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Abstract: In this paper, how to collect the data related to personal information of students by smart education system (SES), and how to open these data to faculty members for improving online education at Kanazawa University are discussed from the perspective of SES design and user usage. In the new era of big data, administration and education management in universities adopt online SES. Even though Kanazawa University started to encourage faculty members to start dynamic teaching course using SES, few faculty members use the SES to improve the education style because they must teach in the ordinal classroom way. However, SES improves the convenience of personal information management of registered students in universities, including basic information, course registration, course grade, consultation record, etc. In this paper, we investigated the problems with ordinal classroom currently in the case that SES has been installed.

Keywords: student personal information; education implementation model; faculty member; administration officer; classroom.

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1 Introduction

In this paper, a comprehensive process is considered to explain the challenge of smart education system (SES) in current university campus, so as to fully use big data for education management. In order to improve planning and design of university campus from the perspective of integration of SES with education activities, we take Kanazawa University as a case study to discuss current approaches of implementing SES for education management and education activities, thus finding out the usage obstacles of big data, including student personal information in pilot course using ordinal classroom.

In terms of usage of big data in education, personal information of students is possible to be collected by education system and many sensors using information communication technology (ICT) in university campus at present (Huang et al., 2012), which will have great impact on activities of faculty members and learning activities of students (Nguyen and Williams, 2016). Because education activities can be changed in many aspects by using those data, planning and design of university campus and buildings will be changed greatly by the personal information application of students. ICT provides new functions for education, and how to design the new style classroom for matching the new functions of SES in future is a challenge. In our study, we attempt to find the problems currently in smart education activities in ordinal classroom of university campus, which results in limitations of the education activities using personal information where SES has been installed.

1.1 Education management using SES in Japan

With the development of informatisation in recent years, the higher education institutions also pursue high efficient education using SES equipment installed in the classrooms, which is popular and highly expected. The new reform strategy of information technology (IT) (MEXT, 2016, 2018) has been carried out to promote the education using ICT and SES.

For education, student information is necessary for management of all education activities, and if all students' activities and their information can be stored in cloud system, the degree of convenience of education management will be greatly improved. Based on the modification of the Basic Law of Education in 2006, the basic concept of education based on scientific and technological development using IT are put forward. With the update of smart learning environment, higher education higher education must be IT-oriented, like each person has one computer, electronic blackboard, Wi-Fi, electronic textbooks, the flexible application of the teaching materials. There also are specific suggestions related to build learning environment using IT. The flexible application of SES based on ICT is the national strategic development goal from the worldwide (Zhu et al., 2016).

The survey conducted by MEXT(2016) in Japan showed that the application of ICT-based SES gradually increases year by year, in which the researching of textbooks, guiding and preparation, assessment are highly applied in the application of SES. Accordingly, the application and the usage of SES are gradually improved. 'The higher efficient application of ICT' is specifically and clearly mentioned in the 'basic plans of education prospering', which is decided in the Cabinet meeting in June, 2013.

Meanwhile, based on online education, reversal teaching ways can make open education more efficient, the teaching quality in universities are improved through the publishing the large-scaled public online lectures, like massive open online course (Qaffas et al., 2020; Guerrero et al., 2020), which are spread quickly worldwide in recent years. Additionally, the non-public online courses centred on school students are enlarged in the future with the application of small private online courses (Prates et al., 2019). How to ensure learning efficiency and learning quality has attracted more and more attention.

Taking the national higher education institutions as the objects, Kyoto University (2014) shows that the introduction rate of learning management system (LMS) of SES was relatively applied to a certain extent, with 78.4% of the national universities, 38% of public universities, 55.5% of private universities in 2013. In the higher education of Japan, the high level of contents in education as well as the diversification of teaching methods using SES will play a prominent role in achieving higher efficient teaching (Hiraoka et al., 2005).

As mentioned above, although the higher education institutions are required to apply the advantages of ICT and SES positively, the teaching ways using SES are applied at a low level in Japan.

1.2 Student personal information and its usage for education management using LMS

In the Personal Information Protection Act issued by Japanese Government in 2003, there are many critical issues such as whether the personal information can be provided to the third party without the consent of the person, and how to define the limitations of providing concerning the specific personal information. Lin et al. (2019) investigated on law system in different countries to protect usage of personal information for the usage of collected big data from mobile devices and sensors, which is very valuable for business activities in many fields. In cases, even though the person himself or herself agrees with open their personal information, the personal information still cannot be provided exceeding the application scope. Even though it is related to the schooling assistance procedures and others, it must be applied cautiously if any personal information is involved.

There are many student personal information that should be recorded in LMS for education management (Sinn et al., 2019), such as students' name, telephone numbers, tutors' name, locations of the students, grades, registered courses, related documents such as 'survey of health status', 'diagnosis certificates of physical examination', 'original copy of family situation', including all information of both students and parents.

The students in a university have the risk because they open their personal information to LMS, and there are strict online personal protection regulations towards the online personal information for online business management at present (Steppe, 2017). Japanese universities have formulated the regulations of personal information protection based on the Personal Information Protection Act, including rules to the objects of personal information, rules of obtaining the personal information, protection and management, rules of personal information, rules of providing personal information to the third party when considering the design concept of SES (Higashi et al., 2013). Therefore, it is necessary for university authorities to protect personal information in all educational activities.

1.3 The application of SES and the limitations of ordinal classroom

The advantage of the electronic course is that it can serve more students than ordinal classroom approaches (Elleithy and Sobh, 2015). However, the ordinal classrooms basically exist in all universities, and face-to-face education approach is helpful for learning, thus the integrated education approach of flipped classroom and ordinal classroom that combines face-to-face education with SES is indispensable (Rutkowski, 2015). Meanwhile, if student interaction recorded in a cloud system of SES can be used as real-time feedback to teachers in classroom, SES will change the education style thoroughly (Kobayashi et al., 2017; Kim et al., 2011).

In this paper, how to collect the data of personal information of students by SES, and how to open these data to faculty members for improving education quality at Kanazawa University are discussed from the perspective of system design of SES and usage of users. SES improves the convenience of personal information management of registered students in universities, including basic information, course registration, course grade, consultation record, etc. However, improvement of education quality is limited to information management. Even though the university started to encourage faculty members to start dynamic teaching course using student personal information stored in

SES in some classes, few faculty members use the SES to improve the education style because they must teach in the ordinal classroom way

In the remained parts of this paper, we discuss about methodology in the second section. Following with description on the students' personal information in SES, the teaching process using LMS is introduced in 3–4 sections. In Section 5, we use questionnaire to investigate smart teaching activities in our case studies, so as to figure out what are problems in the ordinal classroom when carrying out dynamic teaching course using SES.

2 Theoretical concept and methodology

General speaking, the application of personal information is changing the business style in the world, for which physical urban and building environment have not been developed enough to match the style of business using ICT. In the case of our research in campus planning and design, education activities as mentioned above are more and more depended on SES, in which those data stored in SES are a mass of personal information, which is helpful to education management. In order to improve education management using SES, the changing of education ways based on current physical campus and building environment is facing a challenge to satisfy the application of personal information using SES.

Firstly, focusing on the weakness of current classroom while comparing with the functions of SES, it is necessary to make clarified how to fully use the application of SES in learning process. Secondly, in order to discuss on how to improve education quality by using classroom based on the functions provided by SES, we investigated the education activities managed in SES and clarified how the student personal data support those activities. In particular, we summarised how faculty members use SES to manage LMS. Finally, how students use and evaluate the SES of Kanazawa University in their learning process such as preparation of a lesson, learning in classroom, review.

3 Pilot teaching practice at Kanazawa University

The authority of Kanazawa University is planning to use LMS to improve the quality of education by the new education way suitable to LMS. Therefore, a project namely pilot teaching practice has been started from 2018. Two courses in School of Earth Science and Civil Engineering were chosen as case study for teaching experiment.

One of two courses is planning process, in which teaching faculty planned to use LMS as a teaching experiment, so as to find out how to use the ordinary style of classroom for the teaching activities using LMS. There were 90 students in this class who were studying in the spring semester from April to July 2019 in their second academic year. The faculty member A who took charge of this class, chose a teaching time as an experiment to carry out pilot teaching practice. One teaching assistant and another faculty member B help main faculty member A to conduct this teaching experiment.

3.1 ICT in ordinal classroom

The pilot teaching practice is preferred by most of students when faculty members announced the experiment. However, the ordinary style of classroom shown in Figures 1–2 is not suitable for students' activities in the pilot teaching practice. It is very difficult for students to conduct group work for discussion and cooperation, as shown in Figure 3.

Figure 1 Devices in ordinal classroom (see online version for colours)

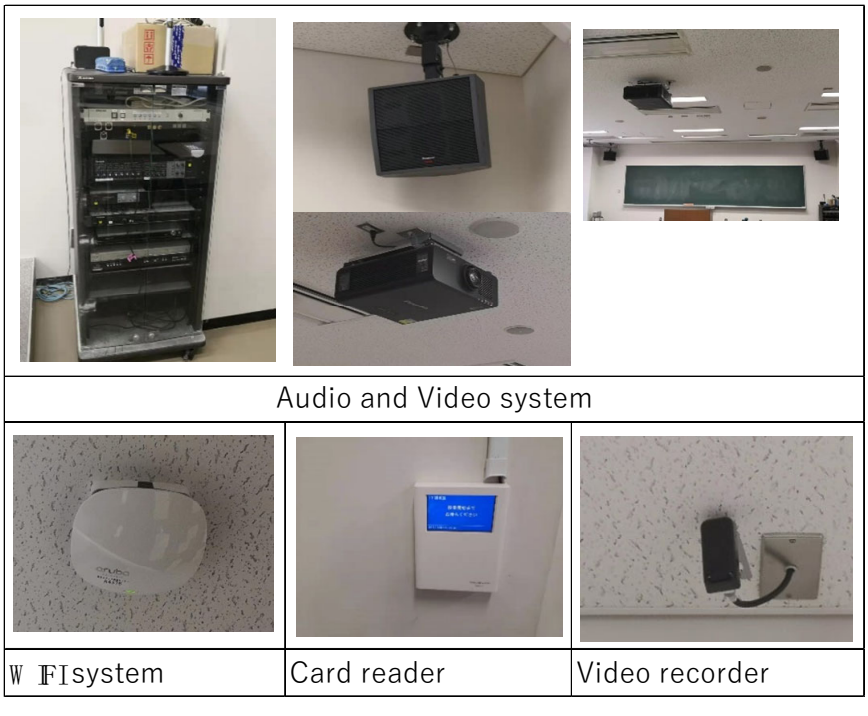


Figure 2 Ordinal classroom (see online version for colours)

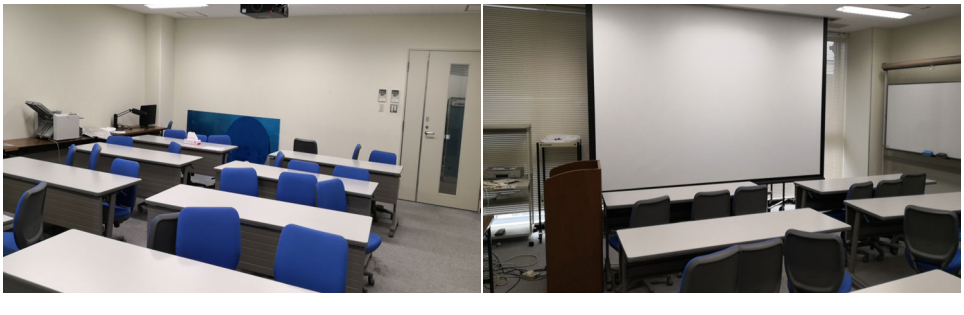


Figure 3 Pilot teaching practice in ordinary classroom (see online version for colours)

3.2 Students' activities in their preference spaces for pilot teaching practice

As shown in Figure 4, some of the students went out of classroom and look for space for group work, where discussion and cooperation were carried out more comfortably and freely. Therefore, we can conclude that the conventional style of classroom is not suitable for the teaching way using LMS, the design of ordinal classroom faces the challenges from LMS in SEM, so as to improve the quality of education.

Figure 4 The preference spaces of students for group work and personal work using LMS, (a) teaching by teachers (b) group wok for discussion (c) group wok for cooperation (d) individual exercises (see online version for colours)

(a) (b)

(c) (d)

4 SES and registered student personal information

SES is popular in the universities, which is expected to increase the capabilities of students with the help of IT, and students can play a major role in learning process. At Kanazawa University, Acanthus System is developed as education management information system, in which LMS is one part of SES for smart education.

Education management information system collects student data, faculty data and university data. In educational management practices, SES fosters systemic changes in education management. The student data collected by Acanthus System of Kanazawa University is shown in Table 1. School registered student information in Acanthus System is student data, which is classified as student information, course registration, course grades, portfolio, students charts, attendance records and shifts.

In our study, we focus on ordinal classroom and application of LMS for improvement of education quality, for which the student information of LMS must be used for interaction with faculty members in classroom. In Table 1, student information and portfolio of school registered student information are available for faculty members. Accordingly, school registered student information in Acanthus System of Kanazawa University can be combined with students' activities of LMS to consider the improvement of education quality.

Table 1 School registered student information of SES at Kanazawa University

School registered student information		*Faculty*	*Students*	*Faculty meeting with students*	*Administration office*	*Related ICT devices*
Student information	Basic information		Fill in paper sheet		Manual input	Computer
	Transfer information		Fill in paper sheet		Manual input	Computer
	Studying		Fill in paper sheet		Manual input	Computer
	Personal address information		Fill in paper sheet		Manual input	Computer
	Parents information		Fill in paper sheet		Manual input	Computer
	Permanent address		Fill in paper sheet		Manual input	Computer
	International student		Fill in paper sheet		Manual input	Computer
	License		Fill in paper sheet		Manual input	Computer
	Qualification		Fill in paper sheet		Manual input	Computer
	Thesis		Fill in paper sheet		Manual input	Computer
	Academic payment				Manual input	Computer
	Scholarship		Fill in paper sheet		Manual input	Computer

Table 1 School registered student information of SES at Kanazawa University (continued)

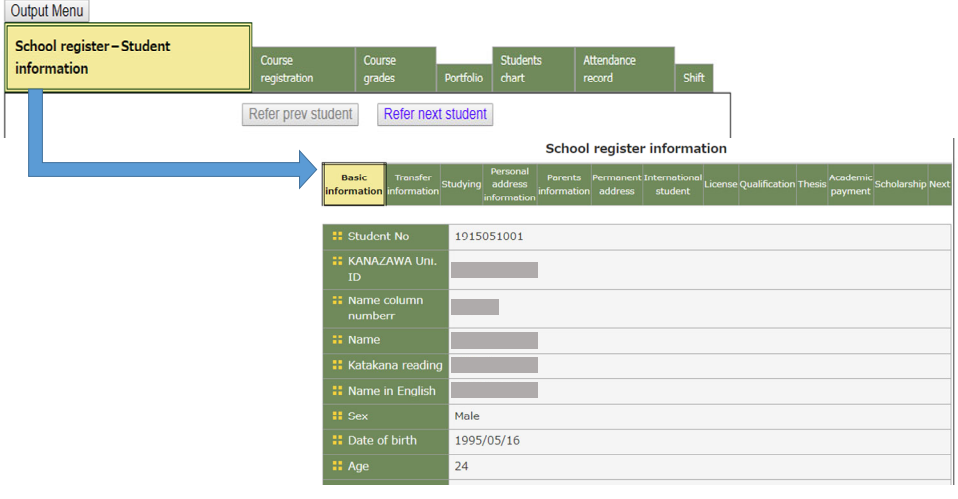
School registered student information		*Faculty*	*Students*	*Faculty meeting with students*	*Administration office*	*Related ICT devices*
Course registration			Manual input			Computer
Course grades		Manual input				Computer
Portfolio	Numerical goal		Manual input			Computer
	Article title, etc.			Manual input		Computer
	Reference papers, etc.		Manual input			Computer
	Activities record		Manual input			Computer
	Record		Manual input			Computer
	Overseas record		Manual input			Computer
	Career history		Manual input			Computer
	Consultation record			Manual input		Computer
	Circle		Manual input			Computer
	LPF portfolio		Manual input			Computer
	English test				Manual input	Computer
Students chart				Manual input		
Attendance record	Class schedule code				Manual input	Computer
	Class schedule period				Manual input	Computer
	Title of the class				Manual input	Computer
	Name of the lecturer				Manual input	Computer
	Day/period				Manual input	Computer
	Number of class sessions				Manual input	Computer
	Times present		Touching student card			Card reading device
	Times tardy				Automatically calculated	Computer
	Attendance		Touching student card			Card reading device

Table 1 School registered student information of SES at Kanazawa University (continued)

School registered student information		*Faculty*	*Students*	*Faculty meeting with students*	*Administration office*	*Related ICT devices*
Shift	Preliminary survey			Manual input		
	1st points					
	Survey			Manual input		
	Final points					
	Registration					

Hereafter, we explain how the university collected school registered student information from students and organised those data in Acanthus System of Kanazawa University.

Figure 5 Basic information record of EMS (see online version for colours)



4.1 Collection of personal information from students

The school registered student personal information is collected from successful applicants who got the entrance permission before entering the university. After entrance, it is necessary for students to complete all student information. For each semester, students can register their courses based on guidance book distributed to all students when entrance.

1 Prepare partially personal information before entrance to the university.

2 Enter all necessary personal information after guidance of entrance.

3 Register curriculum.

4 Use teaching materials in LMS for studying.

5 Check course grades using LMS.

6 Consult the tutor according to the personal information registered in LMS.

4.2 Personal information in education management system

Figure 5 shows the school registered student information registered in education management system (EMS), which is not LMS. All school registered student information as listed in Table 1, from which Figure 5 shows the menu with two layers of them and details of basic information. School registered student information is stored in the table of EMS database.

5 Teaching process using LMS

In terms of teaching and learning practice in education management, EMS provides the functions shown in Table 2, so that faculty members can manage a course and prepare teaching materials for students' learning activities. Referring to schedule, list of students and lecture info are basic information of a course in EMS. Information sending and lecture invitation are functions for interaction with students. Attendance management are function of checking students' attendance status. LMS and setting of LMS are as an entrance respectively for faculty members to manage the course from EMS. All teaching materials can be uploaded to LMS by faculty members who take charge of the course. Faculty members can input manually students' grades to LMS after final examination, students can check their academic record to know if they pass the course or not.

Table 2 EMS for faculty members

Function name	*Outline of processing*
Refer to schedule	You can see the schedule of the class
List of students	You can see the list of students
Lecture info	You can register lecture contacts
Lecture cancel	You can register a cancellation of class
Sending a message	You can send a message to students
Entry of record	You can enter student's records
Entry of syllabus	You can enter syllabi
Refer to syllabus	You can refer to syllabi
Refer to syllabus (English)	You can refer to syllabi in English
Attendance management	You can take attendance in your lectures
Lecture equate	You can submit a few lecture questionnaires
LMS	You can use learning management system
Settings for LMS	You can set whether to use WebClass or Moodle

LMS can support learning and teaching, which is one kind of SES. Learning process can be simply divided into pre-class, in-class and after-class, namely preparation for a lesson, learning in class and review after class in Table 3.

Table 3 LMS for faculty members and students

	Students' work	*Teaching materials and functions in LMS*
Preparation for pre-class	Reading textbook	E-textbook system
		Video teaching materials
		PPT for course
Learning in-class	Practice	Report system
	Attendance	Card reader system
	Listening	PPT for course
	Q&A	Question corner system
	Examination	Test system
Review after-class	Reading textbook	E-textbook system
	Finishing home works	Report system
	Evaluation of teaching	Questionnaire system

In the steps of preparation and review for a class, students can use LMS for study. During class, LMS is available for students to access while faculty member uses screen to present teaching materials in ordinal classroom. The problem is how to employ all functions of LMS in ordinal classroom during lesson? However, few faculty members consider using all functions of LMS for enhancing interaction between faculty members and students. As mentioned above, while comparing the three steps of LMS, teaching materials are prepared before class by all faculty members, which can be reviewed by students after class as digital material. During the step of studying in ordinal classroom, LMS is very easy for students to use even if the SES including functions such as teaching resources, education management are prepared well.

5.1 Data prepared in LMS and review

In the step of preparation of a lesson, PPT, e-textbook and video materials for lesson can be prepared by faculty members who take charge of the course. After class, students read the e-textbook, PPT to review the teaching context, so as to finish homework by report system.

5.2 Student learning activities in classroom

In the step of learning in class, students can register their attendance by card reader system, finish their practice during the class using report system and join the mid-term exam using test system.

5.3 Dynamic teaching activities and requirements

For a suitable way for using LMS in lesson, teaching plans of faculty members are expected with diversity of learning strategies and different learning styles, so as to boost performance and foster a classroom atmosphere, which is compatible with LMS. Multiple teaching approaches should be adopted to support the students' learning, which is main function of LMS in smart education process. For considering if ordinal classroom is

suitable for students to use the teaching materials uploaded to the LMS, we carry out a teaching experiment for the pilot teaching practice at Kanazawa University. In the teaching course, namely planning process that is the pilot teaching practice using the LMS as shown in Figures 6–7, introduced multiple teaching approaches including pre-learning, group work and individual work and Q&A chat into the class of planning process.

Figure 6 LMS used for planning process (see online version for colours)

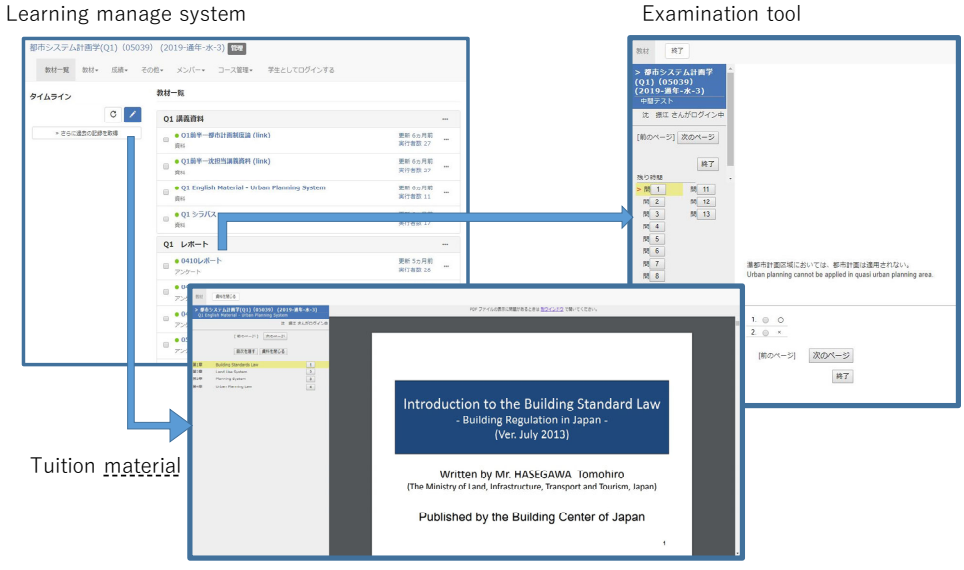
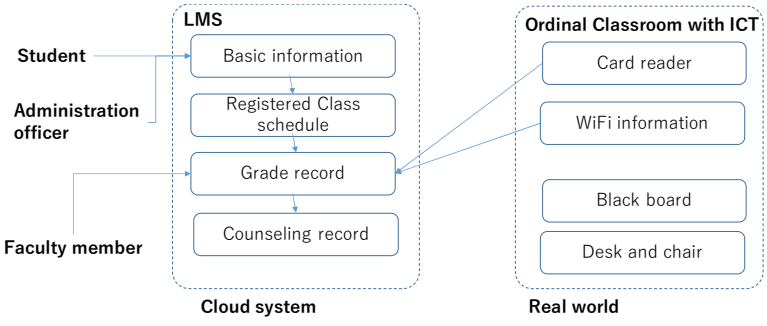


Figure 7 Framework of pilot teaching practice in planning process (see online version for colours)



As required by the way of pilot teaching practice, teaching materials should be uploaded to LMS firstly. For this, teaching materials including a video uploaded to YouTube, a PPT, an excise web page with four questions have been prepared for students. In addition to the teaching materials, a chat room is also prepared in the LMS for question and answer between teacher and students as shown in Figures 8–10.

Students who registered for this course can watch the video as shown Figure 8 before the class. They have to finish the four questions as excise during the time of class as

shown in Figure 9. If they have questions, they can ask them in the chat room as shown in Figure 10 in class, pre-class and after-class.

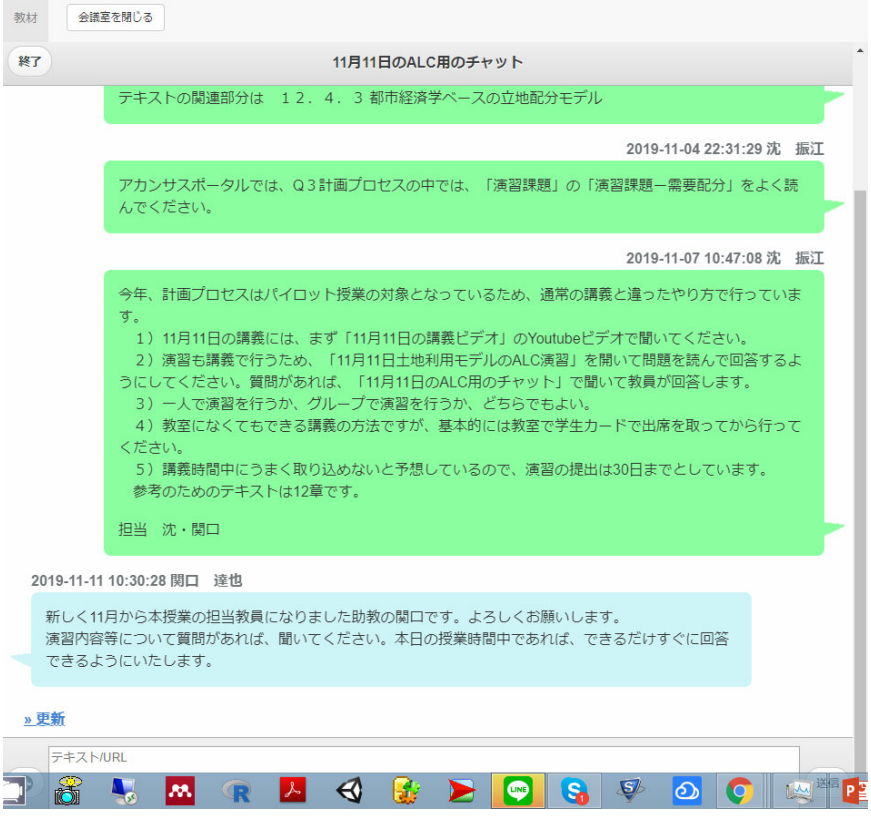
Figure 8 Teachers' talking using YouTube (see online version for colours)

Figure 9 Exercises by individuals or groups (see online version for colours)

In the new way of multiple teaching approach using the LMS for pilot teaching practice, namely active leaning class (ALC) including pre-learning, group work, individual work and Q&A chat were designed in the LMS. All students' active learning behaviours can be recorded in the system, which include starting time point and ending time point of each learning material in all steps of learning such as pre-learning before class, learning in class and review after class. Therefore, faculty members are possible to master all learning activities of each student by accessing individually student personal data in LMS. Even for any examinations, it is possible to ask students to complete using LMS in classroom.

Actually, pre-learning before class and review after class can be conducted anywhere, and listening is possible to carry out in a dynamic interactive way between teachers and students, or online anywhere outside the classroom. In the case of final examination, students should finish all examination questions respectively without cheating and ordinal classroom is necessary. Therefore, only examinations need all to stay in classroom. For the pilot teaching practice in an ordinal classroom, the teaching materials are uploaded to the LMS for our teaching experiment. Therefore, we investigate the dynamic teaching using LMS in next section.

Figure 10 Q&A chat room during the time of pilot teaching class (see online version for colours)



6 Faculties' checking on students active learning behaviours

All students' active learning behaviours are recorded in LMS, all faculty members are possible to access all recorded learning process of each student. Therefore, all student personal information will be used by all faculty members if using LMS. Figure 11 shows how many times of each student use LMS for learning, and Table 4 shows how long their total consumed time is. As shown in Figure 12, faculty members can check each student's homework, report and other submissions using LMS.

Figure 11 Students' practice times recorded in LMS (see online version for colours)

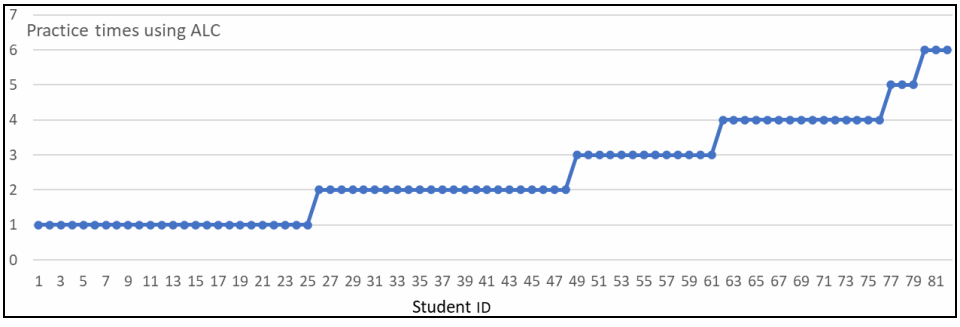


Table 4 Faculty members and students' consumed time using LMS for practice

	User number	*Login times*	*Total consumed time*
Faculty members	3	28	2:47:59
Students	82	839	272:06:41
Total	85	867	274:54:40

Figure 12 Check of students' practice recorded in LMS (see online version for colours)

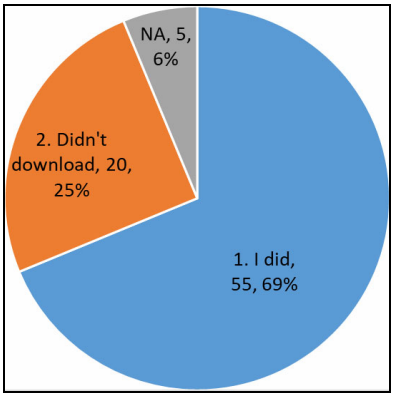
7 Students' evaluation on pilot teaching practice

As explained in the previous section, a teaching experiment has been carried out in the class of planning process scheduled on 11 November 2019. A questionnaire to the students who joined the ALC class was prepared and students responded to the questions after the class. There are 82 students who are respondents to this questionnaire using LMS. All students understood that all their learning behaviours has been recorded automatically by LMS and will be used for evaluation on their studying of this class.

7.1 Pre-learning

The pre-learning situations of all students were recorded by LMS. Within 82 students in this class, 75 students downloaded the teaching materials. However, only 55 students conducted pre-learning using the LMS after downloading the teaching materials responded to our questionnaire as shown in Figure 13.

Figure 13 The pre-learning status after downloading teaching materials (see online version for colours)



7.2 Pilot teaching practice

The new teaching way, namely pilot teaching practice, includes group work for discussion and cooperation and individual work for exercise.

We asked students to response if they studied as group work or individual work to the question prepared in the questionnaire as freely input text area in LMS. As shown in Figure 14, there are totally 26 students who responded to this question, who answer that they understood the teaching content prepared in the pilot teaching practice by using dynamic teaching ways and the excise in the ALC class. However, 4 of the 26 students answer that they failed to understand the content prepared in the class as shown in Figure 14.

For ALC including group work and individual work, there were 15 students who like the new way of teaching because they could discuss with each other and confirm with classmates to find the solution of the question in exercise by group cooperation and discussion to support individual work in class. However, there were no questions in the

Q&A chat room system, which was probably ignored by students because they are busy finishing the individual work during class time.

Figure 14 Understanding of teaching and evaluation on pilot teaching practice (see online version for colours)

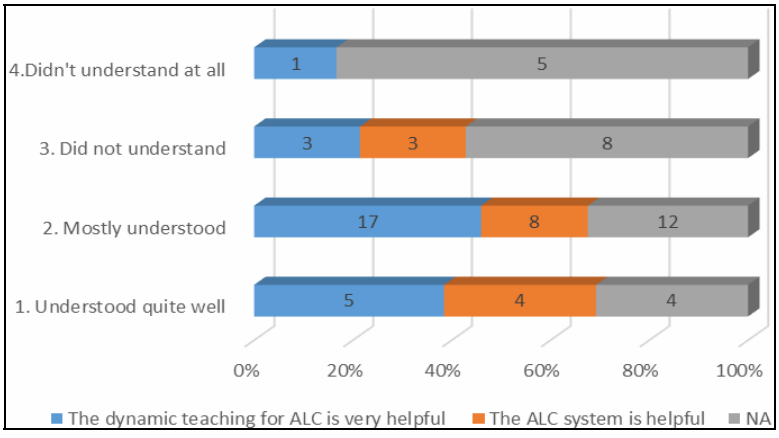
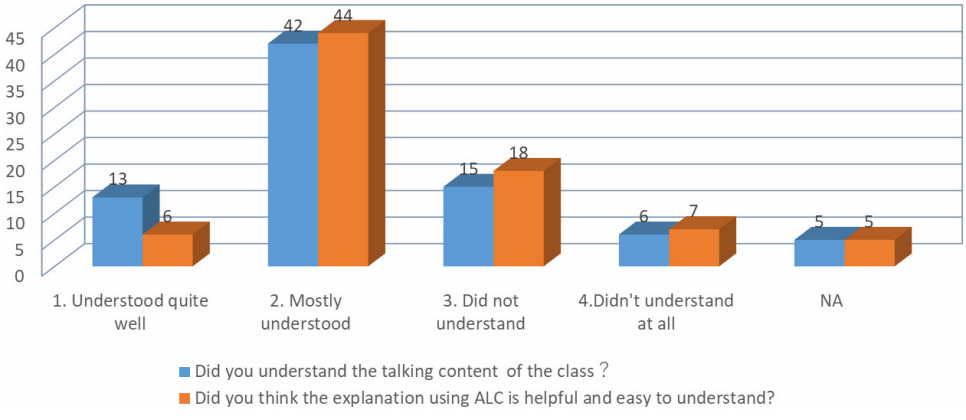


Figure 15 Comprehensive evaluation (see online version for colours)



7.3 Comprehensive evaluation on the polite teaching practice

As shown in Figure 15, in terms of the satisfaction degree related to understanding of the content prepared in the class, there were 13 students who could fully understood how to find the solution of the excise designed in the practice, and 42 students who could almost understood how to complete the excise work. There were 21 students who campaigned that it was very difficult to find the solution of the exercise work during class time.

For the satisfaction degree of the teaching way, there were six students who said that the new teaching way was very easy to understand the teaching in class, and 44 students who said that the new teaching way was relatively easy to follow. There were 25 students who said that the new teaching was difficult for them to understand and they liked the conventional teaching way instead of the pilot teaching practice.

As a result, it can be concluded that the pilot teaching practice is somehow successful in our teaching experiment, and most of students expect that the new way of teaching can be put into the future class instead of conventional teaching style. Regarding the classroom, we can conclude that the ordinal classroom is also available to the 50 students who preferred the dynamic teaching way using LMS. However, remaining 32 students including some students who did not make response to the question, preferred the conventional teaching way in an ordinal classroom. In the future, when a new style classroom for group work is available, it is expected that students prefer the dynamic teaching using LMS.

8 Conclusions

In this paper, how to collect the data of personal information of students by SMS, and how to open these data to faculty members for improving education management at Kanazawa University are discussed from a practical view of teaching experiment in an ordinal classroom. In Japan, SES improves the convenience of personal information management of registered students in universities, including basic information, course registration, course grade, consultation record, etc. However, improvement of education quality remains to be unclear. Even though the university started to encourage faculty members to start dynamic teaching course using student personal information stored in SES in some classes, few faculty members use the SES to improve the education style because they must teach in the ordinal classroom way.

A teaching experiment has been conducted in this paper. As a result, the pilot teaching practice is somehow successful in this experiment and most of students preferred the new teaching way even in an ordinal classroom. With regard to the classroom, the ordinal classroom is also available to students who preferred the dynamic teaching way using LMS. In the future, a new style classroom for group work is necessary to improve the dynamic teaching way using LMS.

There are still many future works to be further performed by us. For example, what kind of the classroom style can be designed for application of SES based on student personal information, how to organise classroom layout for group work for improving interaction between students and faculty members, as well as the extent to which ICT-based SES improves the quality of education.

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