

# Web-based Time Schedule System for Multiple LMSs on the SSO/Portal Environment

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*Abstract*— We developed a web-based time schedule system as an important feature of the university portal along with our university's long-term ICT (Information and Communication Technologies) plan. By using the system, students and professors can get their own course timetable in collaboration with the Student Information System (SIS). Each course name on the timetable is linked to the corresponding course page on the Learning Management System (LMS) through the Single Sign-On (SSO). The system is adapted to multiple LMSs which can be selected by the course professor. In order to widely cooperate with other systems, the system is designed by using global standards (IMS Enterprise, JSR-168 Portlet, etc.) and open source software (uPortal, CAS, JSE, Hibernate, etc.) as possible as we can. This paper shows the major functions, the measured use of the portal and the time schedule system over eight months, and the implementation especially for supporting multiple LMSs, syllabus and grade books.

*Keywords*—timetable; schedule; LMS; Portal; SSO; IMS; CAS

## I. INTRODUCTION

In recent years, the university's learning environment is becoming more and more convenient, effective and efficient by various ICT (Information and Communication Technologies)-enhanced systems, for example, Student Information System (SIS), Learning Management System (LMS), portal, e-Portfolio, electric library, etc.

Our university noticed that the quality of education and the university management can be improved through the appropriate ICT adaptation, and has established a long-term and university-wide ICT strategy (called the Integrated Campus Information System Plan) in 2001. Along with the plan, our organizations, the "Center for Multimedia and Information Technologies" and the "Institute of the e-Learning Development" were established in 2004 / 2008, and we have introduced various ICT systems.

Good collaborations among the systems should be very important to build ICT-enhanced learning environments. We therefore always try to use global standards and open source

software as possible as we can for data interoperability and source transparency.

Along with the ICT plan, we developed a Single Sign-On (SSO) university portal for all students and staff since 2006 [1]. Once authentication is complete at entrance of the portal, user gets personalized web pages including information for each role, direct links to the available systems without re-authentication, etc.

As an important feature of the portal, we developed a web-based time schedule system placed on the portal as a tab page, where students and professors can get their own course timetable depending on their registration of the SIS [2]. Each course name on the timetable is directly linked to the corresponding course page on the LMS through the SSO.

Our university provides WebCT (now Blackboard LS) as a university-wide LMS since 2004. For the last few years, number of online courses has been increased and some professors requested to use different LMSs e.g. Moodle or Sakai. For this reason, we improved the time schedule system to adapt to multiple LMSs.

This paper will show the status of using the time schedule system and its new features not only as the multiple LMSs support, but also as functions of syllabus and grade books.

## II. THE STATUS OF THE TIME SCHEDULE SYSTEM

### A. ICT-Enhanced Learning Environment

Our university has been advancing the ICT-enhanced learning environment [3]. Better collaborations among the systems such as SIS, LMS, portal and many related systems, should be important to enhance the learning environment. We therefore developed the university portal for all students and staff (teaching, technical and administrative) based on the open source software (uPortal [4] and CAS (Central Authentication Service) [5]) and the original tools for connecting several university-wide systems since April 2006 [1]. Once authentication is complete, each user gets personalized web pages, including information for each role, direct links to

available systems, the timetable linked to the corresponding course on the LMS, etc.

The uPortal is open source software and supports the Portlet (JSR-168 standard [6]) which provides pluggable user interface components to add functions to the portal. It not only ensures high portability but also it made us easier to add convenient functions specialized for each role, position, department, and so on (10,000 students and 2,000 staff).

The CAS is also open source software and it provides SSO environments. The university-wide LDAP is used as authentic data source for the CAS, users therefore can login wireless LAN, PCs for IT classrooms (1,300 PCs over the university with exactly the same usability), emails etc. with the same user ID and password as CAS as shown in Fig. 1. The CAS has been already supported by more than twenty systems, including both campus supports (library, carrier support, registrations, address book, etc) and learning supports (LMS, SIS, timetable, etc.) as shown in Fig. 1.

The time schedule system has been added to the portal

since 2008, and where students get their own course timetable depending on their SIS registration. Each course name on the timetable is directly linked to the corresponding course page on the LMS through the SSO. Professors also can use their own timetable directly linked to the LMS course page as instructor and creator modes.

In the same time, we developed an IMS-capable [7] web-based management tool for synchronizing courses [8]. The tool provides functions of various queries by HQL, some IMS-type output files (courses, persons and cross-listed courses), and timetables for the queried persons with LMS access if possible.

We improved the time schedule system to support multiple LMSs as shown in Fig. 2, which describes data flows as the time schedule system are synchronized by the CSV data from the SIS and three LMSs (WebCT (now, Blackboard LS), Moodle, and partly Sakai) are synchronized by the IMS data from the time schedule system. Details will be shown later with the other new features.

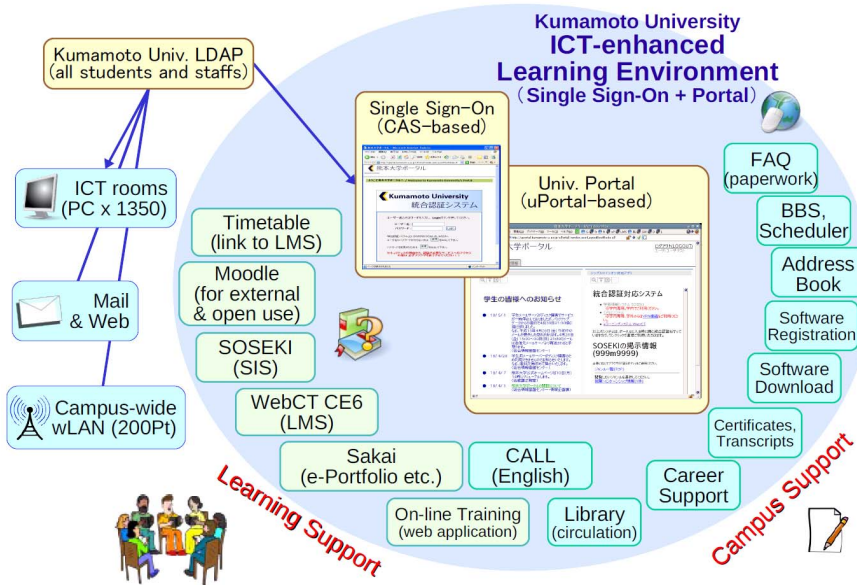


Figure 1. The Kumamoto university's ICT-enhanced learning environment with portal and the single sign-on system with web applications.

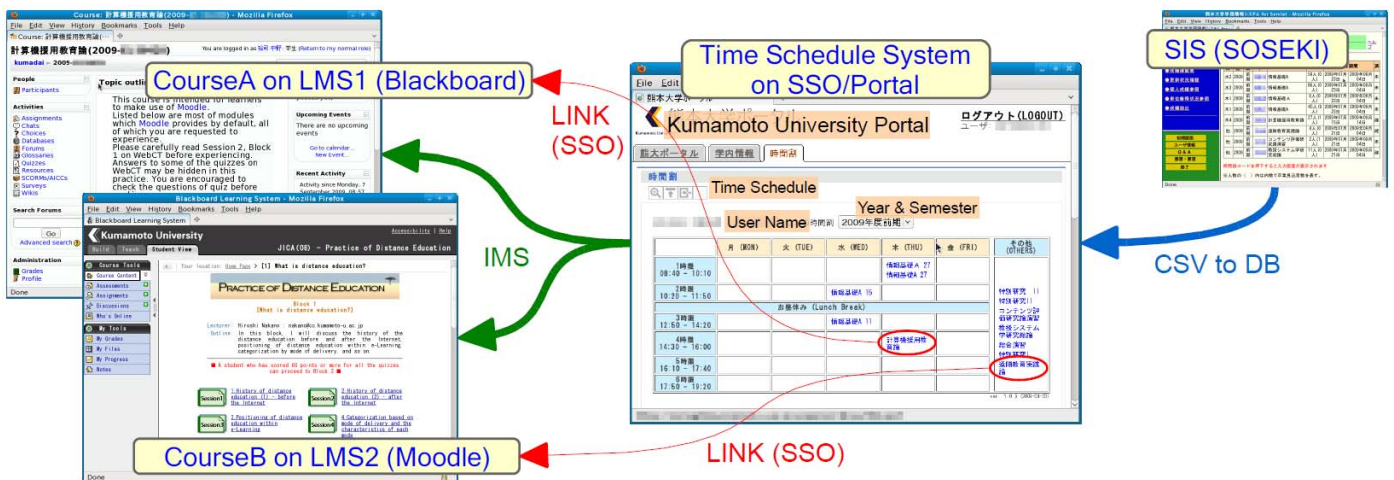


Figure 2. Data flow and SSO connections between the time schedule system on university portal, LMSs and SIS.

**B. Use of the University Portal**

Fig. 3 shows the use of the university portal. Left figure (a) shows the daily access number from August 29, 2008 to May 9, 2009 (for about eight months). The valleys are at the weekends and holidays as the New Year holidays. Almost all Japanese universities including us have two semesters in university year which start from April and October respectively. More than 7,000 accesses are observed at the beginning of the semesters, and a few thousands of accesses are on weekdays, and several hundreds of accesses still remain even on holidays as shown in Fig. 3(a). Because our university has about 10,000 students and 2,000 staff, we can say that the portal is used very well.

Fig. 3 (b) shows the hourly access number averaged for the same period. The curve of the daytime is not smooth, the reason is thought that many students begin to use the LMS

through the portal at the beginning or break time of the courses. After 6pm, they are still using from their home and there are some accesses even in midnight.

**C. Use of the Time Schedule System**

Fig. 4 shows the use of the time schedule system. Left figure shows the daily access number from April 16, 2008 to October 31, 2009 (for about eighteen months). We can say that the time schedule system is also used well, because about 10 to 30 percents of the access of the portal are occupied by the time schedule system, in comparison between Fig. 3(a) and 4(a). The valleys are at the weekends as same as the portal. The largest difference to Fig. 3 (a) is that very low access areas can be found during spring and summer vacations. It means that users are accessing the portal even during the vacations, but they are not accessing LMS course contents through the time

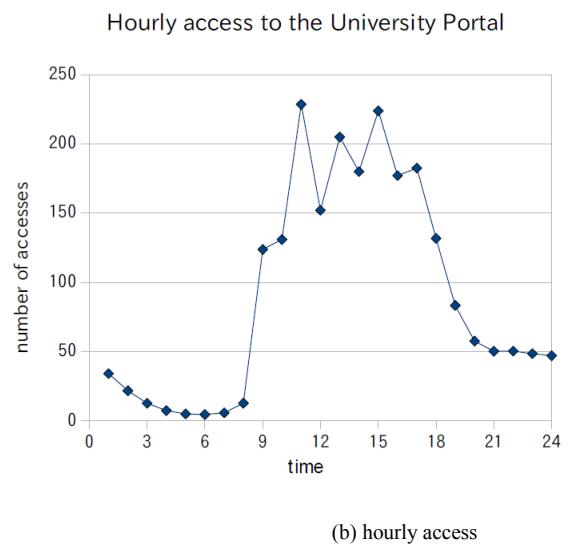
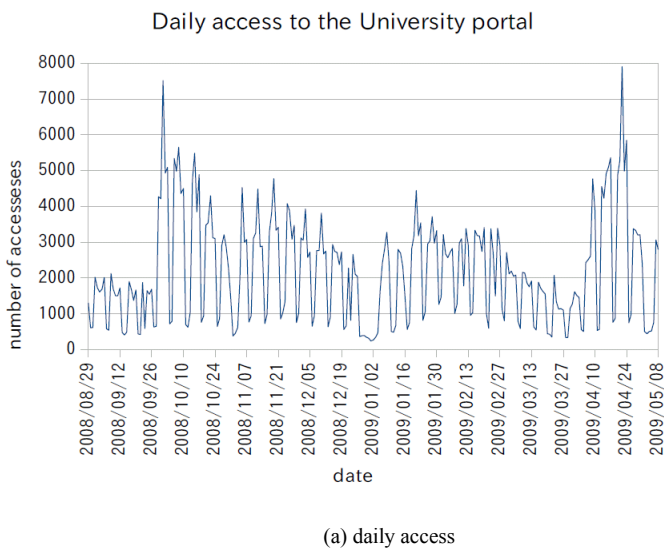


Figure 3. The use of the university portal.

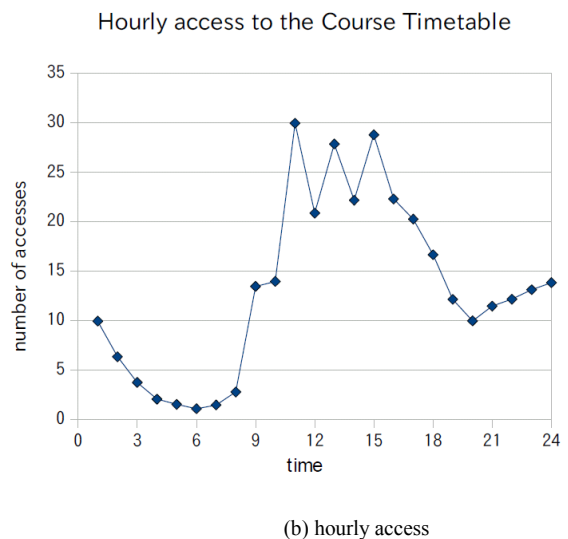
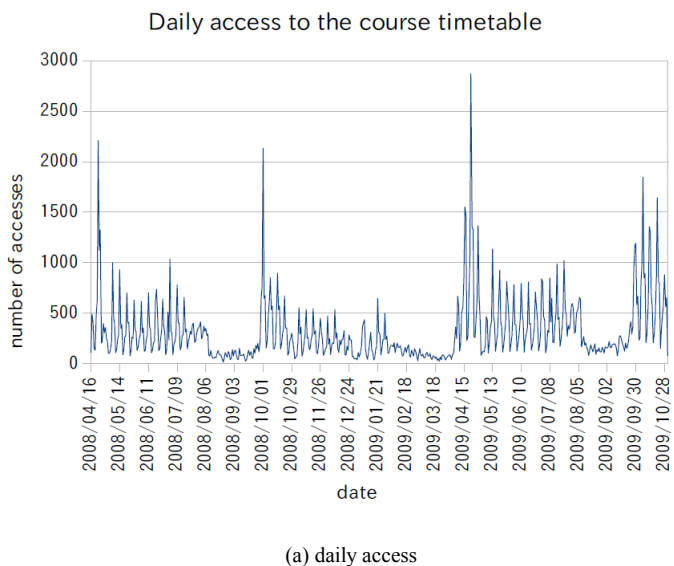


Figure 4. The use of the time schedule system.

scheduling system.

Fig. 4 (b) shows the hourly access number averaged for the same period. The averaged number of accesses seems to be low as the maximum is around 30, because of the very low access areas on vacations as mentioned. The curve of the daytime is also not smooth as same as the portal. After 6pm, the curve increased again, but we could not find the reason yet. In either case, students are still using the system even at midnight from their home.

### III. THE IMPLEMENTATION OF THE TIME SCHEDULE SYSTEM

#### A. Developing and Running Environment

The WebCT CE6 (Blackboard LS 6), the Moodle 1.9 and the Sakai 2.6 are targets for supporting multiple LMSs now. Our sakai support is still experimental because the courses can not be synchronized yet (only manual registration is possible).

As many users (more than 300 in the maximum case) are accessing at the same time, a relational database is used for extracting a schedule quickly for each user. User profiles and registered course information are daily synchronized from SIS to the system by CVS format, and also synchronized from the

system to LMSs by IMS Enterprise format [7] as shown in Fig. 2. The WebCT and the Moodle support IMS format and all the courses are synchronized daily. WebCT does not support CAS, and we therefore developed adapters using the portlets for the Blackboard LS [9]. The system is developed by using fully open source tools; Hibernate and JSF on J2EE (Tomcat), and MySQL.

#### B. The Course Timetable

Fig. 5 shows a course timetable example on the university portal for some student. The “(e) Course timetable” shows the timetable unique for the students ID, the semester and the year. The timetable can be changed to the other one for different semester and year by using the selection box “(d) Select Year & Semester”. The view of the checkboxes (f) is adjusted for the role of students / professors and on- / off-campus as shown in Fig. 6. The score icon can be shown only on campus, and the setting icon can be shown only for professors. All enabled check box can change the state (show or hide each icon) of all cells of the timetable.



Figure 5. Course timetable on the university portal.

- シラバス(syllabus),  成績(score)
- (a) for students, on campus
- シラバス(syllabus),  成績(score)※学内専用 campus only
- (b) for students, off campus
- シラバス(syllabus),  成績(score),  設定(setting)
- (c) for professors, on campus
- シラバス(syllabus),  成績(score)※学内専用 campus only,  設定(setting)
- (d) for professors, off campus

Figure 6. Four cases of the check box (f) in Fig.5.

#### 科目LMS設定 (LMS setting for course)

科目(course) 情報基礎B 16 (2009-58-...)

担当教員(professor) 中野 浩司 (Hiroshi Nakano)

この授業を行うLMSを1つ選択してください。  
Please select one LMS for this course.

Blackboard LS (WebCT)

Moodle

Sakai (experimental)

Not using LMS (not recommended)

保存 (Save)    キャンセル (Cancel)

Figure 7. The course setting menu for professors.

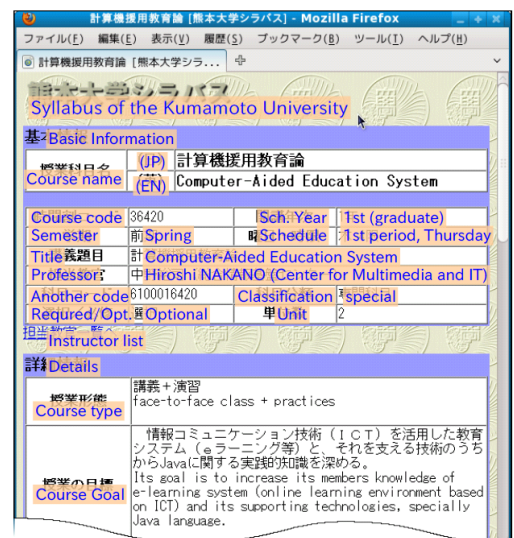


Figure 8. The syllabus for the selected course.



### C. The Course Setting Menu

Fig. 7 shows the course setting menu for the professors when they click the setting icon (shown in Fig. 6 (c)) on each cell of the timetable. The professor can select one from four choices; WebCT, Moodle, Sakai and “not using”. WebCT is the current default value, and once professor select Moodle or Sakai, all students and professors will jump to the selected LMS when they click the course name in the cell of the timetable. If professors select the “not using”, the course name's color will change to black without any links. These settings can be reset or changed anytime from this menu.

### D. The Syllabus Icon

When students or professors click the syllabus icon (shown in Fig. 6) on each cell of the timetable, the syllabus of the course will be shown in a new window (Fig. 8). Our university open all syllabuses over the Internet and this system simply jump to the corresponding syllabus page directly for convenience. On the syllabus, students can get whole course information as shown in Fig. 8 (translated).

### E. The Score Icon

When students or professors click the score icon (shown in Fig. 6) on each cell of the timetable, the grade-book page of the SIS system will be shown in a new window (Fig. 9, translated). For students, they will get the score list of the grade book corresponding to the semester as shown in Fig. 9 (a), where they can check their course scores for the semester. The grade book of the current semester may not have no meaning except on the end of the semester, but previous semester's ones

are meaningful and it can easily shown by the selector “(d) Select Year and Semester” in Fig. 5 anytime.

For professors, they will get the students list of the corresponding course with scores as shown in Fig. 9 (b), where they can not only see but also enter or edit scores for each student.

The score function is limited to use only on campus, because of the security policy of the SIS system.

## IV. FUTURE PLAN

The time schedule system has been used university-widely more than three semesters (eighteen months) as shown in Section II, and we have already improved several points as supporting the multiple LMSs, the syllabus and the grade-book, with fixing bugs. We have several valuable comments from users, and some ideas to do.

Now we are using the university-wide course timetable, but we do not have university-wide calendar as a function of group wares. We are planning to introduce a university-wide group ware for staff and students, where the all functions of the current course timetable had better to be available on a calendar with additional information, e.g. the class subject on the date, planed examinations, cancellation, etc.

Some students asked us to use the grade-book function through the Internet (outside of the campus network), because they want to know the scores far from the campus during vacations between semesters, when they go back to their born place or stay their internship place, etc. We therefore have a plan to provide the grade-book function with limited information over the Internet, by developing a secure intermediate server which keeps only limited information synchronized to the SIS.

Some professor gave a valuable comment that he wants to use the time schedule system for leading or counseling students if he could see the course timetable of the specified student with each course scores, because he can find easily subject, time and semester dependency of the student activity. We have a plan to add a counselor mode to the system for designate persons.

## V. CONCLUSIONS

We developed a web-based time schedule system as an important feature of the university portal along with our university's long-term ICT plan. By using the system, students and professors can get their own course timetable in collaboration with the SIS. Each course name on the table is linked to each course contents on the LMS through the SSO.

We developed the system based on open source software and global standards as possible as we can for data interoperability and source transparency in order to connect several systems in standard and portable ways.

The use of portal and the time schedule system were measured for about eight and eighteen months respectively. The result shows that the both systems are used well even on

No	Course name	Professor	Unit	Year	Score	Pass
1	...	...	2	2009		
2	...	...	2	2009		
3	...	...	2	2009		
4	...	...	2	On going		
5	...	...	2	2009		

(a) for students

No	Student affiliation	St. Year	Student ID	Student name	Score	Grade Pass
1	...	...	...	...		
2	...	...	...	...		
3	...	...	...	...		
4	...	...	...	...		

(b) for professors

Figure 9. The grade page from SIS.

holidays or at midnight from homes, and reflect students' activities in weekly, daily or hourly.

The system is adapted to multiple LMSs; WebCT, Moodle, and Sakai (experimentally). The LMS can be selected by the professor for each course. The time schedule system also provides the functions of showing syllabus and scores of the course. All these functions can be selected whether visible or not.

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