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Academic IR on National University Corporation Hokkaido Higher Education and Research System

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Abstract

Three national university corporations in Hokkaido: Otaru University of Commerce, Obihiro University of Agriculture and Veterinary Medicine, and Kitami Institute of Technology, are merged as "Hokkaido Higher Education and Research System" from April 2022. In the integration of those three universities, the basic policies include business integration, research collaboration, educational collaboration, and innovation creation, and academic IR is becoming increasingly important as a framework for educational collaboration. This paper focuses on the academic IR, describing the integration of infrastructure supporting IR, inter-university efforts in specific subjects, etc., and provides an analysis of the current status and future prospects. The status to the integration of the three universities, their visions and prospects are described, and as actual examples, the results of IR in Kitami Institute of Technology and Otaru University of Commerce are presented.

Keywords: Academic IR, Integration of institutes, Educational Cooperation, Data Science on inter-institute.

1 Introduction

Japan is currently experiencing an unprecedented trend of declining birthrates and aging population, and the number of so-called "18-year-olds" preparing to enter college is decreasing year by year. The impact of this trend appears also in terms of university enrollment capacity, and various efforts have being made at various universities.

Under these circumstances, the three national university corporations in Hokkaido, Otaru University of Commerce (OUC), Obihiro University of Agriculture and Veterinary Medicine (OBI), and Kitami Institute of Technology (KIT), has been integrated as one corporate organization called "Hokkaido Higher Education and Research System" in April

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2022. The purpose of this integration is to strongly promote the mission of the system, e.g. education, research, and regional contribution, and also to address the current situation of universities and to achieve more developed university management [1].

In addition to this, several other mergers of national university corporations have been implemented or are planned, e.g. "Tokai Higher Education and Research System" of Nagoya University and Gifu University, and the merger of Shizuoka University and Hamamatsu University of Medical Science, etc. There are two types of integration, (1) multiple universities are integrated as a single university, and (2) an integrated organization is established and each university is integrated as a member of that organization. Our Hokkaido Higher Education and Research System and Tokai Higher Education and Research System correspond to the latter.

What makes Hokkaido Higher Education and Research System unique compared to other university consolidations is three fold: (1) the very large distance between the universities, (2) single-department colleges of roughly equal size, and (3) different research fields: commerce, agriculture, and engineering.

As for (1), Hokkaido itself is a very large prefecture, so even the shortest distance between OBI and KIT is about 150 km, and the farthest distance between OUC and KIT is about 350 km, which in Honshu is equivalent to the distance of another prefecture or another region. In order to collaborate under such a remote situation, it is desirable to make full use of the high-speed and powerful network on SINET [2] and integration of ICT infrastructure. For this purpose, we have been systematically promoting network coordination, infrastructure integration and ID integration.

What is expected from educational collaboration based on (2) and (3) is the development of educational programs that integrate different fields and a system to share these programs in remote areas. Under these circumstances, Hokkaido Higher Education and Research System has organized the "Innovation Center for Education (ICE)" for the promotion of educational collaboration and integration and the "Open Innovation Center (ACE)" for the promotion of research collaboration. The ICE is designed to promote the fusion of education and research, and the ACE is designed to promote research collaboration.

This paper focuses on educational collaboration at the Hokkaido Higher Education and Research System and the academic IR that supports it, and discusses the development of ICT infrastructure to back up educational collaboration and actual IR examples for courses offered at KIT and OUC, respectively.

ICT utilization is the key to educational collaboration, especially between universities located far from each other, and ID integration is essential to integrate LMS and academic management systems and student services, as well as ICT infrastructure integration. This paper describes the creation of a framework for ICT integration and the coordination of related departments in each university. On the other hand, educational collaboration and activities to analyze the data that emerges from such collaboration and link it to specific academic IR are also important, and several courses have already been established as collaborative education courses, which are distributed and shared among universities.

In order to describe and discuss these current conditions, this paper is organized as follows. Section II describes the ICT infrastructure integration and ID integration efforts, Section III describes the results of data analysis in specific subject collaboration, and Section IV develops a discussion of the results.

2 ICT Infrastructure Integration and ID Integration

The most visible difference in the integration of the Hokkaido Higher Education and Research System compared to other university organizations is the large distance between the three universities.

The shortest distance among the three universities is between OBI and KIT, but it is still approximately 150 km, which requires considerable travel time and limits the time spent at the universities visited in a day trip. Hence, various factors such as securing schedules and transportation, and the burden on the faculty members in charge of the lectures should be considered when offering lectures in the form of visits and in person meetings. Therefore, it is important to devise educational collaboration that maximizes the use of the network connecting each university. In terms of ICT infrastructure, this includes efforts toward integration at each layer, such as network utilization, server integration, service integration, and ID integration.

In terms of network utilization, most Japanese higher education institutions are connected to SINET [2], an academic information network managed by the National Institute of Informatics (NII), OUC, OBI, and KIT are also connected to this network. SINET has performed five major upgrades, and moved to the sixth generation, SINET6, in April 2022, which provides a great improvement of line speeds, more stability, variety of network services, and integrations of other NII services.

With the move to SINET6, the number of data centers (DCs) for connectivity has been greatly expanded, making it possible for OBI, for example, to switch from a DC that used to be connected via a long distance to a nearby DC, see Figure 1. In addition, the cost for line speed has also dropped to some extent, which has enabled a significant increase in speed for all three universities: Otaru (200Mbps →10Gbps), Obihiro (1Gbps → 10Gbps), and Kitami (10Gbps → 200Gbps). By taking advantage of this high-speed communication, server-intensive infrastructure can be developed no matter how large the distance between the three universities, which will lead to server integration, service integration, and even ID integration.

Faster and more stable network layers facilitate server consolidation, which in turn leads to server and service consolidation. The three universities of Hokkaido Higher Education and Research System, i.e. OUC, OBI, and KIT are preparing for server integration in anticipation of the 2022 university merger and the equipment upgrade five years later, in 2027. The basic policy of the integration is to consolidate servers at KIT, and to use a virtualization infrastructure to ensure efficiency and scalability of the integration. The equipment has already been updated based on this vision before the university consolidation in 2022. The virtualization infrastructure is located at KIT, and 30, 30, and 200 virtual servers are running at OUC, OBI, and KIT, respectively. The roadmap to the consolidation is shown in Figure 2. The lease term of the equipment will expire in five years, and in 2027, Hokkaido Higher Education and Research System plans to introduce the equipment in the form of a single renewal and consolidate more servers.

Server consolidation is the so-called “outer” consolidation; what is more important and requires coordination is the consolidation of services. Moving from a state in which education, research, and operations have been conducted using separate software and services at the three universities to the same one will result in changes in UI and workflow, and will require “inside” consolidation, i.e., consolidation of requirements definitions among the universities and coordination within each university.

For this purpose, Hokkaido Higher Education and Research System has organized the

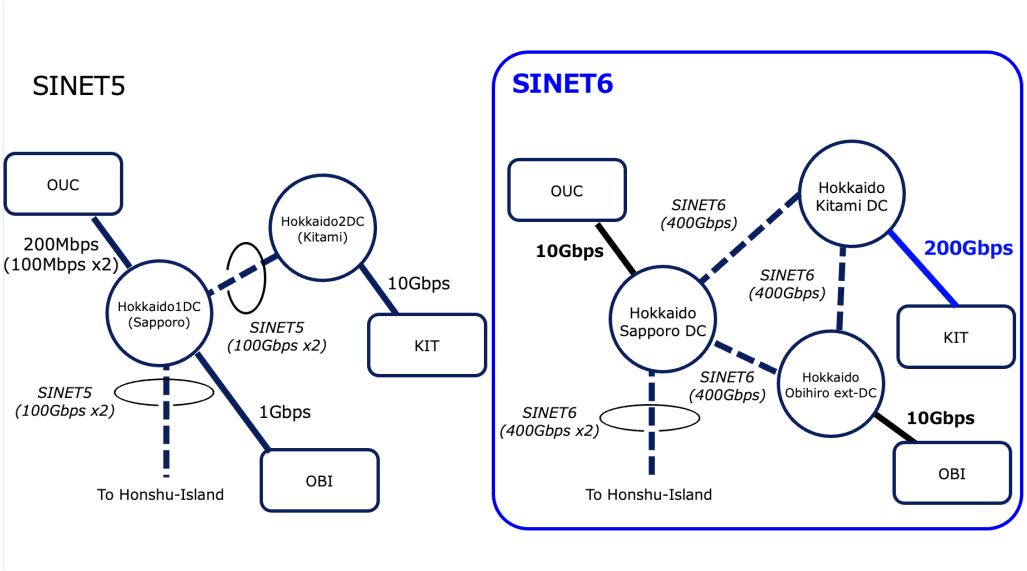

Figure 1: Transition from SINET 5 to SINET 6 on OUC, OBI, and KIT.

"Information Strategy Promotion Office" and the "Information Strategy Promotion Division" and develops the information strategy coordinating with ICE and ACE, which are innovation centers for education and research.

Furthermore, service integration must simultaneously achieve identity integration, which has the greatest impact on the user end side. IDs are at the core of current ICT utilization, and they are also the perimeter for the use of public services such as cloud computing and software subscriptions. Therefore, it is necessary to establish a management system and accompanying workflow from an integrated perspective for university IDs, which have been handled under separate management systems and workflows.

In response to these goals, Hokkaido Higher Education and Research System, through its Information Strategy Promotion Office and Information Strategy Promotion Division, is in the process of understanding the current status of ID management at each university, defining requirements for integration, and defining workflows.

While preparing for these infrastructural aspects, the implementation of academic IR among universities through educational collaboration will be discussed in the next section.

3 Academic IR in KIT and OUC

3.1 IR in KIT

Kitami Institute of Technology conducts the following IR activities:

Academic Affairs:

- Aggregate analysis of new student questionnaires
- Analysis of satisfaction questionnaires for classes
- Analysis of questionnaires for graduates and companies

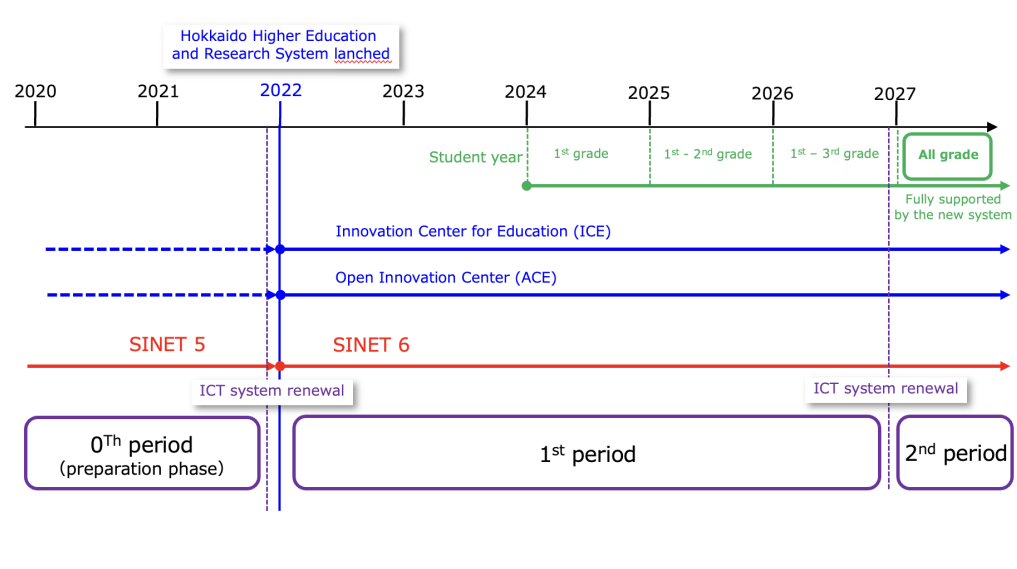

Figure 2: The roadmap to the infrastructure integration.

- Analysis of grade evaluation biases for educational improvement

Admission:

- Analysis of trends in entrance examinations
- Calculation of enrollment rate and analysis of calculation method for the number of successful applicants in entrance examination

Research cooperation:

- Analysis to increase the adoption rate of Grants-in-Aid for Scientific Research
- Analysis of joint research through questionnaires

As IR activities related to the Academic Affairs, an analysis of student and graduate trends is conducted every year, and their results are regularly reported during Faculty Development (FD) seminars. In terms of admissions, one of the features of the entrance examinations in KIT is the need to carefully determine the number of successful applicants to account for the certain number of students who pass the exam but do not enroll. The actual enrollment rate typically hovers around 50-60%. It is crucial to estimate and calculate the number of successful applicants accurately. In the realm of research cooperation, the target number of applications is computed by considering the faculty members' success rate in obtaining Grants-in-Aid for Scientific Research, the number of applications received, and the budget for acquiring them. Moreover, the outcomes of its in-house efforts to obtain Grants-in-Aid for Scientific Research is analyzed. Additionally, we conduct a questionnaire survey among partners involved in joint research initiatives with companies and government agencies to identify the characteristics of partners who are highly satisfied with their collaborative work.

Hereafter, we present the results of a questionnaire survey on fundamental skills for working adults conducted during the class "Practical learning about the Okhotsk Region,

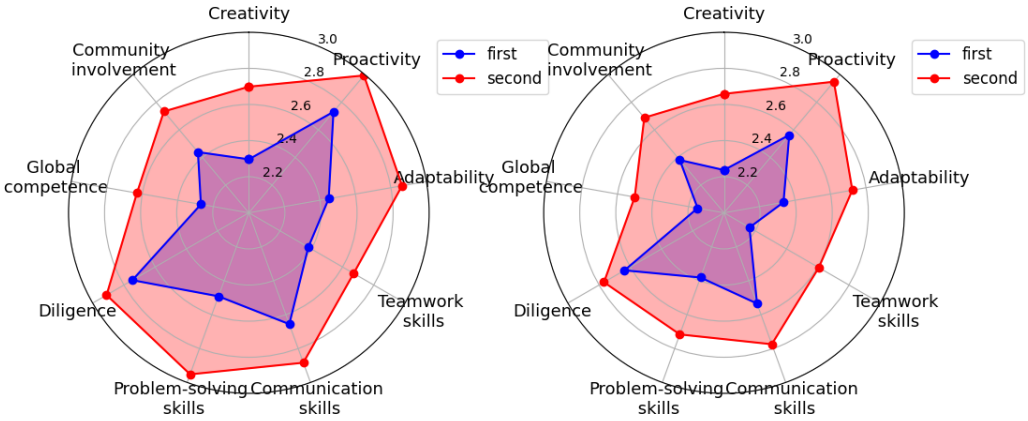

Figure 3: The average value of each evaluation item for first-year students in 2022. (Left) School of Earth, Energy and Environmental Engineering (Right) School of Regional Innovation and Social Design Engineering.

its history and the natural environment". This class aims to provide students with an understanding of the Okhotsk region and its environment by delivering lectures on the region's features, the activities of people in the region, the relationship between the region and the university, and the natural environment. At the first session (in April) and the final session (in February) of the class, a four-level rubric evaluation [3] is conducted on the following nine fundamental skills for working adults [4]:

Creativity, Proactivity, Adaptability, Teamwork skills, Communication skills, Problem-solving skills, Diligence, Global competence, Community involvement

The number of student respondents was 431 (98% response rate) for the first survey and 345 (79% response rate) for the second survey. According to the results over the past five years, students in KIT have been identified as having strengths in *proactivity* and *diligence* but weaknesses in *global competence* and *creativity* upon entering the university. However, throughout the academic year, significant improvements are observed in *creativity* and *adaptability*.

In Figure 3, the average value of each evaluation item for first-year students in 2022 is presented by department[1]. The evaluation of all items has increased as indicated in the figure. Figure 4 illustrates the distribution of the total value of all evaluations, revealing an improvement in the second evaluation compared to the first. Notably, approximately 69% of students showed an improvement in their evaluation, while approximately 25% of students showed a decline. The distribution of the difference between the first and second summaries is presented in Figure 5.

The results of this survey are included along with the first-year grades and utilized as a reference for self-reflection. Students who observe an improvement in their evaluation are motivated to continue building upon their strengths, while those who notice a decline are encouraged to investigate the reasons for the drop throughout their academic journey.

Moving forward, we intend to carry out this survey at the other two universities in collaboration to explore variations between universities and academic disciplines.

[1]KIT has two schools, *School of Earth, Energy and Environmental Engineering* and *School of Regional Innovation and Social Design Engineering*

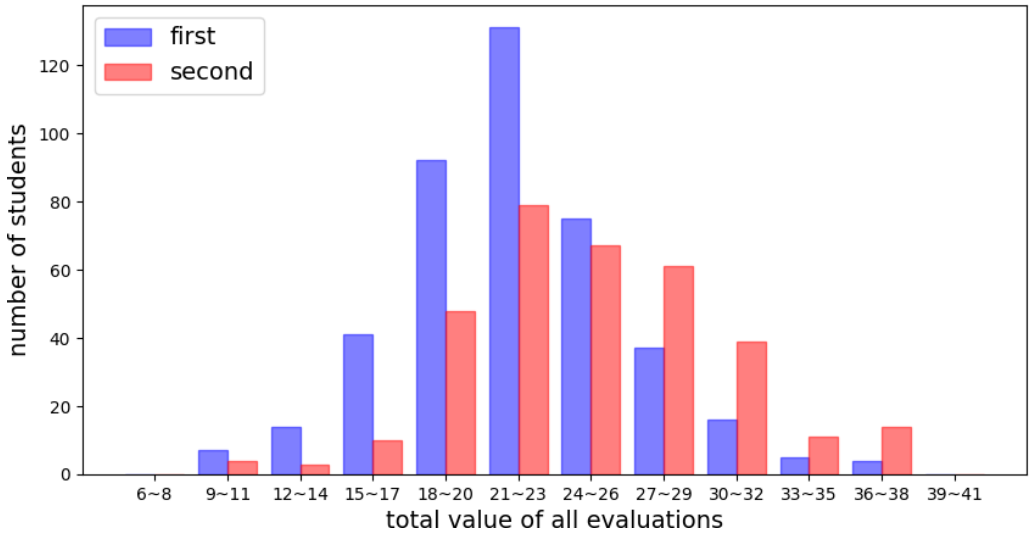

Figure 4: The distribution of the total value of all evaluations.

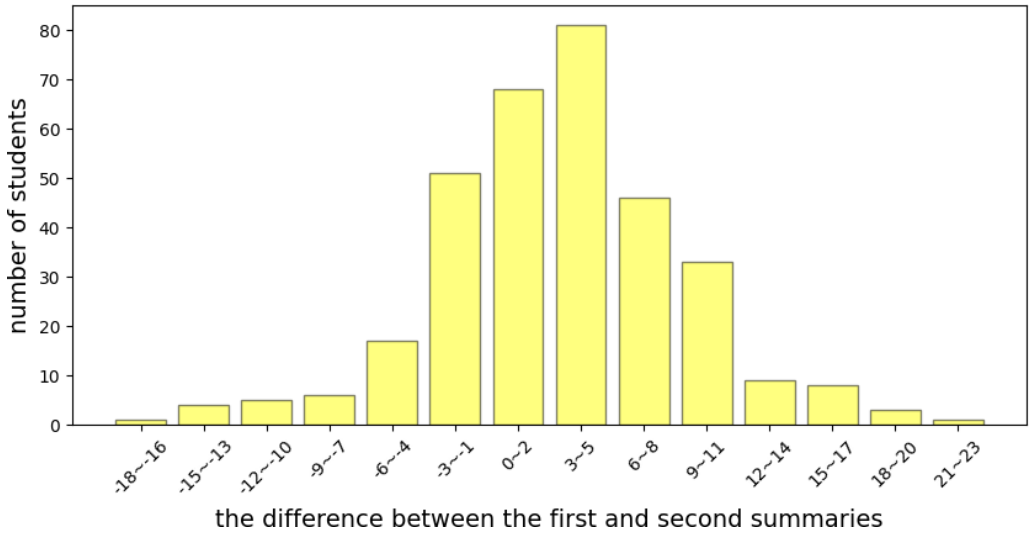

Figure 5: The distribution of the difference between the first and second summaries.

3.2 IR in OUC

Otaru University of Commerce established the IR Office in 2020 and has been promoting IR by assigning full-time faculty members. Since the Office is a newly established department, its role and functions are being explored through various initiatives. The initiatives undertaken so far can be broadly divided into the following three areas.

- Collection and organization of data and database building
- Monitoring and regular reporting of basic data
- Analysis of individual issues at the request of departments, divisions, executive offices, etc.

In order to effectively carry out IR, it is necessary to grasp and organize data that is dispersed within the organization and build a database system that integrates this information. To achieve this goal, we constructed an integrated database system that automatically collect data managed by each department through an ETL system. The database stores various types of data such as student enrollment, academic records, grades, and entrance examination data, allowing us to always access the latest data in a centralized manner. And based on this database or regular student surveys, etc., we monitor basic information that corresponds to the university's annual schedule and provide regular reports to the university executive team and relevant departments. The main initiatives are presented below.

- Analysis of Admissions Results
- Implementation and Analysis of Survey for New Students
- Implementation and Analysis of Graduation Year Survey
- Implementation and Analysis of Alumni Survey
- Analysis of Grade Distribution for Each Semester
- Analysis of Course Evaluation Survey

3.2.1 Analysis of viewing data for On-demand Video Lectures

The IR office in OUC conducts a range of surveys and analyses to support decision-making and enhance institutional effectiveness. Here, we present as one of case study focusing on the collection and analysis of viewing data for on-demand video classes. Some of the classes offered mutually among the universities are in on-demand video format. It is possible that there are differences in viewing patterns and learning effectiveness of class videos among universities, and this needs to be verified.

The course exemplifying here consists of three parts: Writing, Economics, and Business Administration. It is designed to provide students with an understanding of the fundamentals of economics and business administration, as well as basic writing methods for reports in the social sciences. Classes are conducted via on-demand video, with students watching weekly videos and submitting quizzes and reports. This course is delivered to three universities, and the IR office needs to understand and analyze the learning status and differences between each university. Therefore, to record the viewing logs of this on-demand class, we built our own modified video distribution server in the university [5][6] . In the server,

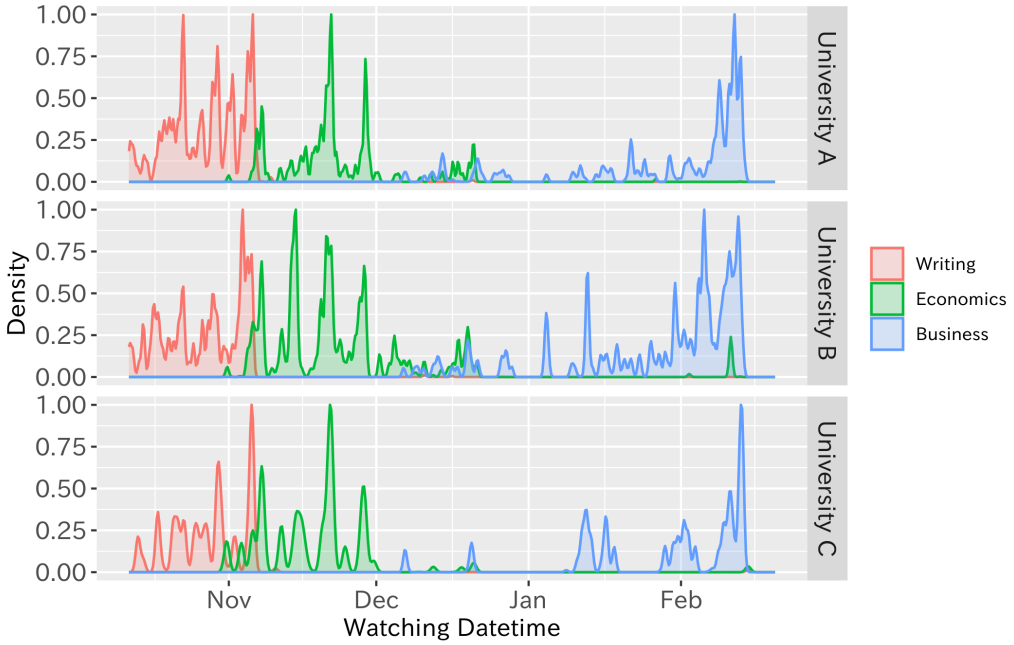

Figure 6: The density of viewing logs in the time series by University.

when a student watches a video, "user ID," "session ID," "video ID," "playback position (second)" "time," etc. are recorded in the database every 2 seconds in video time.

A total of 109 students from three universities took the course, and 2.01 million viewing logs were recorded during the approximately four-month class period. In the following section, we present several examples of data analysis performed on the viewing logs to provide insights to the faculty member regarding the students' learning progress and to facilitate course improvement based on this vast amount of data.

Since on-demand videos are viewed at different times by different students, we visualized them as shown in Figure 6 to analyze when class videos are viewed. The density of viewing logs in the time series of each class segment was estimated using the kernel density function, as depicted in the figure. The graph displays areas with prominent peaks, which indicate times when a large number of students are watching the class videos. These peaks exhibit roughly a one-week cycle, corresponding to the distribution schedule of the videos. Also, there does not appear to be a significant difference in viewing patterns among universities.

Figure 7 visualizes which parts of each video are frequently viewed. The higher peaks on the graph indicate that the video is viewed repeatedly. One feature of the on-demand videos is that students can freely watch any part of the videos as many times as they wish. From this figure, it is possible to analyze which parts of the class videos students are interested in. This information could lead to improvements in future class content. When we checked the areas where the graphs peaked in some of the videos, many of them were still related to report assignments, quizzes, etc.

Figure 8 shows a scatter plot of the relationship between cumulative viewing time for the entire class and grades. In the graph, the dashed line represents a local Polynomial regression line, while the solid line corresponds to the regression line incorporating the squared

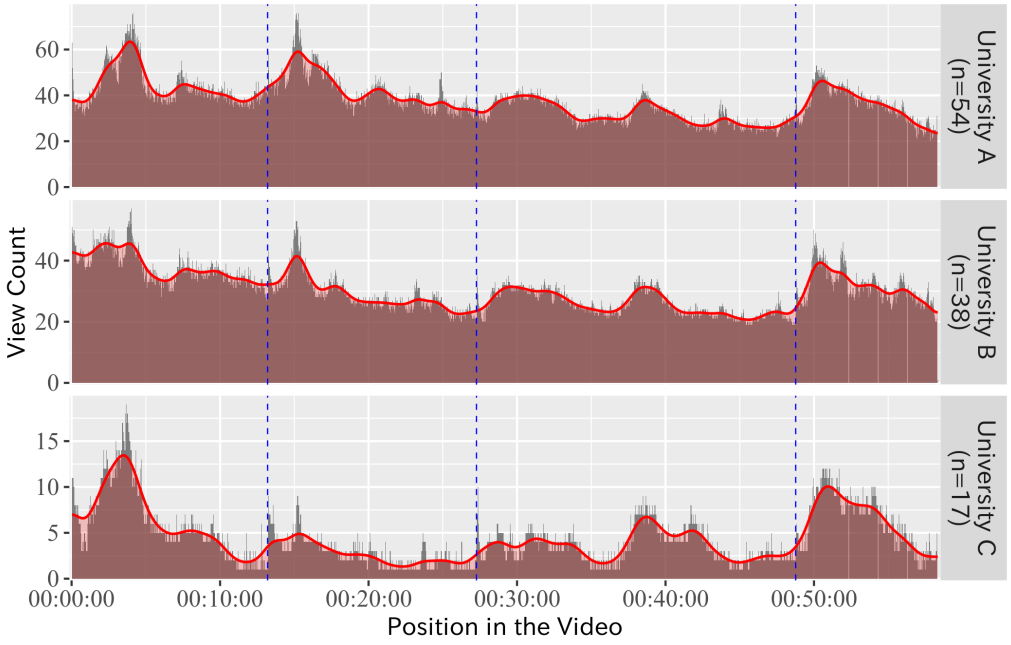

Figure 7: View count by video position.

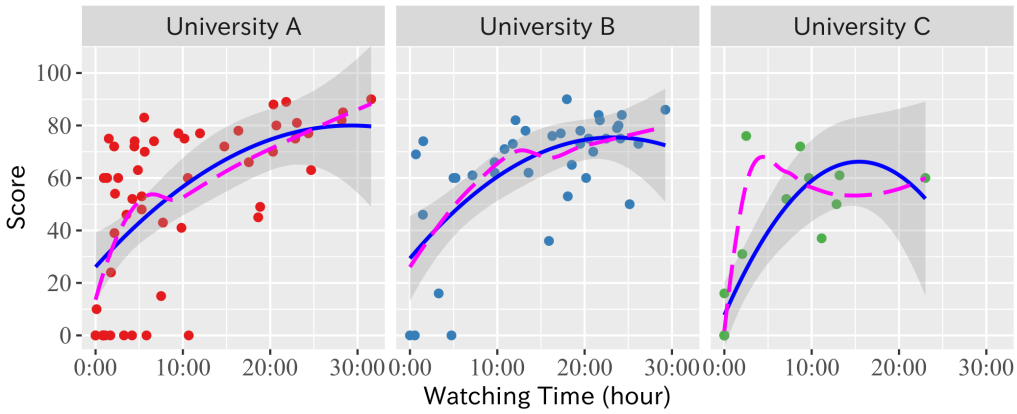

Figure 8: Scatter plot of the relationship between cumulative viewing time and grades.

term of watching time. This figure shows that students who spend more time watching tend to perform better.

A multiple regression analysis was conducted using a model that explains grades based on viewing time, the square of viewing time, and the interaction between college and university with viewing time. The results of the analysis are presented in Table 1. Based on the results, the coefficient associated with viewing time was found to be statistically significant at the 5% level, implying that longer viewing time is associated with better performance. Furthermore, the quadratic term for viewing time also yielded a significant result, with a negative coefficient, suggesting that the rate of performance improvement decreases as viewing time increases. Moreover, there appears to be no difference in intercept or the effects of viewing time among the universities.

Table 1: Multiple Regression Analysis with Grades as the Dependent Variable

	Beta	**p value**
Watching Time	4.3	<0.001
Watching Time (Squared)	-0.09	0.011
University		
University A	—	
University B	5.0	0.6
University C	-13	0.14
Watching Time * University		
Watching Time * University B	-0.31	0.6
Watching Time * University C	0.38	0.7
R^2	0.494	
Adjusted R²	0.465	
No. Obs.	109	

These analyses exemplify the examination of viewing data for on-demand classes. The analyses presented herein are preliminary in nature, and further detailed analyses and discussions remain as future tasks. The findings from these analyses will be disseminated to the faculty members responsible for the respective classes and the universities where the classes are offered. The results will be expecte to utilized to inform and enhance the quality of the classes.

4 Summary and Discussion

In this paper, we describe the efforts to date in the development of academic IR and the infrastructure for it at the Hokkaido Higher Education and Research System, which was established through the corporate merger of Otaru University of Commerce (OUC), Obihiro University of Agriculture and Veterinary Medicine (OBI), and Kitami Institute of Technology (KIT).

In terms of infrastructure integration, several servers have been already consolidated and operated to the virtualized infrastructure installed in KIT before the corporate integration in 2022, and further infrastructure integration and integration of IDs and services tied to IDs will be an important issue to be achieved by 2027. In the teaching and learning IR, we

analyzed the distribution of "Practical learning about the Okhotsk Region, its history and the natural environment" for first-year students at the KIT, focusing on student questionnaires. In addition, the degree of viewing of the on-demand teaching materials for a class delivered by OUC was compared among universities and the correlation with grades was analyzed.

In order to create an advantage by integrating the three universities: OUC, OBI and KIT, it will be important to formulate educational programs that integrate arts and sciences, recurrent education programs, etc., based on the feedback from this type of academic IR. To realize this, it is desirable that the integration of ICT infrastructure and academic IR interact organically to strengthen the management of the Organization.

Acknowledgments

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