted that there were situations in which the learners lost sight of what they were doing due to such reasons as "inability to focus interest precisely," "inability to envision which were the necessary activities," and "childlike idealistic questions or attempts to gain the favor of the adults." The present report omits details, but in the previous section from the point of view of the learners "thinking from the stance of the information they wish to research anew based on their club activities," website activities were relatively weakened in spite of the information provided by the volunteers. It seemed that fostering ongoing motivation was a difficult matter, perhaps due to a weakness in the pursuit of a logical focus in the activities or in application to real-world society.

4 CONCLUSIONS

This report concerned a practical approach to the utilization of science museums with exhibits on emerging science and technology to raise the interest of high school students in scientific fields. Prior research was referred to, and a report made on a practical application using a research system.

At present, the design of the abovementioned website is being renewed. It will be similar to that of the SNS (social network site) format recently increasing in use among young people. This innovation will enable learners to more readily engage in information-based learning activities.

In the future, the authors wish to study educational efficiency in actual classroom application through questionnaires, interviews, and observations from the point of view of "motivation to study science and self-starting study," "the scientific way of thinking, and a scientific outlook," and "becoming informed about leading edge science and technology" through ongoing and wide-ranging application.

Furthermore, by referencing multiple cases, in the future in will be necessary, to gain further in-depth experience with learner activity situations and thoroughly grasp ideal issues for discussions at a level of possible participation.

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REFERENCES

Akahori, K., 2002. Supports for digitization of education in Japan. In *Information Education (in Japanese)*, University of the air. Chiba, Japan. 106-107.

Ambrose, T., 1993. *Managing New Museums*, The Stationery Office Books. Norwich, U.K. (Satoshi Ohori & Eiji Mizushima, Trans. in Japanese: Tokyo Japan: Tokyodo Book Publishing, 1997)

Bell, L., 2004. Collaboration and the Public Understanding of Current Research. In *Creating Connection*, AltaMira Press. Lanham, MD. USA.

Bruner, J. S., 1986. *Actual Minds, Possible Worlds*, Harvard University Press. Cambridge, MA. USA.

Cité des Sciences et de l'industrie, On-line. *Education (in French)*, Available: http://www.cite-sciences.fr/francais/ala_cite/act_educ/global_fs.htm

Fujitani, S., Iwazaki, K., Kishimoto, T., Okazaki M., Wasaki, H., 2005. Building Learning Community in a Science Museum for Exploring Emerging Science and Innovation: A Case Study. In *The Proceedings of ICMTL 2005: International Conference on Method and Technologies for Learning*, 600-601.

Harlow, S. D., Johnson, LaMont，1998. An Epistemology of Technology. In *Educational Technology Review*, AACE, Spring/Summer 1998.

Hooper-Greenhill, E., 1999. *The Educational Role of the Museum*, Routledge, Oxford, U.K., Second Edition.

Japanese Ministry of Education, Culture, Sports, Science and Technology, 2002. *Educational Survey of Japan*, Ministry of Finance. Tokyo, Japan.

Musedu.jp, On-line. Available: http://musedu.jp/

Roberts, L., 1997. *From Knowledge to Narrative*, Smithsonian Press. Washington, D.C. USA.

Stocklmayer, Susan M., Gore, Michael M., Bryant, Christopher R., 2001. *Science Communication in Theory and Practice*. Kluwer Academic Publishers, Norwell, MA. USA.

The National Museum of Emerging Science and Innovation, On-line. Available: http://www.miraikan.jst.go.jp/