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Analysis of Ubiquitous Learning Logs in the Context of Science Communications in a Museum

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Abstract: This paper describes how to use a ubiquitous learning log system called SCROLL (System for Capturing and Reusing Of Learning Log) in a museum, especially, in order to support science communicators (SC). Ubiquitous Learning Log (ULL) is defined as a digital record of what you have learned in the daily life using ubiquitous technologies. It allows you to log your learning experiences with photos, audios, videos, location, QR-code, RFID tag, and sensor data, and to share and to reuse ULL with others. Using SCROLL, you can receive personalized quizzes and answers for your questions. This paper describes how to support science communicators in a science museum by using SCROLL, and shows the role of ULL to integrate the quantitative and qualitative analysis.

Keywords: ubiquitous learning log, life log, science museum, science communicator.

1. Introduction

CSUL (Computer Supported Ubiquitous Learning), or context-aware ubiquitous learning (u-Learning) is defined as a technology enhanced learning environment supported by ubiquitous computing technologies such as mobile devices, RFID tags, and wireless sensor networks (Ogata et al, 2004a). CSUL takes place in variety of learning spaces, e.g., classroom, home and museum. Also it provides the right information using the contextual data like location, surrounding objects and temperature.

One of the application domains of CSUL is language learning. For example, TANGO (Ogata et al, 2004b) supports learning vocabularies. The idea of this system is to stick RFID tags to real objects instead of sticky labels, annotate them (e.g., questions and answers), and to share them among others. JAPELAS (Ogata et al, 2004b) aims to support foreigners to learn Japanese polite expressions according to surrounded persons and the place. JAMIOLAS (Ogata et al, 2006) supports learning mimetic words and onomatopoeia using wireless sensor networks. Those researches support learning that happens at anytime and anyplace. However, the other issues emerge how to capture ubiquitous learning experiences and how to reuse them for future learning. Therefore, a ubiquitous learning log system called SCROLL (System for Capturing and Reminding Of Learning Log) (Ogata et al, 2011) has been developed.

Ubiquitous Learning Log (ULL) is defined as a digital record of what learners have learned in the daily life using ubiquitous technologies. It allows the learners to log their learning experiences with photos, audios, videos, location, QR-code, RFID tag, and sensor data, and to share and to reuse ULL with others. Using SCROLL, they can receive personalized quizzes and answers for their questions. Also, they can navigate and be aware of their past ULLs supported by augmented reality view. SCROLL has been used for overseas students learning Japanese, and for Japanese students learning English. Also, seamless learning was conducted using SCROLL in English as the second language course (Uosaki et al, 2012, 2013).

This paper describes how SCROLL can be used in a science museum, Miraikan in Tokyo. There are science communicators in Miraikan so that they can link scientists/engineers with the general

public. When a SC communicates with a visitors, just an explanation of the technology is not good. One of the important skills of SCs is to create mutual communication with visitors and motivate them to know more. However, they have to acquire this skill from the daily experiences because this skill is not shared among SCs. Also, this skill is not easily taken over because the employment term of SCs is 5 years (Bono et al, 2013). Therefore, SCROLL can be applied to capture SCs' skill, share and reuse them for educate SCs.

2. SCROLL: Ubiquitous Learning Log System

2.1 LORE model

Ubiquitous learning log (ULL) is defined as a record of what a learner has learned in the daily life using ubiquitous technologies. ULL is considered as a set of ULLOs. The learning can also be considered as the extraction of meaningful knowledge from past ULL that serves as a guide for future behavior. Figure 1 shows the learning processes in the perspective of the learner's activity model called LORE (Log-Organize-Recall-Evaluate).

(1) Log what the learner has learned: when the learner faces a problem in the daily life, s/he may learn some knowledge by him/herself, or ask others for a help in terms of questions. The system records what s/he learned during this process as a ULLO.
(2) Organize ULL: when the learner tries to add a ULLO, the system compares it with other ULLOs, categorizes it and shows the similar ULLOs if exist. By matching similar objects, the knowledge structure can be regulated and organized.
(3) Reuse ULL: the learner may forget what s/he has learned before. Rehearsal and practice in the same context or in different context in idle moments can help the learner to recall past ULLOs and to shift them from short-term memory to long-term one. Therefore, the system assigns some quizzes and reminds the learner of past ULLOs.
(4) Evaluate: it is important to recognize what and how the learner has learned by analyzing the past ULL, so that the learner can improve what and how to learn in his future. Therefore, the system refines and adapts the organization of the ULLOs based on the learners' evaluation and reflection.

All the above learning processes can be supported by SCROLL

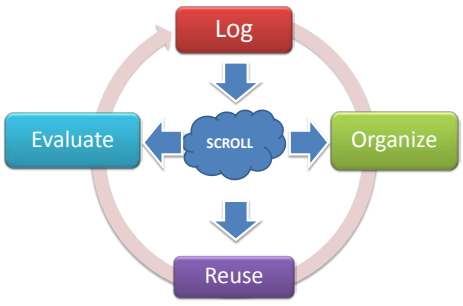

Figure 1: LORE model.

(1) Add ULLO (2) ULLO list (3) Quiz

Figure 2: SCROLL Interface of Android mobile phone.

2.2 System Interface

This section describes the Android user interface of each component.

(1) ULL recorder

This component facilitates an easy way for the learners to upload their ULLOs to the server whenever and wherever they learn. As shown in Figure 2(1), in order to add a ULLO, the learners can take its photo, ask questions about it and attach different kinds of meta-data with it, such as its meanings in different languages (English, Japanese and Chinese), comments, tags and location information. Also the learner can select whether the new ULLO can be shared or not. There are two ways to record ULLO. One is active mode, in which the learner actively take a photo using a smart phone. The other is passive mode using a wearable camera (Hou et al, 2012).

(2) ULL finder

The list of the learner's ULLO is shown in Figure 2(2), which helps him to recall all his past ULL. Besides, it allows him to be aware of the others' learning objects and to re-log them; it means that the learner can make a copy of them into his log. Therefore, the learner can obtain a lot of knowledge from the other learners even though he has not experienced that knowledge by himself. By sharing ULLOs with the other learners and re-logging the other learners' ULLOs, the acquisition of the knowledge is enhanced. As shown in figure 2(3), the system generates simple multiple-choice quizzes based on the meta-data of the stored ULLOs. For example, the idea of "quiz with image" is to ask the learner to choose a word to describe the image given by the system. The system immediately checks whether his answer is correct or not. These quizzes are generated according to his profile, location, time and the results of past quizzes and help the learners to recall what they have learned (Li et al, in press).
The quiz function is designed not only to help the learners to practice what they have learned, but also to recommend what the other learners have learned and to remind them to re-learn their past knowledge according to their current location and their preferred time. In order to achieve these targets, the learner can practice with the quizzes whenever they want. In addition, the client can send the learners' location information to the server all the time. Therefore, the sever side can automatically assign quizzes for the learner based on the location and time information. It notifies the learner to check the quiz by showing an alert message and vibrating the mobile phone. Whenever the learner moves around an area where he has experienced some objects, the system will send him quizzes regarding that objects. Furthermore, the learner can set a time schedule to receive the reminder quizzes.

(3) ULL Navigator
ULL navigator provides mobile augmented reality that allows the learner to navigate through the ULLOs (Mouri et al, 2013). Like Wikitude [www.wikitude.org] and Sekai-Camera [sekaicamera.com], it provides the learner with a live direct view of the physical real-world environment augmented by a real time contextual awareness of the surrounding objects. While a learner is moving with his mobile phone, the system sends an alert on the phone as soon as entering the region of ULLOs according to the GPS data. This view is augmented, associated with a visual compass, and overlapped by the nearest objects in the four cardinal directions (figure 3, left). Also, it provides the learners with a list of all surrounding objects. When the learner selects one or more of these objects, the Google map will be retrieved, and marked with the learner's current location and the selected objects. Moreover, the system shows a path (route) for the learner to reach to the objects locations (figure 3, right). This assists the learner to acquire new knowledge by discovering the existed ULLOs and to recall his ULLOs. In order to reduce the power consuming of the phone battery, the light-mode (blank screen) is developed. In this mode, the phone camera is turned off, and the system displays only information about the surrounding objects. Moreover, by touching the phone screen, a menu will be displayed; it provides the learners with additional facilities, such as displaying a list of all surrounding objects and photos capturing (Camera-mode).

Figure 3. SC's memo (left), SC and visitors (middle), SC inputting data into SCROLL (right).

3. A case study in Miraikan

3.1 Miraikan and Science Communicator

Miraikan is the National Museum of Emerging Science and Innovation in Tokyo, which is a new type of science museum that links people directly with the new wisdom of the 21st century. At the heart of Miraikan's activities is cutting-edge science and technology. This is state-of-the-art knowledge and innovation, which Miraikan aims to share with the whole of society as part of an enriched human culture.

The role of science communicators in Miraikan is to link scientists/engineers with the general public. They create mutual communication between science and society through activities such as providing demonstrations and explanations on the exhibition floors, planning or producing media, events and exhibits as they investigate the trends behind cutting-edge science and technology research. Miraikan also conducts training programs for external personnel working as science communicators, in order to promote interactive communication between citizens, and scientists and engineers. There are about 50 SCs in Miraikan, who have a variety of background such as engineer, news reporter, and medical staff.

When a SC communicates with a visitors, just an explanation of the technology is not good. One of the important skills of SCs is to create mutual communication with visitors and motivate them to know more. However, they acquire this skill from the daily experiences because there is no handbook for acquire this skill. Also, this skill is not easily taken over because the employment term of SCs is 5 years. Therefore, SCROLL can be applied to capture SCs' skill, share and reuse them for educate SCs.

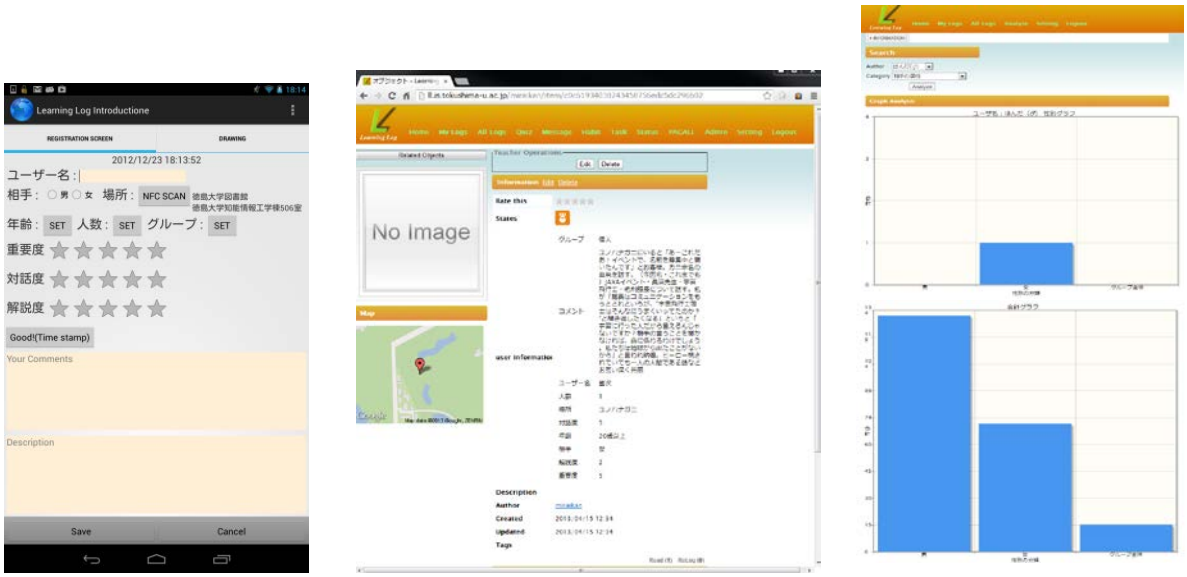

Figure 4. Android interface (left), Web interface (middle), analysis interface (right).

3.2 SCROLL interface

Figure 3 (left) shows SC's memo, which includes visitor's information such as date, place, gender, and the number of the group. Also it includes how to start the communication, and what was told with the visitors. These information is crucial to remind the context of the commutation. We apply these items for the data using mobile devices. In addition, the level of interactivity and the level of explanation are added. The higher the level of interactivity is, the better the interaction is. Using a mobile tablet or smartphone, SC inputs data as shown in figure 3 (right). SCs also can share the data as shown in figure 4 (middle) using SCROLL and analyze them as shown in figure 4 (right) by selecting an attribute of data such as the level of interactivity.

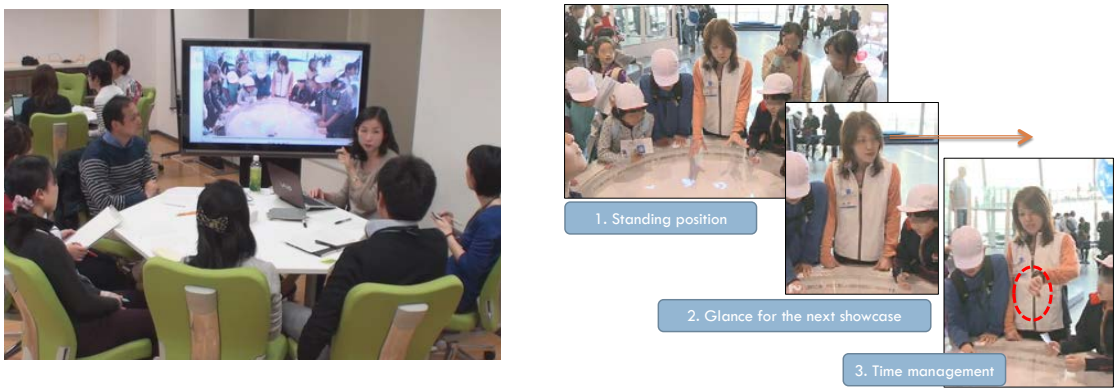

Figure 5. Reflection meeting (left) and results of interaction analysis.

3.3 Reflection meeting

The interactions between a SC and visitors are recorded into video. In reflection meeting, SCs discuss about the video with interaction analysts (IA) and engineers. Also the learning logs stored in SCROLL are referred in the reflection session at the same time. The IAs create the interaction scripts from the video in order to analyze the contents of the video, and find important interactions and gestures. For example, IA pointed out that the standing point of the SC, check the availability of the next showcase, and management of time of visitors are very important at the beginning of the interaction with visitors. Especially, the beginning of interaction are highly significant to attract visitors and to make them want to know more. Therefore, the reflection meeting is essential to integrate the results from quantitative analysis using SCROLL and the results of qualitative (micro and content) analysis.

4. Conclusion and Future Works

This paper describes a learning log system called SCROLL. This paper also proposes how to support science communicators in a science museum by using SCROLL, and shows the role of ULL to integrate the quantitative and qualitative analysis. In the future woks, we will conduct a long time evaluation in Miraikan in Tokyo and create a guideline for SCs.

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