Time series cross table for looking through teacher's instruction and students' reactions from the page view history of digital teaching materials

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Abstract: This paper presents research about the blended learning that is carried out in the classroom using the Learning Management System; we have conducted a time series analysis by utilizing the viewing times of digital teaching materials that have been stored in the LMS. We have proposed the creation of a time series cross table for looking through the students' reactions numerically, along with the teacher's instructions, regarding the browsing of digital teaching materials. The proposal of the time series cross table indicated parts of teacher instruction that might not be clearly understood; thus the benefit of its utilization for future class improvement was revealed.

Keywords: time series analysis, cross table, page view, e-learning, educational data mining, learning history

1. Introduction

To further analyze the blended learning that is carried out in the classroom using the Learning Management System, we have conducted a time series analysis of the viewing times of digital teaching materials, which have been stored in the LMS. We also have been researching creating a time series cross table numerically for looking through the students' reactions to and the teacher's instructions of digital teaching materials browsing (Dobashi, 2015).

Using the page view history of Moodle, which describes which digital teaching materials were opened and when students opened them during class, we cross tabulated time series data in a list format using Excel. Furthermore, from the time series analysis of the page view history during class, we were able to identify cases in which materials were opened by students at a later time than that instructed by the teacher. This information can serve to improve instructions given to students in future classes. The time series cross table can be used to show which parts of teacher instructions are unclear, serving to improve instructions given to students in future classes and improving overall learning.

2. Related research

Lesson improvement is the object of educational data mining utilizing a learning management system. As summarized in Romero & Ventura's paper (2007a), digitizing such materials as conventional paper texts and quizzes and posting them on an e-learning system makes it possible to collect learning history that is useful for improving teaching methods from various viewpoints, such as through page view history and test results (Romero & Ventura, 2007a). Also, in targeting accumulated learning history data by applying data mining techniques to find data directly related to class improvement, the development of new methods to enhance the training effect was expected. Romero et al. (2007b) also classified the trends of data mining in the field of education in such areas as statistical analysis, visualization, and text mining, and investigated the various methods that have been attempted (Romero & Ventura & Garcia, 2007b). Furthermore, it has been shown that using learning history data in Moodle

to classify learners with features from the results of mining can be applied to improve the educational effects of data mining (Romero & Ventura, 2010; Huebner, 2013).

In addition, Google Analytics provides a wide-access website analysis service that makes it possible to analyze different perspectives. With the help of these services, it is also possible to improve digital teaching materials and lessons (Google, 2015). Google Analytics can be used only by an administrator of Moodle; however, the method proposed in this paper can be utilized by any Moodle user. Also, as regards previous learning history, the number of studies using the time series cross table in class, which we have proposed in this paper, is extremely small.

3. Time series cross table using in class page view history

Table 1: Time series cross table of page view history of digital teaching materials that were used in the lesson ("China data analysis," 2015/06/23)

2015/6/23 Resource name	13:05	13:10	13:15	13:20	13:25	13:30	13:35	13:40	13:45	13:50	13:55	14:00	14:05	14:10	14:15	14:20	14:25	Total
China data analysis	38	19	1										1					59
Quiz Chapter 6	8	2																10
9.0 Cross table	1	36	5	1											1			44
9.1 Name of the cro	1	2	26	6		1						1						37
9.2 Preparation of a	1		5	32	2	1	1											42
9.3 Creating a pivot			3	3	6	4	14	4	2	1		1						38
9.4 PivotChart				1	1		1	3	9	2		2			1			20
9.5 Percentage Cros						2	1	5	25	2			2	1	2	3	1	44
9.6 According to the								1	1				14	1	1		1	19
Exercise 9		1	1					1	1				37	6	1	1	3	52
Total page views	49	60	41	43	9	6	18	10	18	28	2	4	54	8	6	4	5	365

Table 2: Time series cross table of page view history of students that participated in the lesson ("China data analysis," 2015/06/23)

2015/6/23 Student ID	13:05	13:10	13:15	13:20	13:25	13:30	13:35	13:40	13:45	13:50	13:55	14:00	14:05	14:10	14:15	14:20	14:25	Total
Student	2				1								1					4
Student	1			1		1										1		4
Student	1			2						1			1					5
Student		1	1	1			1						2					6
Student		1	1	1			1			1			1					6
Student			3	2	1													6
Student	3	1	1	1									1					7
Student	1	1	1	1						1			2					7
Student		2	1	1				1		1				1				7
Student		1	1	1			1			1			2					7
Student	1	2		1			1			1			1					7
Student		1	1	1						2			3					8
Student		1		2			1			1			3		1			9
Student		2	2	1			1			1			1	1				9
Student	3	2		1				1		1			1					9
Student	2	1	1	1						2			1	1				9
Student		4		2									3					9
Student	3	1		1			1			2			1					9
Student		2	1	1			1		1	1			2		1			10
Student		1		1	1		1			2			1	3				10
Student	2	2		3			1			1			1					10
Student		1		2					1	2			4					10
Student	1	4	3	1									1					10
Student	2	1		1			1					1	2				3	11
Student		3	4	1							1			1	1			11
Student	2	1	1	1	1	1	1			1			2					11
Student	1	1	2	1		1			2	1			1			1		11
Student		3	1	1					1	2			4					12
Student	1	4	2	1			2	2										12
Student	1	1		2		2			4				2					12
Student	1	3	2	1			1	1	1				2				1	13
Student			4	1			1	1			1	3	2					13
Student	1	3	1	1	1	1	1		1	1			3		1			15
Student	3	2		2	2		1	1		1				3			1	16
Student	2	4	6	1				2	5	1			2					23
Student	15	3	1		2		1		1	1			2	1				27
Total page views	49	60	41	43	9	6	18	10	18	28	2	4	54	8	6	4	5	365
Total students	21	31	22	34	7	5	17	8	10	22	2	2	29	6	4	4	3	36

Table 1 shows the time series cross table of the page view history of digital teaching materials (separated in 5-minute intervals) and collected during a class called "China Data Analysis," The contents of this course and the digital teaching materials contain a commentary concerning introductory statistics using Excel and related exercises. The aim was to learn the basic techniques required for the analysis of statistical data in the classroom while actually using Excel. This class occurred in the spring semester (2015/06/23). Eight files (A5 size, 12 pages) of digital teaching materials were used. The content included "Basic operation of Pivot table," etc., for students who have already learned the information literacy. There were 36 students in attendance that day.

Table 1 was obtained by counting the total number of students who opened the digital teaching materials. First, students had to login into Moodle, then open the table of contents (Entry page: "China Data Analysis"). The 13:05 and 13:10 columns contain increased values; the students initially opened the entry page and then opened the resource page captioned "9.0 Cross table," Looking at the right sum of Table 1, there is a smaller number of attendees (36). From these numbers, it can be understood that students who did not open the digital material were present.

In Table 2, the 13:10, 13:15, 13:20, 13:35, 13:50, and 14:05 columns contain increased values, and these columns also include the time that the teacher instructed students to open the digital teaching materials. A delay in students' opening of the digital teaching materials can also be seen at 13:50, 14:55 etc. Also, in column 13:35, 17 students had opened the digital teaching materials, but 19 students had delayed or not opened the materials. Therefore, in this column, it might be inferred that teacher instruction was not thorough or had no importance for students. In the lesson, the teacher opened the 8 files of digital teaching materials. However, the lowest number of page views was four, and the highest number of page views was 27, as seen at the rightmost sum of Table 2.

4. Conclusion

In this research, the teacher manipulated the computer at the teacher's desk in the classroom and displayed the digital teaching materials on the projector. Therefore, the number of students viewing the digital teaching materials is smaller, because they were looking at the projector screen while listening to the teacher's instruction; i.e. they received the lesson without opening the digital teaching materials on their own PC.

From the data collected via the time series cross table regarding opening the digital teaching materials used in class, when the description and instructions of the teacher are clear and thorough, more students will open their own digital materials on their computer, and there is a tendency toward shorter differences in viewing start times. If the teacher's instructions are not clear, variations occur in the time at which the student views the digital teaching materials, and a tendency toward delayed viewing of the digital teaching materials appears in the time series data.

Acknowledgements

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