The Value Improvement in Education Service by Grasping the Value Acceptance State with ICT Utilized Education Environment

Yoshiki Sakurai

NEC Learning, Ltd., Learning Scientist, Japan
sakurai.y.ab@m.titech.ac.jp

Abstract. Value co-creation in education service with an ICT utilized environment is argued. Service provider (teacher) does data collection and analysis on learning behavior of each service receiver (students), proposes the improved service content successively based on the result of analysis, and gradually improves his competency. This paper describes some methodologies of learning behavior data collection and analysis.

Keywords: service engineering, value co-creation, learning analytics, formative evaluation, xAPI, LRS.

1 Introduction

Recently, value co-creation has become an important issue in the service research field. Shimomura et al showed the basic definition of service, from the viewpoint of service engineering, as "the act in which a service provider causes the service receiver's desired change of state in exchange for consideration" [1]. We expand this definition to the ecosystem of service stakeholders considering service provider's change of state, and discuss service value co-creation in this paper. Many studies related to the change of a service receiver's state, in other words the perception of the service value, have been performed in the past. But there have been relatively few studies about changes to the service provider.

Simultaneousness is generally known as one of the typical characteristics of service. For example, a hotel employee will observe the state of guests and will make minute adjustment of his service on site in order to improve customer satisfaction, as well as increasing the service value. Consequently, the employee himself will achieve the change of his state through the reactions of the customers, acquiring the ability of better service provision. Improvement of his ability (competency) is the most important of all possible desirable changes of state for a service provider. In this paper, we consider the learning at the time of a service encounter as the most important factor which influences competency improvement. First, we make a premise that a service provider can learn at the time of a service encounter because of the simultaneousness of service. As can be easily imagined, we also think this on-site learning will be the most effective and efficient means of learning.

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Although once difficult, grasping the state of a service receiver can be achieved easily thanks to the recent developments in ICT. Therefore, a service provider can grasp the value acceptance state of the service receiver in real time, and can correct the service contents accurately by collection and analysis of this information in a service encounter. As a result, it's possible to cause a desirable change of state for both of the service provider and service receiver, including learning for the service provider. Picking up the education service, we will discuss the effect of the utilization of information systems for the collection and analysis of real time state of the service receiver in this paper.

2 Model for Value Co-creation in the Education Service within an Environment Utilizing ICT

Arai, Shimomura, and Murakami have proposed "S3FIRE1306" as a model of value co-creation in service. Based on this model, we propose the modification corresponding to the education service in Figure 1, adding the competency and information channel in the context of classroom lectures, which are the most general type of education service.

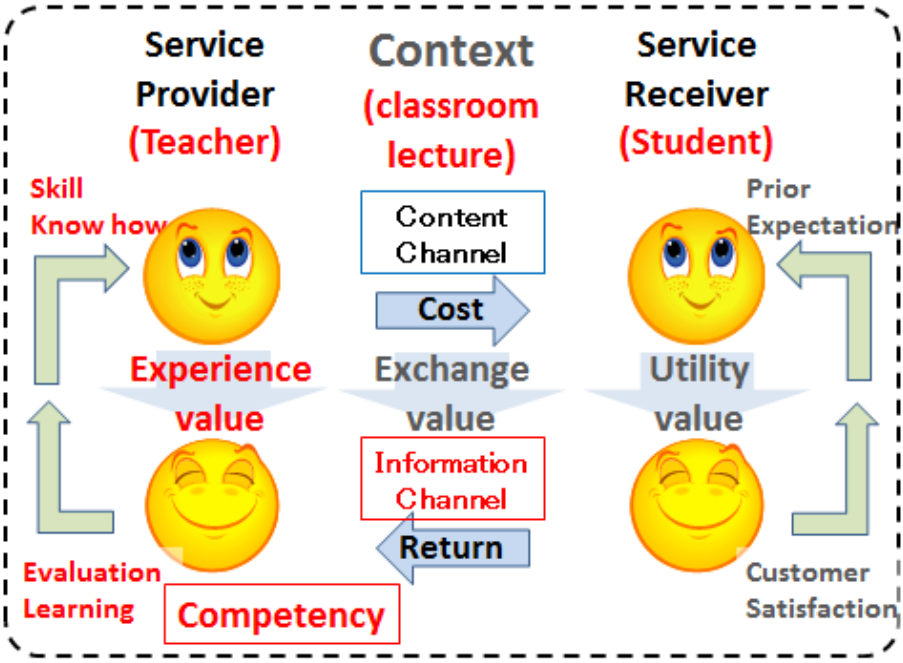

Fig. 1. Value co-creation model of the education service

A service provider (namely, a teacher) gives his service (namely, classroom lectures) to service receivers (namely students). A skilled teacher may manage the lecture contents which weren't incorporating into syllabus planning, according to the information about the state of students, such as whether students understood the contents sufficiently or not at this time, what concepts best held the attention of the students, etc. The teacher will accumulate experience and gradually improve his teaching skills, which are his competency. It's very important for teachers to change such know-how from tacit knowledge to explicit knowledge in order to share this information among many teachers. Such activities have long been carried out as "lesson research." But in many cases, only the data of class observation and questionnaires were used as information for investigation. Until now, collecting data on the state of students in real time has been virtually impossible.

The educational environment has seen remarkable changes in these past 5 to 10 years, made possible through the introduction of equipment that utilizes ICT. One major example of this is the introduction of electronic blackboards and tablet PCs in primary and secondary education. This introduction of equipment is a revolution in the methods and tools used to provide service. In other words, it is an actuator. It is dramatically transforming the traditional lesson to a learner-centered environment. For example, if students write the answer to a quiz incorporated in their electronic textbook, and then the answers of every student are lined up on the electronic blackboard, this enables them to compare and discuss their answers. In this way, the students can find the correct answer themselves. The students will recognize the existence of various opinions, and get the learning literacy of self-regulated learning. At the same time, ICT introduction also gives us the ability to collect information about the state of the students.

So this introduction of equipment also provides us with the tools and methods to measure the service value acceptance state. In other words, a sensor. The significant advantage of this method is that data and information is collected in a digital format, and can be visualized easily. This helps the investigation of a teacher's know-how and lecturing process. Expanding ICT utilization in the educational environment as a means of collecting data on the service receiver's value acceptance state in order to improve classes is the main study theme of this paper.

3 Learning Analytics

3.1 SCORM

Interest in Learning Analytics is rising rapidly. It depends on the same trend of big data analysis as a hot issue in the research for information and communication technology. The aim or purpose of Learning Analytics is to collect various data related to learning and find new viewpoints through analysis of this data, leading to the generation of high-quality learning service and learning materials. It is only in the last several years that the word itself has attracted attention, but similar studies and measures were

precedent already in the field of e-learning, or ICT-enhanced education. The creation of SCORM (Sharable Content Object Reference Model) is largely thought to have lead to the spread of e-learning. SCORM was an e-learning platform and a content standardization specification. The main purpose of SCORM was the assurance of e-learning content portability. When providing an education through e-Learning, besides the e-Learning courseware itself, an LMS (Learning Management System) is needed to deliver content and to manage and register the learning historical data. SCORM, having been created as an international standard to allow easy cross-LMS transferability of content, has made a great contribution to the spread of e-Learning. But while it has provided for the portability of content, at the same time it has also limited the scope of standardization for information on students' learning histories (beginning and ending of learning, test scores, etc).

3.2 xAPI

Efforts to create the next generation SCORM standard had started in ADL (Advanced Distributed Learning) [2], and its first version (V1.0.0) was published in 2013 under the name xAPI. It doesn't limit the collection of data to that of just e-learning activities, but also data collection from the classroom learning activities. We have to consider the concept of LRS (Learning Record Storage) in this standard carefully. It aims to collect data related to the various kinds of learning experiences and unify the database management. LRS may be appropriate to realize the concept of Learning Analytics and apply it in the improvement of classroom learning.

3.3 IMS Caliper

IMS GLOBAL, which is an international standardization organization, announced the Learning Measurement Framework IMS Caliper in 2013[3][4]. This framework consists of the following three concepts.

(a) IMS Learning Metric Profile
(b) IMS Learning Sensor API and Learning Events
(c) IMS LTI/LIS/QTI

(b) and (c) are almost the same concept as that of xAPI. But it should be noted that (a) further aims to standardize the metrics of learning activities. While it's still under consideration, it may possibly become a foundation of big data analysis in the learning field in the future.

4 Study of Learning History Data Analysis

4.1 Preceding Study-1

Practical Learning Analytics study in the field of education is also being advanced concurrently with the worldwide standardization activities described in the previous

chapter. The analysis of the learning history data recorded on LMS by Gohda et al (2013) [5] is the latest study on Learning Analytics in e-learning in Japan. The transition of learning dates for every partial unit of the e-learning program is analyzed for about 3 months. According to the analysis of this data, the authors had classified learner's learning behavior into 7 patterns; "deadline focus," "periodical learning" "getting ahead," "random," "declining motivation," "mountain shaped," and "middle stage catching up"

4.2 Preceding Study -2

Katase et al tried to analyze the learning behavior in the classroom lecture through the page view history data of each student using a simulated e-textbook [6]. They investigated the correlation between the synchronous rate and personality factors of each student. Synchronous rate was calculated by the time rate of the situation that the target student had been viewing the same page of what teacher showed in the front screen. Personality factors was classified by the Big Five. As a result of analysis, they've found that it seems that the students with high levels of "Extroversion" or "Openness to Experience" on the Big Five tended to have low synchronous rates. It can be presumed that both of them are likely to learn with self-regulated style rather than follow the teacher faithfully.

5 Visualization of Learning Behavior

5.1 Experiment

We assume that it'll be useful and effective for a teacher, as a service provider, to recognize the value acceptance state of the students as service receivers. So we tried to verify the effect of the visualization of learning behavior. We created an experimental environment using the same environment of the preceding study introduced in 4.2.

Subjects of this experiment were the 62 first-year students of a vocational school. PCs and simulated e-textbook data were provided to all of the students, so they could see any page of the text on the PC display. Experiment had been held in the lecture of communication skill. The lecture consisted of two 50-minute lessons with a 10-minute break between lessons. In the first lesson, the teacher explained the operation of simulated e-textbook but he didn't mention it any more. In the second lesson, teacher announced to students to use the function of page turning on the simulated e-textbook freely. 30 minutes into the lecture, the teacher instructed the students to perform an exercise. The exercise was easy to answer if students had seen the previous pages of the simulated e-textbook.

A data server collected "page view data" for every time the student changed the page they were browsing. This data consisted of student ID, new page number, and the time. The teacher's "page view data" was also collected in the same way based on their use of the PC. Data was only collected for the second 50-minute lesson.

5.2 Result

There are 5 graphs of typical leaning behavior patterns observed in this experiment. The browsing page transition graphs of the teacher is shown here superimposed with those of the target student. The red line with circle dots is the data of the teacher, while the undotted blue line with is the data of the target student. Horizontal axis shows the time. The start time of the operation explanation was 73, the start time of second lesson was 103, and the start time of exercise in the second lesson was 128. The vertical axis shows the page number of e-textbook from 1 to 16. Each graph of the 5 students is shown in Figure 2-6 with our estimation below.

Student 12001 didn't perform page turning in the first 15 minutes of the second lesson, but at Time 118 he suddenly performed page turn backward to almost the start page (page 4) and then followed the teacher's page. However, during the exercise, he also performed backward page turning. The synchronous rate was 27%.

It seems that student 12001 wasn't interested in the lesson initially, but in the latter part of the lesson he studied eagerly with the learning activity of looking back on the textbook.

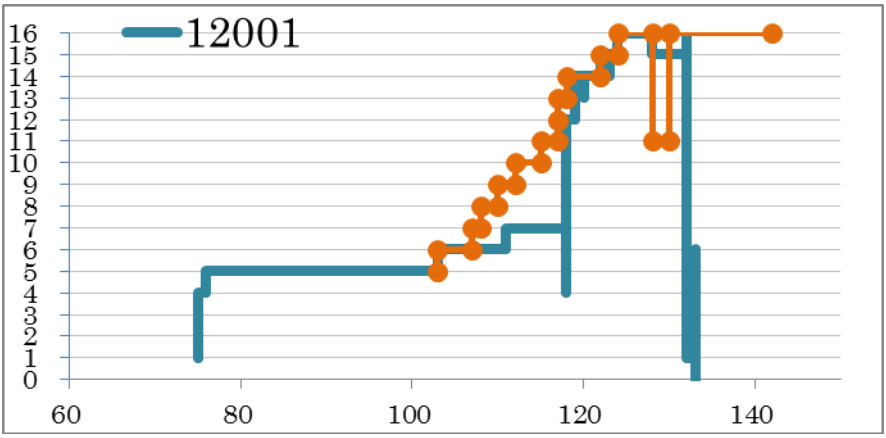

Fig. 2. Visualizing the transition of browsing page (teacher vs. student 12001)

Student 12015 followed the teacher's page turning in the first 15 minutes of second lesson, but stopped page turning on Time 117 until the end of the lesson. The synchronous rate was 52%, and the synchronous pattern was almost inverted with that of student 12001(described above).

It seems that student 12015 had the willing to learn in the first half of the lesson, but he got tired of the lesson or the e-textbook.

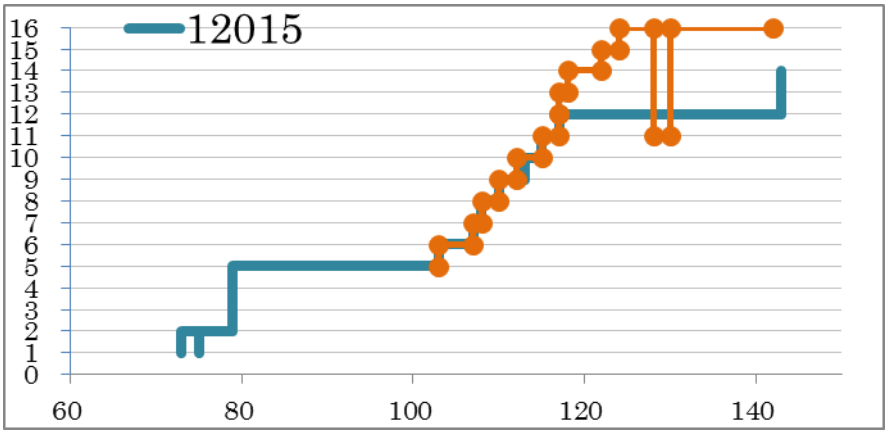

Fig. 3. Visualizing the transition of browsing page (teacher v.s student 12015)

Student 19004 took a specific activity at the start of lesson. He read through to the end of the textbook (page 16) on Time 106, when the teacher showed the page 6. After that he followed the teacher's page turning with a slight delay until the end of the lesson. The synchronous rate was 55%.

I t seems that student 19004 have the both characteristics of some intellectual curiosity and faithfulness.

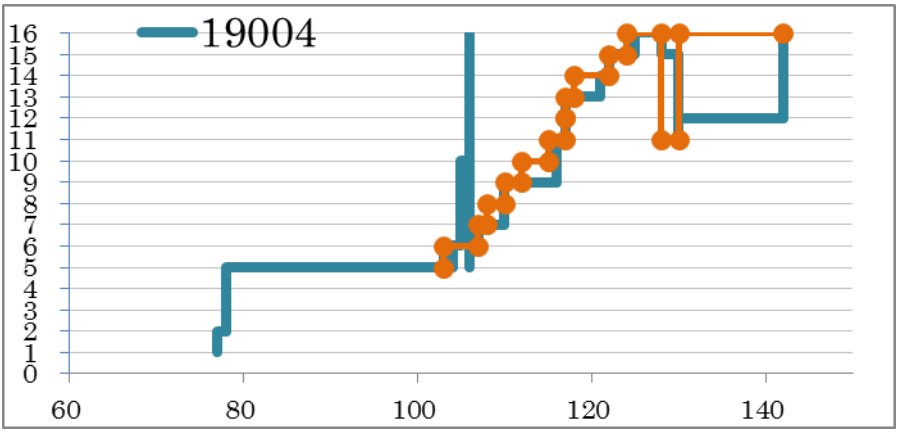

Fig. 4. Visualizing the transition of browsing page (teacher vs. student 19004)

Student 16001 actively read through the textbook during the period of operation explanation in the first lesson. In the period of the second lesson, he followed the teacher's page turning faithfully. Only on Time 112 did he perform page turning backward to the first page of the lesson (page 5). The synchronous rate was 71%.

It seems that student 16001 have the characteristics of slightly strong faithfulness because the synchronous rate was fairly high.

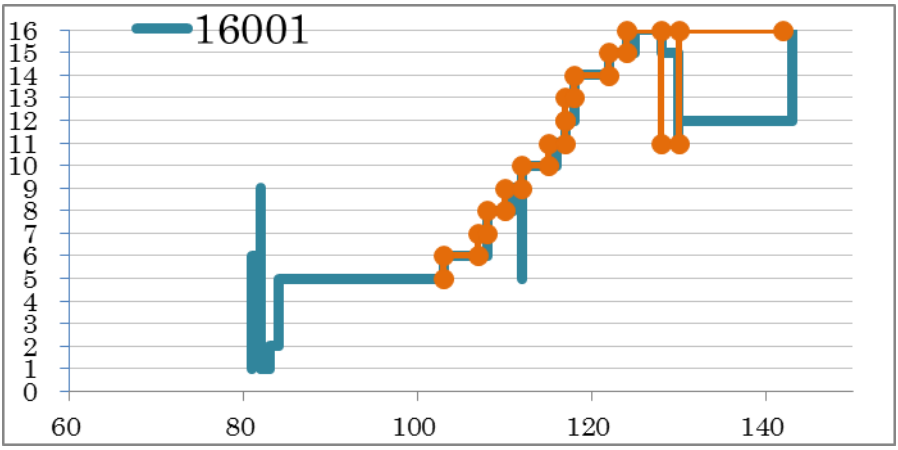

Fig. 5. Visualizing the transition of browsing page (teacher vs. student 16001)

Student 12019 took the page turning activity to the end of the textbook twice during the period of operation explanation in the first lesson. In the period of the second lesson, he almost followed the teacher's page turning, but there was a unique activity of page turning backward 6 times. The synchronous rate was 53%.

It seems that student 12019 has the characteristics of a steady learning style.

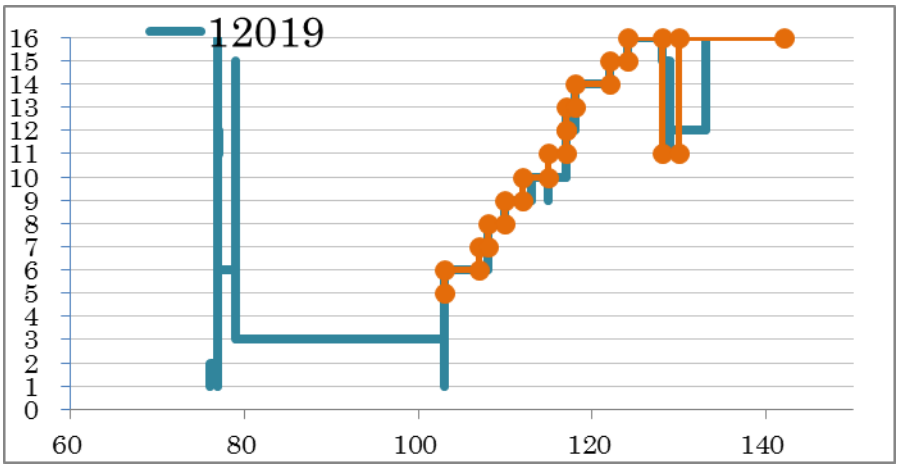

Fig. 6. Visualizing the transition of browsing page (teacher vs. student 12019)

6 Conclusion and Future Issue

In this paper, the effectiveness of collecting and analyzing the value acceptance state of service receivers was investigated. The usefulness of learning behavior data is suggested in education service. In the following research, We will develop the prototype

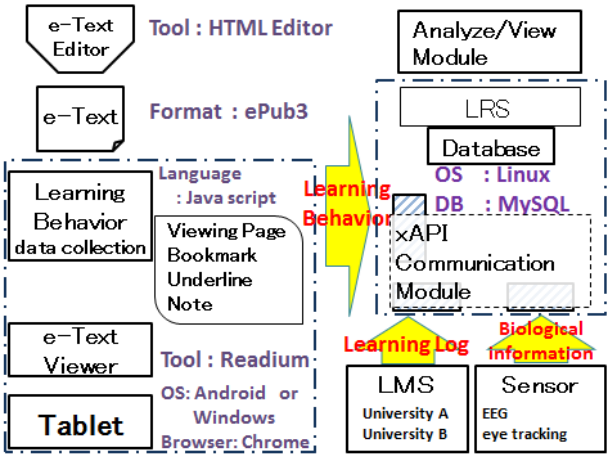

Fig. 7. Learning experience data collecting and analyzing system

LRS(Learning Record Store) and experiment system shown in Figure 7 taking account of typical global standards mentioned in chapter 3.

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