M2B System: A Digital Learning Platform for Traditional Classrooms in University

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ABSTRACT: We present M2B system, the digital platform of learning in Kyushu University, Japan. Combined with our "Bring Your Own PC" program, currently the M2B system is used by about 19,000 students and 10,000 faculty staffs, and more than 700 courses have been registered in the system since September 2014. What makes M2B system unique is that it is designed to be integrated into traditional classrooms. The system consists of three subsystems Moodle, Mahara, and e-book system, and it provides functionalities needed by classes such as managing assignments, delivering textbooks as e-books, and storing journal writings. This results in availability of learning logs from traditional classrooms and outside classes, and we can perform learning analytics on them. We have developed learning analytics methods, and they are provided as tools on M2B system for supporting teaching and learning in classes on site. As of October 2016, totally 28 millions of learning logs are collected from our system and have been used in our learning analytics. In this paper, we describe our system and learning analytics tools that we have developed. In technology showcase event, we demonstrate how our tools work and how we are using them in our classes.

Keywords: traditional classroom, learning logs, learning analysis, real-time processing, e-book, Moodle, Mahara

1 INTRODUCTION

Recently, researchers have examined Open Educational Resources (OERs), such as Open Course Ware (OCW) and Massive Open Online Courses (MOOCs) (Eisenberg & Fischer, 2014; Siemens & Dillenbourg, 2013). Compared with OERs, traditional educational resources, such as books, textbooks, or their learning contents, cannot be easily accessed online, and data on students' learning activities are unavailable. Therefore, verifying the educational effectiveness of traditional educational resources remains challenging. Despite the variety in types of traditional learning resources, research on the measurement of their educational effects is limited.

In Kyushu University, we have developed a digital learning platform, named M2B system, and it has been used in more than 700 courses over few years. M2B system is designed to be used in traditional classrooms, and we have been collecting students' activity data (learning logs) from face-to-face classes, which now forms an educational big data. We have been doing the Educational Big Data Learning Analytics Project on it, which has been supported by Commissioned Research of National Institute of Information and Communications Technology, Japan (No. 178A03, 80,000,000 JPY, 2014—2017).

In this paper, we describe the architecture of M2B system and learning logs collected from the system. We also provide introductions to tools available on the current system, which has been developed by us to support teachers and students based on the outcomes of learning analytics.

2 THE STRUCTURE OF M2B SYSTEM

M2B system and the learning analytics environment is built on on-premise servers in Kyushu University. We have combined three subsystems into M2B system: Moodle, Mahara, and e-book system; and we

have built an environment for learning analysis and developed tools on top of it. In the rest of this section, the components are described individually.

2.1 BYOPC

Kyushu University implemented the “Bring Your Own PC” (BYOPC) program in 2013, and therefore all students have their own computers into the traditional classroom. Although this is not a system component actually, this program plays a fundamental role in introducing a digital learning platform into face-to-face classes.

2.2 Moodle

Moodle is an open source learning management system. Both instructors, including teachers and teaching assistants (TAs), and students use our Moodle system. Students can use this system to take tests and submit reports, whereas instructors can use it to take attendance, distribute questionnaires, carry out tests, manage students’ achievements, and carry out questionnaire surveys.

2.3 Mahara

Mahara is an e-portfolio system, and it is also open source. We currently use a Mahara system to store students' journals. In some classes, teachers encourage students to write journals for reflection, and also teachers and TAs sometimes write journals themselves. Those journals written by students are automatically shared to the instructors so that instructors can make use of them for improvement of classes. We create Mahara’s blogs for each course and student in advance and have students write a blog entry for each week.

2.4 E-book System

We store lecture materials, such as slides or notes, into the e-book system, and users can access them through a dedicated reader application. With the application, students can read learning contents used in classrooms not only in classes but also at home. All user actions performed on the application, such as turning pages and opening a material, are recorded as learning logs and automatically sent to our database when a network connection is available. Table 1 shows an example of learning logs. The reader application provides additional functions bookmarking, highlighting, noting, and searching; and related data like the input text of a note taking are also included in a log.

Table 1: Example learning logs from our e-book system.

User ID	*Action name*	*Document ID*	*Page Number*	*Action time*
Student1	Next Page	00000000NBU4	16	2014/10/22 8:40:55
Student1	Previous Page	00000000NBU4	15	2014/10/22 8:42:15
Student2	Add Highlight	00000000NBU4	15	2014/10/22 8:42:16
Student3	Add Note	00000000NBU4	15	2014/10/22 8:42:18

2.5 Integration

We integrated the above three systems so that they cooperate and users can use them seamlessly. For example, M2B system provides single sign-on authentication, which means that one can use any of the subsystems without authentication as long as one of the subsystem is logged in. This also makes it possible to connect user activities on different subsystems and to analyze students' learning logs in an integrated manner.

2.6 Learning Analytics and Tools

We perform learning analytics and provides development of teaching and learning support tools are based on the above system stack. Learning logs from the three subsystems are stored in the common database of M2B system. In most cases, we develop plug-ins for Moodle or Mahara systems, and these plug-ins can access every log in the database.

The integration of subsystems enables us to observe students' learning activities from multiple viewpoints to improve traditional classrooms. For example, we can combine logs of reviews of e-books and scores of weekly mini-exams to analyze the underlying relationships among these activities and learning outcomes. Furthermore, teachers can make some actions for students in classes and/or on M2B system based on the analysis.

3 LEARNING AND TEACHING SUPPORT TOOLS

We have developed many tools for teachers and students to analyze their classes and see the relative status of students themselves in M2B system. Most of the tools are provided as plugins, and thus they could be used in other systems using Moodle or Mahara. The following list shows the summary of our tools.

3.1 Active Learner Tools

As Kyushu University encourages active learners, we developed a measure to quantify how active a student is, the score of which is called active learner point. The active learner point is calculated from many students' activities from the three subsystems. Table 2 shows the activities used for the calculation. We provide three tools to visualize students' active learner points from different perspectives.

3.1.1. Active Learner Process

This shows temporal sequences of active learner points differently for teachers and students. On one hand, it shows the average points of students and scores of selected activities for teachers to see how the entire activeness of their classes changes week by week (left hand side in Figure 1). On the other hand, for students, it shows temporal sequence of his or her active learner points as well as the average ones of a class. This enables students to relatively position his activeness in the class.

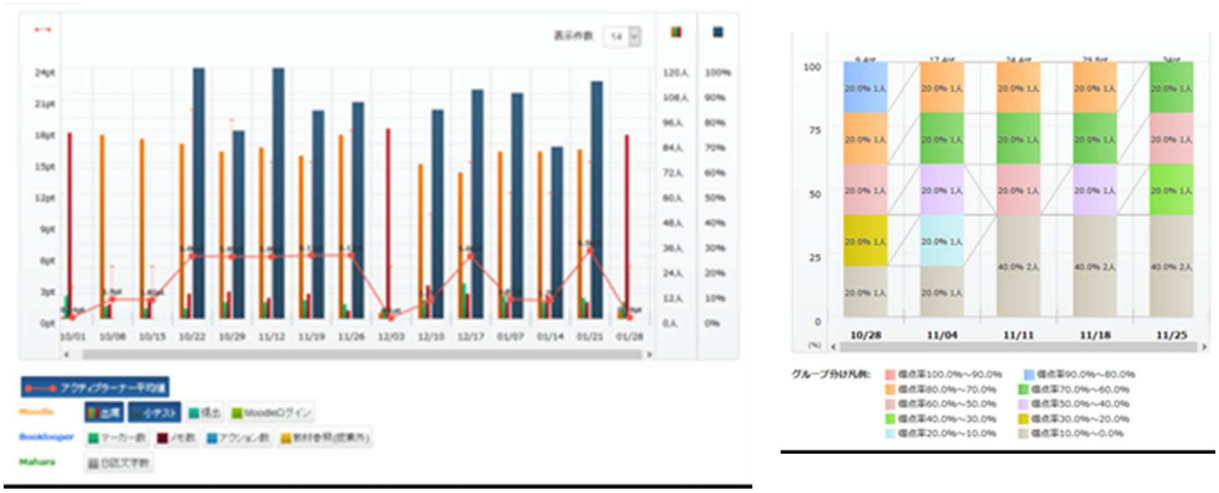

Figure 1: Active learner process (left hand side) and active learner distribution (right hand side)

Table 2: Activities considered in computation of acitive learner points and evaluation methods.

Subsystem	*Activity*	*Evaluation Method*
Moodle	Attendance	Attend: **5**, late: **3**, absent: **0**
	Quiz	**5** if score >=80%, **4** if score >=60%, **3** if score >=40%, **2** if score >=20, **1** if score >=10%, **0** otherwise
	Assignment	**5** if submitted, **3** if late submitted, **0** if no submission
	Viewing Course	Relative percentile scores from **0** to **5**
E-Book	Reading Time	Relative percentile scores from **0** to **5**
	Number of Highlights	Relative percentile scores from **0** to **5**
	Number of Notes	Relative percentile scores from **0** to **5**
	Number of Actions	Relative percentile scores from **0** to **5**
Mahara	Number of Characters	Relative percentile scores from **0** to **5**

3.1.2. *Active Learner Distribution*

This tool shows the distribution of students categorizing them into a specified numbers of levels by their scores for each week (right hand side in Figure 1). Compared to the previous tool, this can be used to know the overall activeness of a class.

3.1.3. *Active Learner Ranking*

This shows the ranking of students according to the active learner points that they acquired. We can know who are the most active students from the ranking table.

3.2 Real-time Analysis Tools

We have developed tools that analyze the states of students in classes to help teaching on site. Currently there are two tools of this kind: response button and e-book heatmap. The former is a simple tool that provides two buttons “Got it” and “Don’t get it” on Moodle’s course page, and students can tell their understanding by clicking either button. The tool aggregates the responses and shows the time sequence of the responses as a bar plot like one shown in Fig. 2.

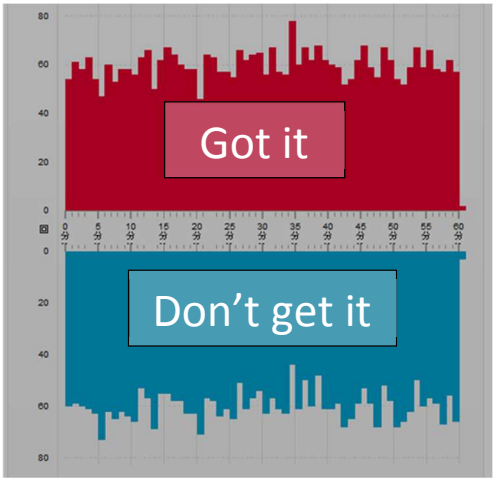

Figure 2: An example of bar plot of response buttons tool

The latter tool presents the reading status of students. Every minute, it computes the distribution of users over the pages of the e-book used in a class, and show the distribution as a heatmap on the system. Figure 3 shows an example of a heatmap, and horizontal axis corresponds to time and the vertical axis represents pages of a material. Every cell is colored according to the number of students who are reading the corresponding page at the corresponding time. From the figure, we can see whether students are being able to follow a teacher or not.

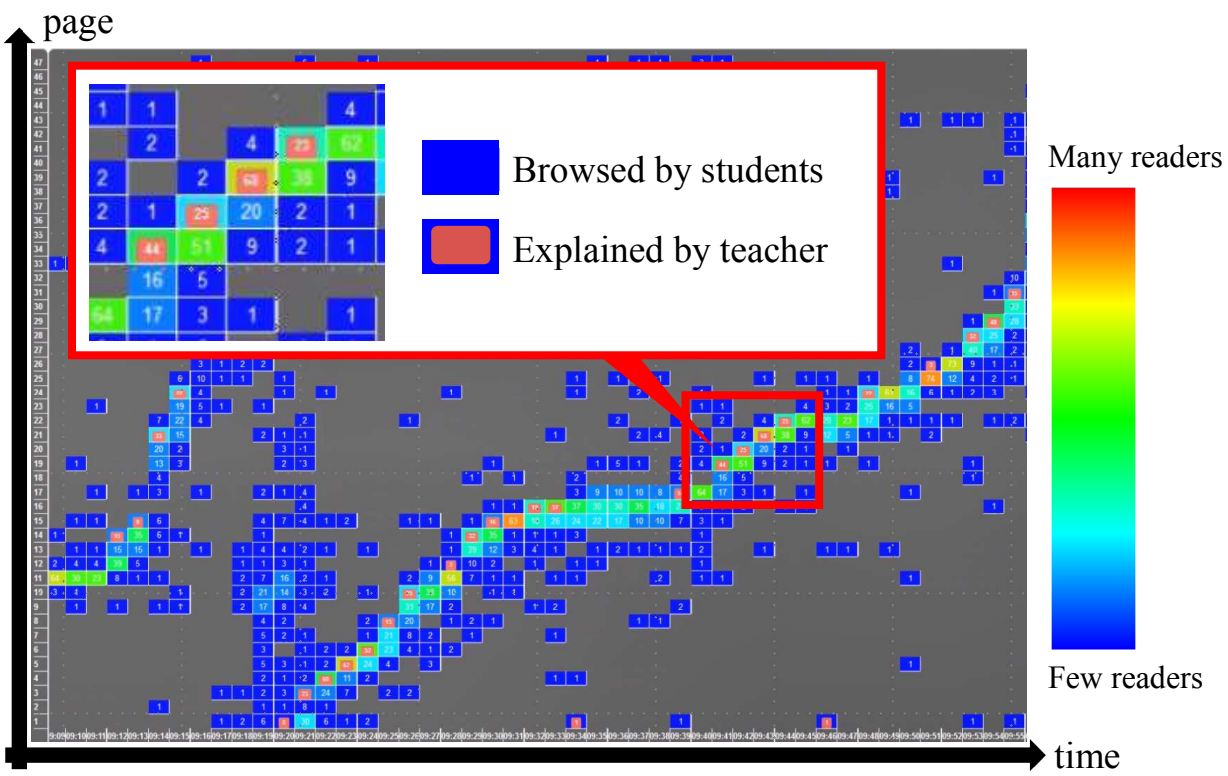

Figure 3: Real-time e-book heatmap

3.3 E-Book Analysis Tools

We provide three simple tools for analyzing the usage of e-books based on our work (Ogata et al., 2015).

3.3.1. *Learning Activities*

In this category, we provide four indicators for teachers to know students' learning activities that uses e-books. The *overall achievement indicator* shows the histogram of percentages of previewed pages for a week, and the *individual achievement rate* shows the same for each student. The *marker indicator* presents the distribution of markers made on an e-book. The *view time indicator* shows the average view time for each page.

3.3.2. *Page Ranking*

This show a ranking of pages which are most viewed by students.

3.3.3. *Word Cloud*

As e-books provide search functionality, we can obtain the history of the queries. This tool shows an image of so-called word cloud (tag cloud) for an e-book.

3.4 Journal analysis tool

This makes a summary report for a lecture from students' journals. For teachers, students' journals are full of resources to improve teaching and makes it possible that teachers assess the learning outcomes of students from a different view point than exam scores. Nevertheless, it is difficult for teachers to read all the journals since a class can have more than a hundred of students and they usually teach several courses.

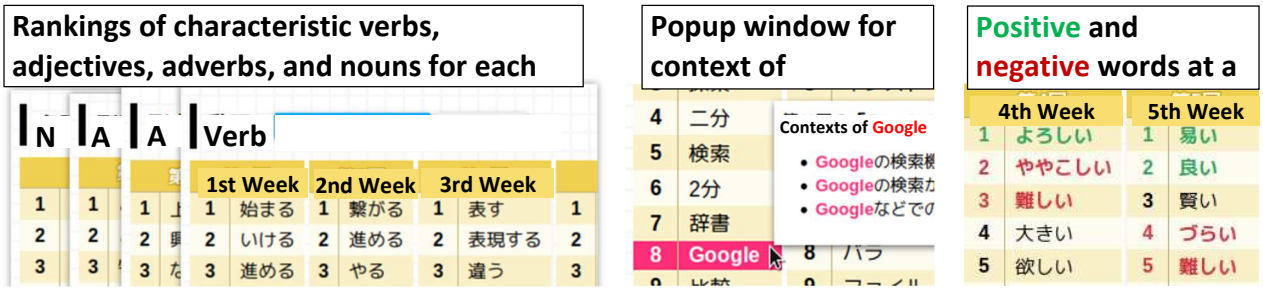

Figure 4: An example of a summary report generated by the journal analysis tool

This tool addresses the problem by enabling teachers to pick up only important sentences from the journals. Figure 4 shows a summary report, which this tool generates. The report shows rankings of week-specific nouns, adjectives, verbs, and adverbs for each week. From the rankings, teachers can briefly see what are mentioned by students and how they felt in the class. It is also possible to read the actual sentences where a word is used to understand it precisely if one needs.

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