

## Determining Students' Learning Characteristics: A Data Analysis of a Distance-Learning Program

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*The Consortium of Higher Education in Shinshu works to realize the development of the university via the mutual cooperation of higher education institutions and a linked social community. An important project for the consortium is the video conference system where students can take courses offered at other universities and earn credits at their own university. This study analyzes the viewing history data of a distance-learning class recorded content in an attempt to clarify the learning characteristics of students in distance-learning classes. By looking at the viewing times, it is possible to make conclusions about students' learning characteristics, e.g., if they study in the morning or evening. This information may be an important element for constructing appropriate e-learning systems that support students.*

*Keywords: Distance-learning, Learning analytics, Reviewing time, Video conference system*

### Introduction

In 2007, the Japanese government's Education Revitalization Conference requested the formation of a university consortium in rural regions to activate regional human resource development and regional economies. The university consortium is an effort to realize the development of the university and the revitalization of the community via the mutual cooperation of various higher education institutions and a linked social community. With enhancement and support of the Basic Plan for the Promotion of Education (2008–2012) from the university consortium, university collaboration among many regions as well as collaboration with the local society and industries has progressed (MEXT, 2008). Now, collaborative education and research across universities is one form of university education.

The Consortium of Higher Education in Shinshu (2008) is a university consortium where nine universities in Nagano Prefecture collaborate based on the aforementioned concept. Connecting mainly through a video conference system, students can take courses offered at other universities and earn credits at their own university. These classes are recorded and content is created; students can view the recorded content on the Internet. Now in the 9th year of the program, there have been 196 subjects taught over 7 years, from 2009 to 2016, and approximately 3,000 distance-learning courses have been transmitted.

For the first 5 years, the trial-and-error method was repeated to create a credit-compatible mechanism and distance-learning delivery system (Morishita & Niimura, 2009). However, in the more recent years, the system and mechanism were completed making stable operation and enrollment possible. In 2016, the program's achievements included over 1,811 students completing courses. This is approximately 10.7% of all students attending university in Nagano Prefecture. This leads us to the conclusion that about 10% of students in Nagano Prefecture are experiencing or have experienced distance-learning.

As we approach the tenth year of distance-learning classes, it is necessary to progress forward with the program.

Rather than simply acquiring credits via distance-learning, it is necessary to have support in place to promote smooth learning. This is because the total number of dropouts and leave-of-absence students in Japan is about 5% of all students and one of the main reasons for withdrawing from school is poor academic performance.

Therefore, our consortium focused on remedial education within a distance education setting. Remedial education is not supplementary to university education, but the correction of high school education (Kazawa, 1997). In Japan, it has become a problem in that the basic academic ability of a university student is decreasing; for example, there are students who cannot calculate fractions (Okabe, *et al.*, 2010). As a result, some students cannot keep up with university classes, and there are cases where they drop out due to poor academic performance.

Major benefits of distance education are the elimination of physical and temporal constraints. Furthermore, with distance education, students can learn what they want, where they want to, and freely design their learning environment (Terry & Brian, 2010). Our consortium hopes to improve students' self-regulated learning abilities and poor academic performance with these benefits. However, it has not been made clear when, where, and how blended learners study using e-learning contents. We imagine that a learner may choose how to learn according to their lifestyle and their learning attitude might be found based on their learning characteristics in the learning selection result.

While it must be clear when, where, and how a student learns, it must be determined if it is necessary to construct a support system according to a student's home university in order to understand the student's viewpoint. Mark, Helen, Mike, Natasha & Liz (2015) pointed out the necessity of support accompanying the transition to distance education based on the narrative of students' first semester of distance-learning. They suggested that it was necessary to design a learning course and construct a learning support system based on students' viewpoints; meaning there should just be little gaps between face-to-face and distance-learning for students. In addition, Won & Adrian (2016) suggested, "it may be more strategic for institutions to emphasize on the design dimension in their e-learning implementations within the blended learning environment specifically for younger learners".

With all of this in mind, we realize we need to understand how e-learning contents are watched by students in distance-learning in order to design an e-learning design that is close to their learning style. Therefore, the purpose of this study is an attempt to clarify the learning characteristics of students in distance learning classes based on an analysis of the viewing history of recorded distance-learning class content.

## Research Design & Methods

The Consortium of Higher Education in Shinshu adopts the hybrid distance-learning method (Morishita, *et al.*, 2012, Figure 1). In this method, distance-learning classes are recorded in real-time and content is created that becomes viewable on the Internet. In particular, students take distance-learning classes at a fixed time in distance-learning classrooms of their universities with the High-Definition Video Conference System. After that, if they want to look at the recorded content, they can log in to the consortium's LMS (Learning Management System) anytime and anywhere, and select the content from a list. Teachers and managers may edit content after recording, but nobody has edited them in the consortium.

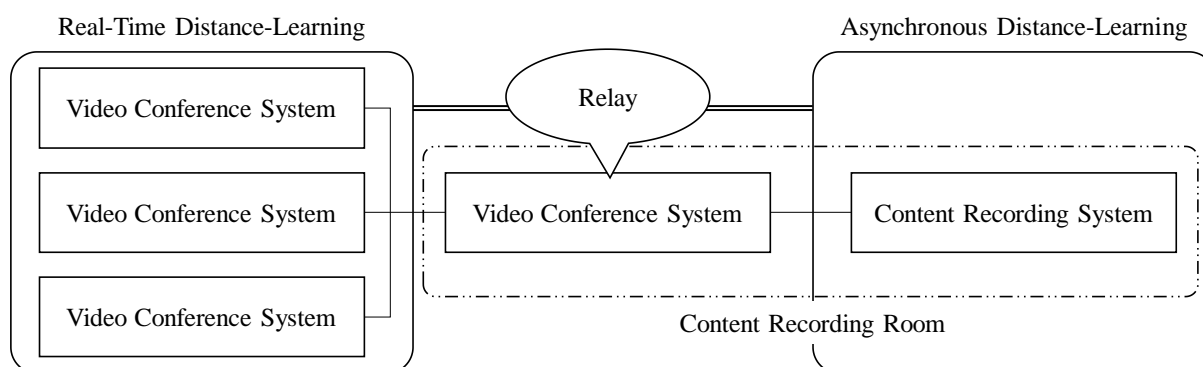


Figure 1. Hybrid Distance-Learning Method

This method includes the following three features:

- (1) By installing recording equipment in a specific facility, classes can be recorded and content created in any remote classroom in the prefecture and cost burdens can be reduced.
- (2) System operation is automatized and there is no need for an expert to maintain each classroom.
- (3) Since regular in-person courses are recorded for network distribution, educational outcomes that are equivalent to in-person courses can be expected for the content.

This method made it possible to publish distance-learning classes that are high quality and in real-time (Real-Time Distance-Learning). Students who are absent from the real-time distance-learning class may look at the supplemented material. And Morishita, *et al.* (2012) suggested that students who attend real-time distance-learning class review the points they do not understand at home and students are encouraged to report their voluntary learning activities (Asynchronous Distance-Learning).

In this study, we target the viewing history for distance-learning class content delivered using these methods from 2015 to 2016. This is because correct data was not recorded on the viewing history before 2014 due to system problems. We analyze the viewing history data after 2015 and study students' learning characteristics in a quantitative and objective process.

## Results & Discussion

From 2015 to 2016, 562 distance classes and 707.4 hours of content were recorded. Upon searching the affiliated universities of students that view the content, we found that students from SHN University and SJC University frequently use the system but usage from the other seven universities is limited. Therefore, in this study, the analytical focus is narrowed to two universities, SHN and SJC.

It should be noted that SHN University is a national university with approximately 10,000 students and SJC University is a private women's college for the humanities and social sciences with approximately 250 students. We thought the size of the student population and the field of study might have a possibility of influencing the comparison between universities. However, as the study progressed it became clear, they were features of each university. We opted to clarify the learning characteristics of each university, including these features. Therefore, we calculated the average viewing time and average viewing time for each university and period, standardized the comparative data, and considered differences between the universities. However, we were unable to clarify the features of the department or major at SHN University because the samples were too small.

The analysis of the two universities' viewing history (Table 1) shows 3,519 students (sum of "Viewing User" of SHN University and SJC University) watched content 14,097 times (sum of "Viewing Time" of SHN University and SJC University). The average number of views per person (View/User) was 3.92 for SHN University and 5.05 for SJC University.

### Polarization in Viewing Range

In this paper, viewing range refers to the actual viewing length of one content item and a viewing instance is defined as watching from beginning-to-end.

Figure 2 shows the percentage of students in each viewing range — the vertical axis: the proportion of students, the horizontal axis: viewing range. At SHN University, 46.25% of the students, and at SJC University, 54.00% of the students, there is a viewing range of 90% or more so about half the students watch the entirety of the recorded content. However, at SHN University, 17.28% of the students, and SJC University, 21.85% students, have a viewing range of less than 10%. Approximately 20% of students stop watching immediately after pushing the play button. Thus, one student-learning characteristic appears to be found by separating the students into two groups: one group who watches content from beginning-to-end and another who watches only the beginning.

However, we cannot make any certain conclusion on students whose viewing range is 90% or more. For example, we do not know how well they are paying attention after pressing "play" button because they do not have to complete certain participatory class activities while the video is running. But, it could be one of the clues to understanding a student's learning characteristics. As for the authenticity of our consideration, we would like to explore it more in future studies.

Table 1

*The Viewing Histories of SHN University and SJC University in 2015 – 2016*

Year	Month	Rec. Classes	Rec. Time(H)	Viewing Time		Min./View		Viewing User		View/User	
				SHN Univ.	SJC Univ.	SHN Univ.	SJC Univ.	SHN Univ.	SJC Univ.	SHN Univ.	SJC Univ.
'15	Apr.	36	15.84	300	84	17.4	40.8	78	30	3.85	2.8
	May	8	11.9	253	189	20.4	46.1	73	29	3.47	6.52
	Jun.	9	13.46	234	139	15.7	48.4	46	23	5.09	6.04
	Jul.	8	10.36	205	71	17.3	40.9	43	15	4.77	4.73
	Aug.	1	0.39	44	3	10.1	59	20	1	2.2	3
	Sep.	3	3.34	2	4	88.8	62.7	2	1	1	4
	Oct.	21	19.2	501	73	23	52.2	99	15	5.06	4.87
	Nov.	18	22.59	444	121	29.7	46.1	92	16	4.83	7.56
	Dec.	15	17.63	318	87	34.5	59.5	81	16	3.93	5.44
'16	Jan.	12	13.27	281	62	37.4	52.7	74	17	3.8	3.65
	Feb.	3	4.12	41	11	27.4	26	22	1	1.86	11
	Mar.	1	0.17	0	0	0	0	0	0	0	0
	Apr.	58	72.39	573	66	41.8	32.7	198	15	2.89	4.4
	May	56	77.55	1167	60	44.6	41.1	256	11	4.56	5.45
	Jun.	65	94.73	1458	46	49.2	42.8	307	7	4.75	6.57
	Jul.	52	71.59	1180	49	46.3	43.1	298	12	3.96	4.08
	Aug.	3	4.48	209	7	28.6	72.2	58	1	3.6	7
	Sep.	9	11.7	19	17	49.9	44.6	8	4	2.38	4.25
	Oct.	44	63.64	941	73	55.5	49.3	299	13	3.15	5.62
	Nov.	42	62.66	1570	28	56.4	41.6	356	8	4.41	3.5
	Dec.	39	56.69	1212	43	53.6	46.6	336	11	3.61	3.91
'17	Jan.	39	49.56	718	37	51.9	64.2	258	7	2.78	5.29
	Feb.	1	1.49	430	12	22.9	55.1	111	1	3.87	12
	Mar.	19	8.65	714	1	14.2	84.6	150	0	4.76	0
Total. / Ave.		562	707.4	12814	1283	42	46.9	3265	254	3.92	5.05

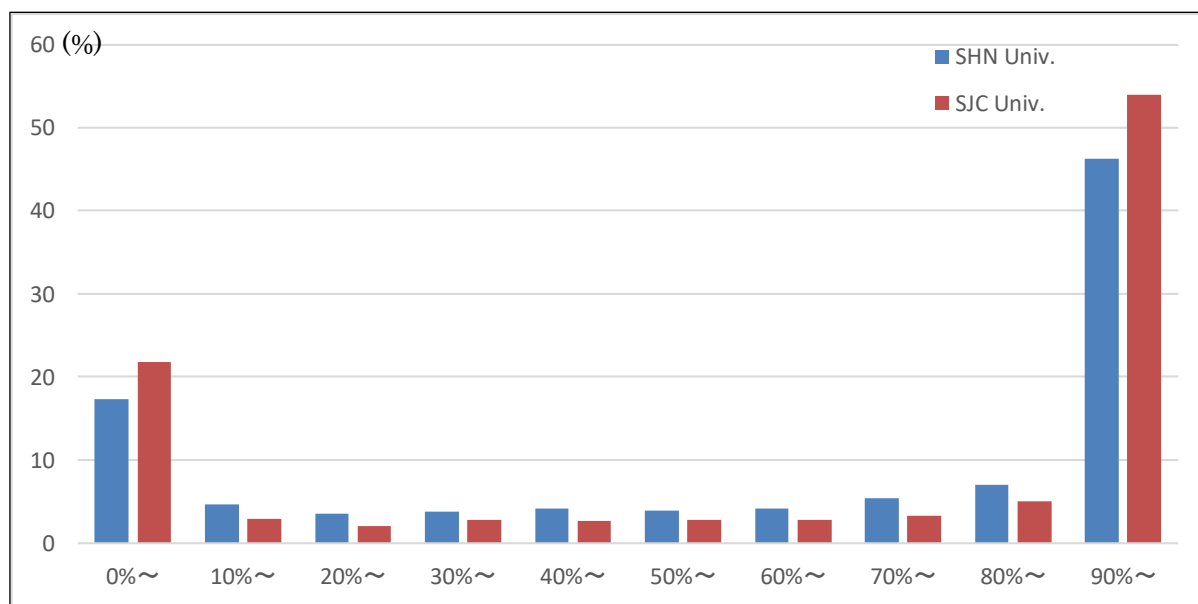


Figure 2. Student's Percentage of Viewing Range (SHN Univ. & SJC Univ.)

## Reviewing Time

Figure 3 displays the ratio of the number of viewers at each university for each time zone viewed. The vertical axis shows the ratio of the number of viewers and the horizontal axis shows the time zone every hour. When comparing trends of viewing time periods based on the percentages of the number of viewers in each university, both universities mostly watched from 15:00-17:00. Thus, we speculate that many students watch in their afternoon free time before going to their part-time jobs in the evening. However, SJC University had many morning time periods (6:00-11:00) and SHN University had many viewings after 22:00. Therefore, for learning characteristics, SJC University students were observed to be morning types and SHN University students were evening types. Various factors such as gender, major field, and grades should also be considered, but could not be clarified in this study.

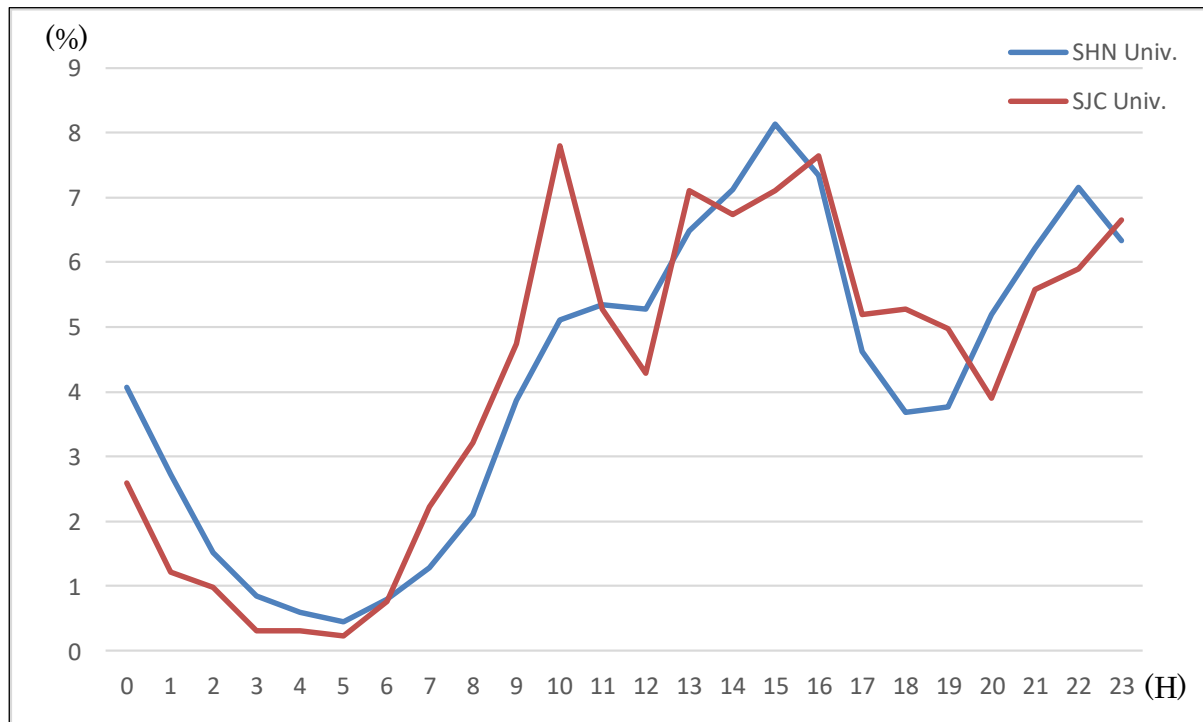


Figure 3. Reviewing Time of the Day (SHN Univ. & SJC Univ.)

Figure 4 shows how much students were watching and listening by day of the week. The vertical axis shows the number of viewers and the horizontal axis shows time zones separated every hour from 0:00 to 24:00. The analysis of one week's credits shows that views at both universities were high from Sunday 18:00 to Monday noon and on Wednesday afternoon to Thursday noon. It is suspected that this arc is influenced by English grammar and physics remedial lessons, which are held on Monday and Thursday, respectively. In Monday morning English grammar classes (9:00-10:30), confirmation tests are taken after class on LMS and if a passing score is not met, students are asked to review and then take the next class. Students at SJC University often view these classes on Sunday afternoon while SHN University students mostly view them on Sunday or Monday afternoon. Thus, we can determine many SJC University students review prior material just before the class day and many SHN University students review material on the same day immediately after class.

Similarly, with physics classes on Thursday afternoon (13:00-14:30), the same differences between SHN University and SJC University students' learning characteristics was observed with reviewing immediately before class or after class. With physics class, in particular, SJC University students noticeably reviewed previous material before class and SHN University students reviewed the same day's material immediately after class. Although the reviewing activity is the same, this is one factor that differentiates students' learning characteristics—reviewing after a short time has passed or reviewing while the memory is still sharp.

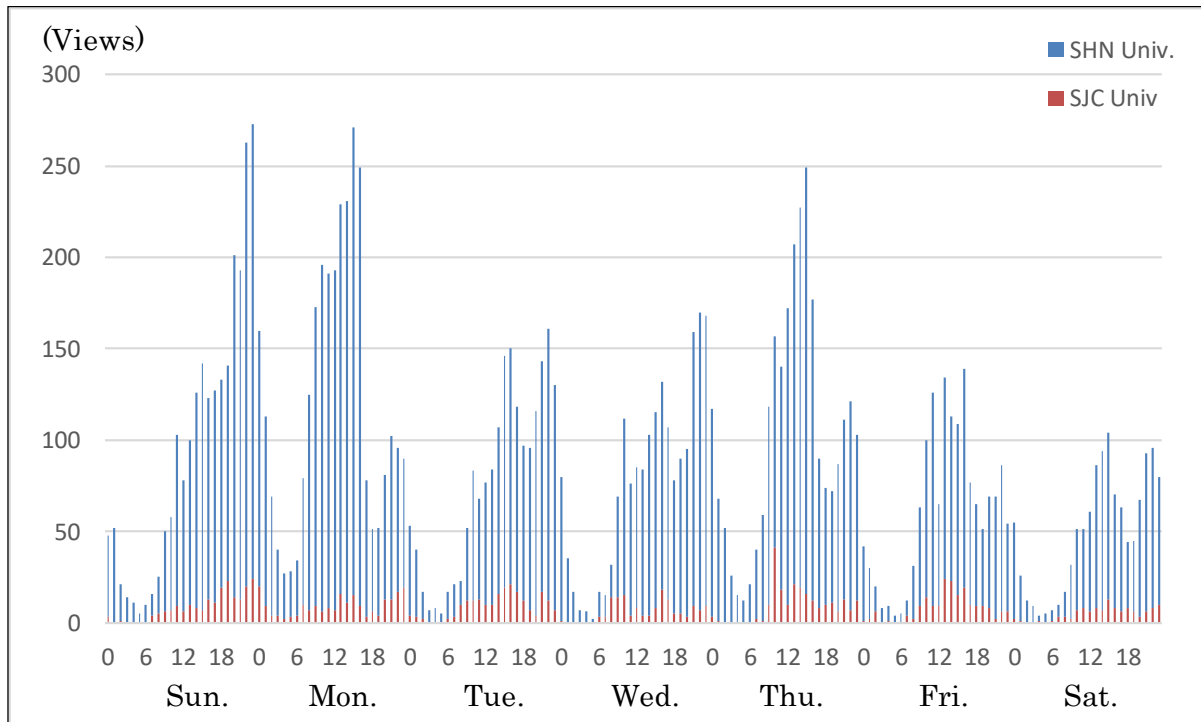


Figure 4. Total Reviewing Time of the Week (SHN Univ. & SJC Univ.)

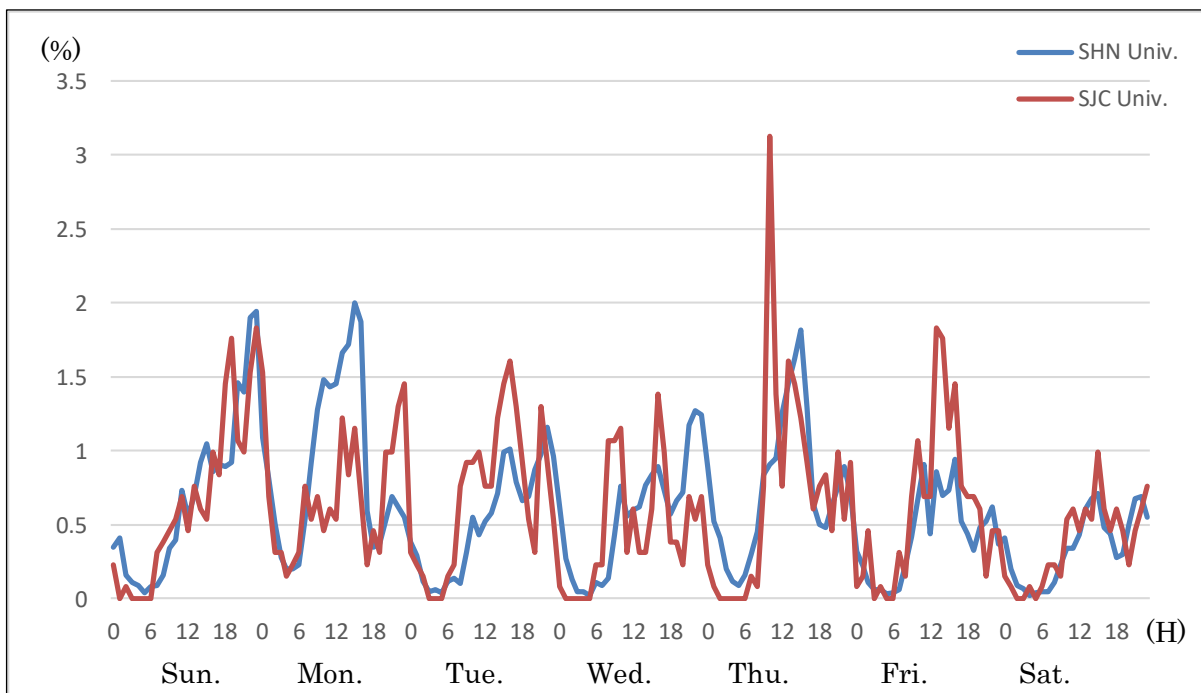


Figure 5. Each Reviewing Time of the Week (SHN Univ. / SJC Univ.)

### Asynchronous Distance-Learning Classes

Many SJC University students also watch content on Friday during the day (Figure 5). The analysis of the viewing history shows that students routinely access content during this time period and watch recorded content of specific classes with a viewing range of over 90%. For these specific classes, if students cannot attend the distance-learning classes in real-time due to various circumstances, they can listen to recorded content. Also, students who do not

wish to earn credit can view the class. While it is based in theory since the students did not confirm themselves, we can guess these students took e-Learning courses since they could not attend in real-time or because they only wanted to audit the class.

## Conclusion

This study's aim was to analyze the viewing history data of recorded distance-learning class content and study students' learning characteristics. A quantitative data analysis revealed the following items about the students' learning characteristics.

- For learning time periods, there are students that study in the morning and students that study in the evening.
- There are students using free time during the day to learn. Among these students, it is possible that some could not attend the distance-learning class in real-time due to various circumstances.
- There are students who review before the class and students who review immediately after the class.
- In terms of viewing range, there are students who view the content from the beginning-to-end and students who quit soon after beginning. In particular, students who are studying with e-Learning and students who wish to audit the class view from beginning-to-end.

Based on these results, we can suggest it is possible to understand students' learning characteristics by looking at time periods and review processes through analysis of viewing history of distance-learning recorded content. These learning characteristics reflect students' lifestyles and how they approach learning. In other words, comprehending the learning characteristics of students based on the viewing history of e-learning contents leads to learner analysis in Instructional Design (ID). This will be an important element when constructing an appropriate e-learning design suitable for students' learning styles and blended learning capabilities.

Many students use content to prepare and review for their distance-learning class. Therefore, we can surmise that distance-learning recorded content can be expected to promote preparation and review material and that it will contribute to the formation of students' learning behaviors. However, this study is unable to clarify how the above learning characteristics influence grades or how they relate to academic abilities that the students possess. Although recording remote classes can impact learning behavior to some extent, it remains unclear whether it can be used to deepen understanding or effectively conduct learning. Therefore, future studies should consider academic ability and grades to help clarify the relationship between learning characteristics and academic ability.

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