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A method of visualizing students' reactions by creation of a time series cross table from the in class page view history of the Learning Management System

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Abstract: Lectures in classrooms reach dozens of students at a time, but the lecturer can find it extremely difficult to gauge students' individual reactions to the teacher's instructions and the content being presented. For this paper, about the blended learning that is carried out in the classroom, we conducted a time series analysis by utilizing the viewing times of digital teaching materials that have been stored in the Learning Management System. And we have proposed the creation of a time series cross table to visualize the students' reactions numerically, along with the teacher's instructions, regarding the browsing of digital teaching materials. The digital teaching materials were created in a PDF file and installed in the Moodle learning management system. We created a time series cross table by utilizing the time of the page view histories collected, and thus we indicate that we could visualize the student's reaction to the teacher's instructions indicating a list of transition of values that represents the status of students viewing the digital teaching materials. The students' reactions when the teacher's instructions are through, including when materials were opened with a delay, are visualized by a numerical value list on time series cross table. The proposal of the time series cross table indicates parts of teacher instruction that might not be clearly understood; thus, the benefit of its utilization for future class improvement was revealed. This information can serve to improve instructions given to students in future classes.

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

1. Introduction

Currently, the active digitization of teaching materials in the field of education as well as the utilization of digital teaching materials in lessons is widely practiced. Furthermore, the classes to be performed by equipping with digital teaching materials on Learning Management System (LMS) have carried out the accumulation of learning histories and the application of data mining has been made possible.

This field has developed into a field called Educational Data Mining (EDM) (Baker & Yacef, 2009; Romero & Ventura, 2013). In recent years, EDM has been positioned in the more important area of research at an international conference that will be held every year (Barahate, 2012).

The background of EDM has become important. This is largely due to the development of a LMS that utilizes tools such as the web browser and the access analysis on the internet (Google, 2015). These tools have also been applied to the research of EDM.

In lectures, however, which are performed by gathering dozens of students, the function of e-learning systems, such as the current state of Moodle, the digital teaching materials the teacher instructs for viewing, and whether the student is viewing as instructed is often hard to know.

In this context, about the blended learning that is carried out in the classroom, we have been conducted a time series analysis by utilizing the viewing times of digital teaching materials that have been stored in the LMS. And also have been making a research creating a time series cross table to numerically visualize the students' reactions to and the teacher's instructions of digital teaching materials browsing (Dobashi, 2015).

In classroom teaching, there are students who open the digital teaching materials late, after the teacher's instructions. There are also students who do not open the digital teaching materials at all and therefore have a limited view of the teaching materials. Correspondence is often required in these situations. Reading of the materials is essential for students. If teachers are able to know instantly when a student views inappropriate digital teaching materials in class, they can draw attention to the student and it is possible to add a twist as to how to proceed with the class as soon as possible.

Therefore, for teachers who use an e-learning system as a teaching tool in class, we have created a commentary in PDF format to be utilized in preparation and review for students. Data regarding the use of the digital teaching materials in the weekly class, such as the date and time, student ID number, and page view history (for example, the page title) were collected (Romero & Ventura & Garcia, 2007a).

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 as time series data in a list format using Excel. In addition, we have created a cross table of the time series by collecting data on the number of students, viewing time, and digital teaching materials the teacher used in class and materials the teacher did not use.

From an analysis of the page view history, there were many students who opened digital teaching materials that the teacher did not instruct them to open. It is possible to identify these students, as well as when and which digital teaching materials were opened, by the time series data via cross tabulation.

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. 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

The object of Educational Data Mining that utilizes a LMS is lesson improvement. For example, in e-learning systems such as Moodle, the use of digital teaching materials in class can be easily exposed, and via the management functions of learning history, such as the page view history of digital teaching materials and quiz results, it is possible to collect some of the data (Romero & Ventura & Garcia, 2007b). By means of applying data mining based on the statistics of the collected learning history of students who participate in the lesson, viewing conditions of digital teaching materials, and score distribution of quizzes, it is possible to check several features (Lai & Sanusi, 2013).

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. 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.

In order to clearly understand the effects of materials and motivation when addressing class improvement, collecting learning history data accumulated early via e-learning systems is an important issue to be analyzed (Ueno, 2004). In past lessons of blended learning, numerous studies were carried out as a result of the analysis of page views and the scores of quizzes that corresponded to materials and teaching evaluation questionnaires (Adachi, 2007). These studies have revealed that the implementation of quizzes and the times of access to digital materials are related to the improvement of learning effects. In these studies, a number of different materials were used, such as booklets, textbooks, websites, PowerPoint slides, quizzes, commentary articles, fill-in-the-blank questions, etc.

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 & Espejos & Hervas, 2008; 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 help improve digital teaching materials and lessons (Google, 2015). The service provided by Google Analytics, such as aggregate visitors and visit time to a given web site, the number of users that have accessed the website, the website content being viewed etc., can be grasped in real time. It is also possible to visually analyze the user who is doing any kind of operation in the page.

Although 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

This study investigated a class that corresponded to the blended learning model and that was performed while viewing digital teaching materials on Moodle in traditional face-to-face teaching. In order to accumulate the learning history of the students using Moodle, it is necessary to provide digital teaching materials or provision a method such as a link to an external URL. We must prepare in advance the digital teaching materials to be browsed by students. In this paper, we have mainly used the digital teaching materials (PDF files) that were created for the sole purpose of this study.

3.1 Overview of the digital teaching material

Files were created in PDF format, a format that can be viewed via PDF Viewer by clicking on a link in the table of contents that we created in the Moodle Topics format. Since it is possible to freely enter the name of the topic in Moodle, we created a digital section that corresponds to the table of contents of the paper textbook by entering the heading that corresponds to the chapter-section and small items of materials.

When the students click these topics and browse the digital teaching materials (corresponding to the resource in Moodle), the name of the topic (resource name) is recorded in the log, in addition to any digital teaching material that was browsed, and is displayed in a table format. In this way, the page view history is obtained (Figure 1).

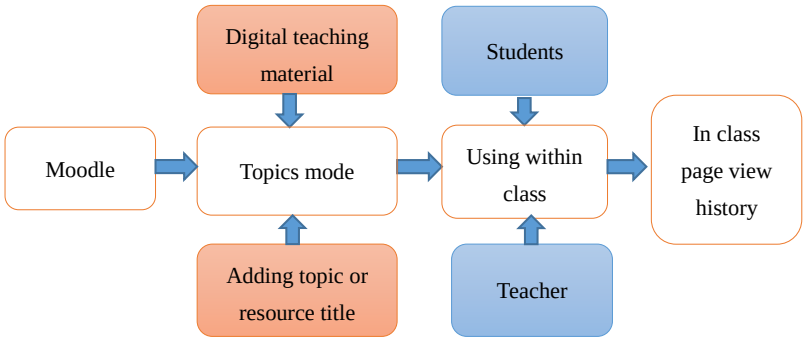

Figure 1. Outline of the flow to accumulate the page view history by Moodle

3.2 Page view history and data cleaning

In the Moodle log report page, a record was kept of students' learning history from enrollment (Course) and the first lesson conducted. Information detailing the time resource pages were viewed (Time), the accessed PC's IP address, student ID and name (User full name), the operations performed in Moodle (Action), and the resource page title opened by students (Information) was stored in a table which can be viewed.

The resources and topics described below are the headlines and subheadings corresponding to the chapter-section and small items of digital teaching materials uploaded on Moodle. In addition, this

paper used a file downloaded from Moodle (in Excel format) of the page view history of students using Moodle. The performance of the lesson was carried out by the teacher (who instructed the viewing of digital teaching materials that were prepared in advance) and the teacher logged in to Moodle from the teacher's desk. Students logged in at the start of classes.

There was sometimes a lack of data (for example, there was no title data for the resources that were accessed, etc.) in the log file downloaded from Moodle. Moreover, the date and time are described in the same column, since it is inconvenient to process and perform data cleaning before performing the analysis. In the following analysis, sample data from the page view history concerning date, month, viewing time, student ID, and the title page of the digital teaching materials used was aggregated using the cross tabulation function (pivot table) of Excel.

3.3 Time series analysis of page view history in class

In this study, we published all of the digital teaching materials that were created for lessons. Students were able to view the materials that were used on the day of the class. Moreover, students were able to read ahead and view materials to be used in future lessons. Also, students were able to use the materials as a tool for review.

From the perspective of teacher, when doing a lesson at the teacher's desk it is often difficult to know whether each student is viewing the digital teaching materials in accordance with the teacher's instruction. Therefore, we distinguished between the materials used in the lesson and the materials not being used in the lesson by the teacher.

In this paper, the digital teaching material that was used refers to the materials opened by the teacher for the lesson of the day. Also, the unused materials refer to the digital teaching materials opened by students that were not used by the teacher during the lesson of the day.

And then we separated the data into five stages, in 1- to 5-minute intervals. We then created a time series cross table from the number of students and the viewing time of each of the digital teaching materials. We also created a time series cross table from the number of page views and the viewing time for each student (Figure 2).

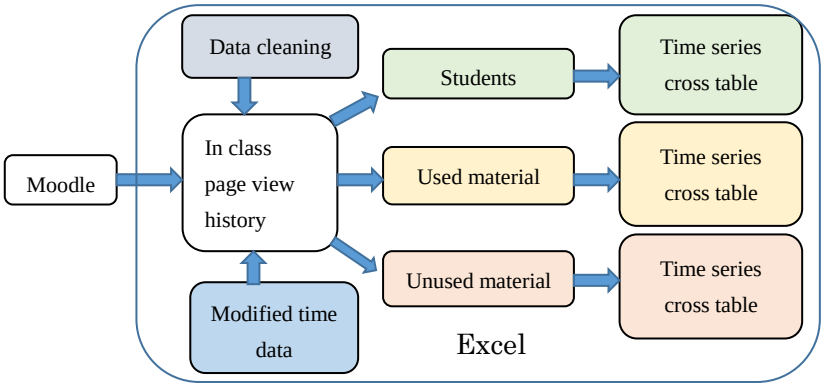

Figure 2. Flow of data mining for time series cross table

4. Time series cross table of page view history

4.1 Course enrollment - Example from "Multimedia Creation" -

Table 1 and Table 2 show the time series cross table of the page view history of digital teaching materials collected in a class called "Multimedia Creation". In this class, we learned about the creation of animation and video works. This course has become a common subject for undergraduates and students in any year of studies can enroll in the class.

The class from which we created the time series cross table was an introductory lesson and occurred in the spring semester on 2015/04/08. One page of digital teaching materials was used (A4 size, eight pages). Table 4 was obtained by counting the total number of students who opened the digital teaching materials.

Table 1: Time series cross table of page view history of digital teaching materials that were used in the lesson (“Multimedia Creation”, 2015/04/08, 5 minute intervals)

2015/4/8	Time (5 minute intervals)										
Resource name	10:55	11:00	11:05	11:10	11:15	11:20	11:25	11:30	11:40	12:05	Total
Role assign	35	4									39
Multimedia creation	71	19	2	12	1	2	1	6			114
Processing of figures	2	23	12	2	2		1	44	1	1	88
Total page views	108	46	14	14	3	2	2	50	1	1	241

Table 2: Time series cross table of page view history of digital teaching materials that were used in the lesson (“Multimedia Creation”, 2015/04/08, 3 minute intervals)

2015/4/8	Time (3 minute intervals)													
Resource name	10:57	11:00	11:03	11:06	11:09	11:12	11:15	11:18	11:21	11:27	11:30	11:39	12:06	Total
Role assign	39													39
Multimedia creation	86	4		3	11		1	1	1	3	4			114
Processing of figures	13	12	12		2	2				33	12	1	1	88
Total page views	138	16	12	3	13	2	1	1	1	36	16	1	1	241

Table 3: Teacher’s page view history (“Multimedia Creation”, 2015/04/08)

2015/4/8 Teacher's page view history				
Time	IP address	User full name	Action	Information(Resource name)
2015/4/8 10:54	192.168.11.7	teacher	role assign (http	Role assign
2015/4/8 10:54	192.168.11.7	teacher	course view (htt	Multimedia creation
2015/4/8 11:26	192.168.11.7	teacher	resource view (h	Processing of figures
2015/4/8 11:27	192.168.11.7	teacher	resource view (h	Processing of figures

Table 4: Time series cross table of page view history of students that participated in the lesson (“Multimedia Creation”, 2015/04/08, 3 minute intervals)

2015/4/8	Time (3 minute intervals)													
StudentID	10:57	11:00	11:03	11:06	11:09	11:12	11:15	11:18	11:21	11:27	11:30	11:39	12:06	Total
StudentID	3													3
StudentID	4													4
StudentID	3									1				4
StudentID	3									1				4
StudentID	3									1				4
StudentID	3									1				4
StudentID	3									1				4
StudentID	3									1				4
StudentID	3									1				4
StudentID	3					1								4
StudentID	3									1				4
StudentID	3									2				5
StudentID	3	1								1				5
StudentID	3									1	1			5
StudentID	3									1	1			5
StudentID	3				1					1				5
StudentID	4		1											5
StudentID	3	1								1				5
StudentID	4									1				5
StudentID	4									1				5
StudentID	3			1						1				5
StudentID	3	1								1				5
StudentID	3									2				5
StudentID	3									1	1			5
StudentID	3			1						1			1	6
StudentID	3									3				6
StudentID	3									1	2			6
StudentID	6	1												7
StudentID	6	1												7
StudentID	3					1				1	2			7
StudentID	4				2			1		1				8
StudentID	3		5											8
StudentID	3		6											9
StudentID	7	1			1						1	1		11
StudentID	7	1		1						3	1			13
StudentID	3				1		1		1		7			13
StudentID	3	9								2				14
StudentID	5				8					1				14
Total page views	138	16	12	3	13	2	1	1	1	36	16	1	1	241
Total students	39	8	3	3	5	2	1	1	1	29	8	1	1	39

This lesson began at 10:45 and ended at 12:15. There were 39 people in attendance. Table 1 and Table 2 show the time series of aggregated results separated into 3 and 5-minute intervals respectively. Table 3 also shows the teachers' page view history in order to make clear the time at which the teacher performed each instruction.

The Moodle system requires students to initially perform enrollment in the course and to assign roles. The role displays the use rights on the Moodle system. In the case of students, each student is assigned the role of "Student" (Role assign in Table 1 and Table 2). The teacher is given an enrollment key at the beginning of the lesson and students enroll in the course on their own.

Table 1 shows the enrollment situation from 10:55 through 11:00. Via comparison of the time series cross tabulation of 5-minute intervals, 35 students were enrolled until 10:55 and then four more people were enrolled until 11:00. This lesson contained students who were late for class, and this it can be seen in the slight variations that occurred as a result of the reactions of the students.

Also on that day, students opened the page called "Processing of figures" in addition to a page outlining the course contents (entry page, course view of "Multimedia Creation" in Table 2). We went on to practice the creation of a shape with Microsoft Word. At that time, the time that the teacher instructed the file to be opened, it was 11:26 or 11:27, as seen from the page view history for the teacher.

From the Table 2 at 11:27 and 11:30, the numerical value is larger because many students have opened the digital teaching materials according to the teacher's instructions. But, at the same time, we also found that many of the students opened the same file immediately after the start of class and prior to the teacher's instruction. We can also see that 12 students were slightly delayed in their opening of the digital materials.

Table 4 shows the time series cross table of students' page view history, and it is possible to see the time each student opened the materials. For example, in the time between 10:57 to 11:00 everyone enrolled in the course and opened the table of contents (entry page). It is understood that the students opened the digital teaching materials as a result of the instructions of the teacher sometime after or around 11:27.

4.2 Multiple digital teaching materials - Example from "Introduction to Social Data Analysis" -

Table 5 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 "Introduction to Social 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 was also an introductory class, occurring in the spring semester (2015/04/08). 10 PDF files (A5 size, 24 pages) of digital teaching materials were used. The content includes "Excel Introduction" and "Basic operation with worksheet," etc., as well as a review for students who have already learned the information literacy (Table 6). Thirty-two students were in attendance that day. First, students had to enroll in the Moodle portion of the course (Role assign). Then, students opened the table of contents (entry page: Social data analysis). Looking at the table right sum of Table 5, there is a smaller number of attendees (32). From these numbers, it can be understood that students who did not open the digital material were present.

Table 7 was obtained by counting the total number of students who opened the digital teaching materials. At 13:10, the students initially opened the enrollment page to the course, and it can be seen that it is they opened the entry page. In Table 7, the 13:15, 13:30, 13:40, 13:45, 13:50, 14:00, 14:15, 14:20, 14:25 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 the digital teaching materials can also be seen at 13:15, 13:35 etc..

Also in Table 7, at 14:20 and 14:25, the teacher requested that students open the digital teaching materials. This was just before the end of the lesson, and the students who opened these two files were relatively few in number: nine and 17 students. In the lesson, the teacher opened the 10 PDF files of digital teaching materials. However, the least page views were five and that most page views 24, as seen at the rightmost sum of Table 7.

Table 5: Time series cross table of page view history of digital teaching materials that were used in the lesson (“Introduction to Social Data Analysis”, 2015/04/08, 5 minute intervals)

2015/4/8	Time (5 minute intervals)																	
Resource name	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	14:30	Total
Role assign	31	1																32
Social data anali	65	8	4	3	1			1							3		2	87
1.0 Excel Introdu	4	19	15	16	1													55
1.1 Starting and	1		1		26	2												30
1.2 Reading and						1	23	2										26
1.3 Screen struct			1			1		23										25
1.4 Data input an			2						25	1			1			1		30
1.5 Basic operati			1								21	3		2				27
1.6 Making of a c		1										1		22				24
1.7 Text and inpu									1					29	3	1		34
1.8 Data moveme												1			6	4		11
1.9 Form of data		1														16		17
Total page views	101	30	24	19	28	4	23	26	26	1	21	5	1	53	12	22	2	398

Table 6: Teacher’s page view history (“Introduction to Social Data Analysis”, 2015/04/08)

2015/04/08 Teacher's page views history				
Time	IP address	User full name	Action	Information(Resource name)
2015/4/8 13:14	192.168.11.74	teacher	role assign (http://l	Role assign
2015/4/8 13:14	192.168.11.74	teacher	course enrol (http://	Social data analisys
2015/4/8 13:14	192.168.11.74	teacher	resource view (http:	1.0 Excel Introduction
2015/4/8 13:26	192.168.11.74	teacher	resource view (http:	1.1 Starting and ending of Excel
2015/4/8 13:35	192.168.11.74	teacher	resource view (http:	1.2 Reading and preservation of a file
2015/4/8 13:40	192.168.11.74	teacher	resource view (http:	1.3 Screen structure and the function
2015/4/8 13:46	192.168.11.74	teacher	resource view (http:	1.4 Data input and data processing
2015/4/8 13:55	192.168.11.74	teacher	resource view (http:	1.5 Basic operation with worksheet
2015/4/8 14:13	192.168.11.74	teacher	resource view (http:	1.6 Making of a chart
2015/4/8 14:14	192.168.11.74	teacher	resource view (http:	1.7 Text and input a figure
2015/4/8 14:18	192.168.11.74	teacher	resource view (http:	1.8 Data movement
2015/4/8 14:20	192.168.11.74	teacher	resource view (http:	1.9 Form of data

Table 7: Time series cross table of page view history of students that participated in the lesson (“Introduction to Social Data Analysis”, 2015/04/08, 5 minute intervals)

2015/4/8	Time (5 minute intervals)																	
Student ID	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	14:30	Total
Student	3	1				1												5
Student	4				1													5
Student	3		2											1				6
Student	3	1			1		1	1	1		1							9
Student	3		1		1		1		1					2	1			10
Student	3			4										2		1		10
Student	3	1		1			1	1			1			2				10
Student	3	1	1		1			1			1	1		1				10
Student	3		1		1		1	1	1		1			1				10
Student	3	2			1		1	1	1		1							10
Student	3	1			1		1	1	1			1			1	1		11
Student	4		1			1	1	1	1		1			2				12
Student	3		1	1	1		1		1			1		2		1		12
Student		4	1		1		1	1	1		1			1		1		12
Student	4		2		1				1		1			3				12
Student	3	1			1		1	1	1		1			2	1	1		13
Student	3	1			1		1	1	1		1			2	1	1		13
Student	3	1		1	1	1		1	1		1			2		1		13
Student	3	2	2			1	1	1			1			2				13
Student	5	1		1	1		1	1	1		1			1				13
Student	3	4			1		1						1	1	2			13
Student	3	1		1	1		1	1	1					3		1		13
Student	3			1	1		1	1	1		1			2	1	1		13
Student	5			1	1		1	1	2					3				14
Student	4			1	1		1		1		1			1	2	3		15
Student	3		2		1		1	1	1		1			2		1	2	15
Student	3		1	1	1			2		1	1			2		3		15
Student	3	1			2		2	1	2		1			3		1		16
Student	3	1		1	1		1	1	1			2		2	2	1		16
Student	3	3	1		1			1	2		1			3		1		16
Student	3		3	1	2			3	1		1			3		2		19
Student	3	3	5	4	1		1	1	1		1			2	1	1		24
Total page views	101	30	24	19	28	4	23	26	26	1	21	5	1	53	12	22	2	398
Total students	31	18	14	13	26	4	22	23	23	1	21	4	1	27	9	17	1	32

In the classroom, the teacher manipulated the computer at the teacher’s desk 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.

4.3 Implementation of the quiz within class and others

Table 8 shows the time series cross table of the page view history of digital teaching materials collected in a class of "Introduction to Software", separated into 5-minute intervals. The contents of this course and the digital teaching materials contain commentary concerning introductory HTML and CSS, and students learned how to make and design web pages.

Table 8: Examples of the time series cross table and the implementation of the quiz ("Introduction to Software", 2015/04/27, 5 minute intervals)

2015/4/27	Time (5 minute intervals)																	
Resource name	13:05	13:10	13:15	13:20	13:25	13:30	13:35	13:40	13:45	13:50	14:00	14:05	14:10	14:15	14:20	14:25	14:30	Total
Introduction to S	56	45	121	16	2	2	3	2				2	2	3	1	1	1	257
Quize Chapter 2	301	358	231	1														891
Syllabus			16	19	2													37
Sample of japane			2	23					8	44	12	1	6	1	1	1		99
The first report su		1	6	56	47	3				3	2							118
4.0 Internet & W				1		53	1	1		1								57
4.1 Hyper Text							45		1									46
4.2 Introduction t							32	7	37	1								77
4.3 Introduction t								25	36				1					62
4.4 Grammar of H								1	46	1	7		1			1		57
4.5 Function of T								1	14	4			1	3				23
4.6 Editing HTML									29	3	1	37	4	3	2	2	4	85
Total page views	357	404	376	116	51	58	81	37	171	57	22	40	15	10	4	5	5	1809

Table 9: Teacher's page view history ("Introduction to Software", 2015/04/27)

2015/4/27 Teacher's page view history				
Time	IP address	User full name	Action	Information(Resource name)
2015/4/27 13:04	192.168.10.103	teacher	course view (http:/	Introduction to Software
2015/4/27 13:04	192.168.10.103	teacher	quiz view (http://lm	Quize Chapter 2
2015/4/27 13:13	192.168.10.103	teacher	course view (http:/	Introduction to Software
2015/4/27 13:14	192.168.10.103	teacher	resource view (http	Syllabus
2015/4/27 13:15	192.168.10.103	teacher	resource view (http	Sample of japanese
2015/4/27 13:16	192.168.10.103	teacher	resource view (http	Sample of japanese
2015/4/27 13:18	192.168.10.103	teacher	resource view (http	Sample of japanese
2015/4/27 13:19	192.168.10.103	teacher	resource view (http	The first report submitting
2015/4/27 13:25	192.168.10.103	teacher	resource view (http	4.0 Internet & Web page
2015/4/27 13:31	192.168.10.103	teacher	resource view (http	4.1 Hyper Text
2015/4/27 13:34	192.168.10.103	teacher	resource view (http	4.2 Introduction to Programing
2015/4/27 13:38	192.168.10.103	teacher	resource view (http	4.3 Introduction to HTML
2015/4/27 13:40	192.168.10.103	teacher	resource view (http	4.4 Grammar of HTML
2015/4/27 13:43	192.168.10.103	teacher	resource view (http	4.5 Function of Tags
2015/4/27 13:43	192.168.10.103	teacher	resource view (http	4.6 Editing HTML
2015/4/27 13:43	192.168.10.103	teacher	resource view (http	4.5 Function of Tags
2015/4/27 13:43	192.168.10.103	teacher	resource view (http	4.4 Grammar of HTML
2015/4/27 13:43	192.168.10.103	teacher	resource view (http	4.3 Introduction to HTML
2015/4/27 13:43	192.168.10.103	teacher	resource view (http	4.2 Introduction to Programing
2015/4/27 14:03	192.168.10.103	teacher	course view (http:/	Introduction to Software
2015/4/27 14:03	192.168.10.103	teacher	resource view (http	4.6 Editing HTML

Fifty-three students attended the lesson that day. First, we carried out a small test in the classroom, and the teacher opened the three files (including the contact regarding this report). Furthermore, seven digital teaching materials (A4 size, total of seven pages) were the subject of discussion in the creation of HTML files.

The quiz began at the same time the lesson started, 13:00, and went until 13:10. Because each time limit in which it was carried out was seven minutes, the numerical value at columns of 13:00 and 13:10 is large. The 13:15 column is due to the time taken to confirm the results of the quiz (Quiz Chapter 2), and it was also numerically large.

Meanwhile in Table 8 the 13:20 and 13:25 columns reflect the figures that have been described for submitting the report. In the 13:45 column, the teacher opened the files (4.5 Function of Tags), but only 19 people opened the files, as instructed by the teacher during that period. This is less than half the students. In the same time zone (the end portion of 13:45) the teacher's page view history indicates the same file was opened repeatedly but the students' page view history shows a variation in the data. It is believed that instruction was not sufficient at this point.

5. Time series cross table of unused digital teaching material

During lessons, browsing the parts of the teaching materials as instructed by the teacher is considered desirable as it encourages students to focus on the lesson as much as possible.

In this study, there were cases in which students opened digital teaching material that the teacher did not use in class, and this information was also recorded. The digital teaching materials that the teacher did not use in class, the title of the materials, the number of page views, and the opening times were cross tabulated in a time series and investigated to see whether there was a trend.

Table 10: Time series cross table of page view history of unused digital teaching materials in the lesson ("Multimedia Creation", 2015/4/8, 3 minute intervals)

2015/4/8	Time (3 minute intervals)										
Resource name	10:57	11:00	11:03	11:09	11:12	11:15	11:21	11:27	11:30	12:09	Total
Participants Teac	2										2
Participants Stud									1		1
1.2 Install				1							1
Participants Stud						1					1
3 Basic Usage				1							1
3 Creating a slide				1							1
4 Drawing tool				1							1
6 Title caption cre					1	2					3
Animation softwa	1			1	1						3
News forum	1			1							2
Processing of figu							1			1	2
Participants	7	5	8		1	3		5	2		31
Effective video sh	1	1		1	1						4
Recent activity				1							1
Totla page views	12	6	8	8	4	6	1	5	3	1	54

Table 11: Time series cross table of page view history of students of digital teaching materials that were unused in the lesson ("Multimedia Creation", 2015/4/8, 3 minute intervals)

2015/4/8	Time (3 minute intervals)										
Student ID	10:57	11:00	11:03	11:09	11:12	11:15	11:21	11:27	11:30	12:09	Total
Student	1										1
Student					1						1
Student									1		1
Student				2							2
Student					1	1					2
Student	2										2
Student								2		1	3
Student	1	1			1	1					4
Student					1	4					5
Student	5										5
Student				6							6
Student	3	5	8				1	3	2		22
Total page views	12	6	8	8	4	6	1	5	3	1	54
Total Students	5	2	1	2	4	3	1	2	2	1	12

Table 10 and Table 11 in the lesson of the aforementioned "Multimedia Creation" (2015/4/8) is obtained via a time series cross table of the page view history of the 3-minute intervals digital teaching materials that were not used. Table 10 shows the number of page views and the time that each digital teaching material was accessed, while Table 11 shows the number of views and the time of access for each of the students.

Looking at the right side of the Total column in Table 10, the numerical value is a portion (31) of the participants. This portion shows that it was open to the list page of class participants. Because it was the first lesson of the semester, participants are believed to be concerned about their participation. Via the number of student page views as shown in Table 11, it was discovered that 22 times out of 31 times one student browsed the pages as not instructed by the teacher.

6. Conclusion and future work

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 towards 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. When such a case happens, the teacher needs to think out a way of indication. Furthermore, students found it increasingly difficult to concentrate in the latter half of each class, and therefore a tendency towards delayed viewing of the digital teaching materials can be seen.

There were students who viewed unused digital teaching materials often. This seems to be related to the teaching method and contents of the lesson in question. If there are many students who view unused digital teaching materials there is a risk that they are not focused on the lesson at hand. However, a detailed discussion is an issue for future research.

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