DEVELOPMENT OF A SUPPORT SYSTEM FOR UNIVERSITY COURSE SELECTION USING SEMANTIC WEB TECHNOLOGY

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Abstract: The authors proposed a support system for university students to create their own course schedules using semantic web technology. The system provides course information, such as syllabus, students' assessment scores and reviews, which are RDF based ontology, while participants create their own course schedules. A prototype system was developed for course selections of two departments, and its effectiveness was determined. As a result, the number of courses selected increased significantly, and participants' subjective responses were encouraged when they consulted the system.

1 INTRODUCTION

The university students have to have core courses, but they can also choose some optional courses which are basic or advanced. Students seek to learn several disciplines in response to the needs of society. Therefore, students seek a variety of information about courses. There are some restrictions however, such as the number of optional courses which can be chosen. As a result, the course selection problem can be defined as an optimization task where the effort taken can benefit each student at the beginning of every academic term. Students are afraid to lose any course credits despite their academic efforts, so they exchange opinions about their experiences and write their impressions of courses using anonymous web sites (Syushoku, 2002). This suggests that students have to browse a number of web sites which include various sources of information.

Some supporting systems have already developed and considered the validation of curricula (Melia and Pahl, 2007; Baldoni et al., 2007). Also students' assessment results and reviews for courses are required for their satisfaction with courses. For these operations, semantic web technology (Berners-Lee et al., 2001; Ossenbruggen et al., 2002) can be a powerful tool for gathering related documents and reproducing referable data. Semantic web technology has been applied to numerous educational tools which are based on specific ontology (Kasai et al., 2005b; Kasai et al., 2005a).

In this paper, we propose a support system for university students to create their own course schedules each term using semantic web technology, where the effectiveness of the system to promote course selection is examined while participants review their own behavior. For this purpose, we have developed a prototype of the system and conducted an evaluation experiment.

2 SYSTEM DEVELOPMENT

2.1 Course Selection Support System

The proposed system for course selection support is illustrated in Figure 1. The procedure for course selection is displayed as a flow chart on the right side of the figure. In the first step, students set their own planning policy for course registration, and they survey course information. During this step, they need precise information and systematic support. Students review their own course schedules and repeatedly revise them using the system. To show the appropriate information on a web browser, a semantic web system has been developed. The system consists of the ontology for university courses and some databases. Here, the ontology defines the logical relationship between required data formats and databases (Mizoguchi, 2006). The databases consist of following data:

- Formal course information (syllabus)

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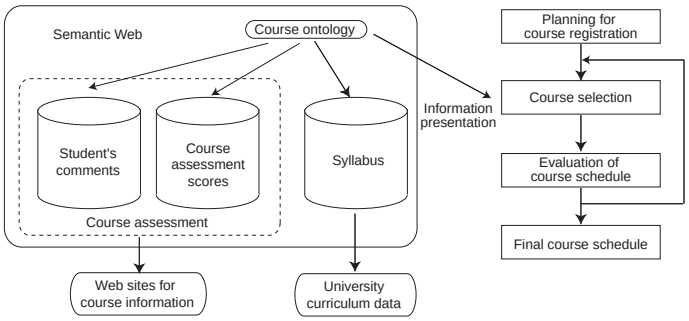

Figure 1: A diagram of the system.

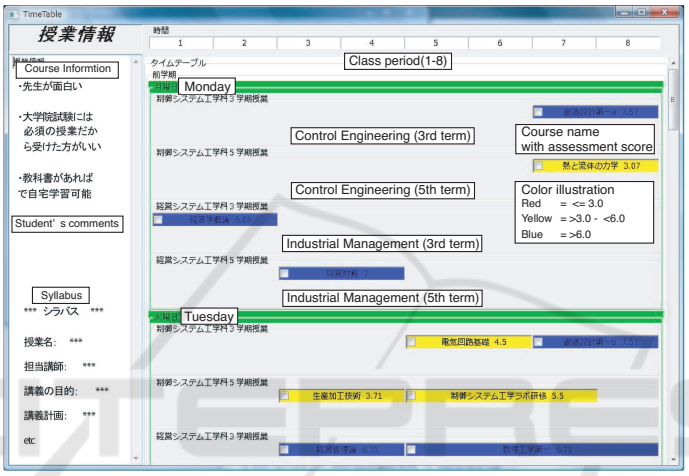

Figure 2: Screen shot of the system.

This is provided by university offices, and includes course names, information about teaching staff, academic credit, course content, the requirements for students, and an assessment guideline. Students can browse these on the university's web site.

- Course assessments
  Assessments for each course are from anonymous evaluations by students. These evaluations are averaged to allow comparisons of usefulness between courses.
- Student's reviews
  Student's comments about courses: Impressions, recommendations and criticisms are noted.

The first type of data can be obtained from the university office, and some universities provide these via their web sites. As the rest of the databases are distributed across the Internet (Syushoku, 2002), a procedure for referring to other web sites is required. Also, since their data formats are not unified, they are transformed into resources for the semantic web using RDF (Resource Description Framework) schema (Kanzaki, 2005). The target information is extracted from the RDF files using a program with SPARQL (Simple Protocol And RDF Query Language) (Kanzaki, 2005), and is converted to files with XML tags to facilitate browsing.

2.2 Web Interface of the System

A screen shot of the web interface for a course selection support system using semantic web technology is displayed in Figure 2. The left vertical subwindow shows course information such as the syllabus. The horizontal column on the top-right side of the panel shows class periods (1-8 per day), the mid-right side shows the names of course available on Monday, and the bottom-right side of the panel shows names of course available on Tuesday. Here, this image shows courses for two departments: Control Engineering and Industrial Management. This information is commonly displayed on systems both with and without semantic web technology. When the system uses semantic web technology, review information is also displayed in the left side vertical window. The

mean value of students' assessment are indicated next to course names, and the color of the background of the course name is illustrated using a color to indicate the level of usefulness, according to students' evaluations. This mean value is represented by three colors: red = less than 3.0, yellow = from 3.0 to 6.0, and blue = higher than 6.0. These color designations, which are based on peers evaluations, may attract participant's attention during the selection of courses. When users click the right mouse button of a course name, the interface sends a query message to the semantic web system and displays information about the course.

The system was developed in an integrated development environment (eclipse 3.3), using JAVA.

The semantic web function was developed using a Jena framework. This can work on Windows and Linux platforms. Therefore, the system can be accessed using any type of browser.

3 EXPERIMENT

3.1 Experimental Design

To determine the effectiveness of the semantic web technology system, the performance of student's course schedule creation process is tested during an experiment. Participants in this experiment were asked to compare courses of two departments and then create their own course schedules using the system. The participants were 13 undergraduate level students who were studying in the Control Engineering department. As seniors, they knew most of the content of courses in their department. In this experiment, the support system displayed all courses in the spring term for the Control Engineering, and Industrial Management departments. If the courses were recommended for sophomores or junior students, these recommendations were clearly displayed as spring term courses (3rd and 5th terms) in Fig. 2.

Our hypothesis is that students select some Industrial Management courses in addition to courses in their own department (Control Engineering), since most students would like to extend the range of their education to various disciplines when the system can provide sufficient course information for them to make informed decisions.

It was not easy to gather enough information about all of the courses which were displayed on the system in this experiment. Therefore, the review comments for some courses surveyed for this experiment used a reviewing system developed in advance. For the courses in the Industrial Management department, 8 disparate senior students who were students in that department rated all of the courses. Their scores and review comments were stored in an experimental database.

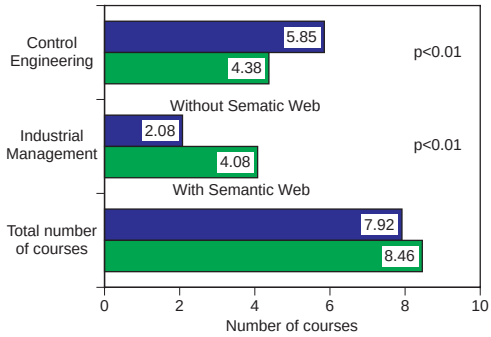

Figure 3: Mean number of courses chosen.

3.2 Procedure

All 13 participants were asked to create their own course schedule twice, once using the system and once using a system without a semantic web function. The procedure was as follows:

1. Instruction of the experiment's aim to participants.
2. Questionnaires about learning attitudes (1st)
3. Creation of a course schedule without a semantic web function system
4. Break
5. Creation of course schedule with a semantic web function system
6. Questionnaire about learning attitudes (2nd)

To evaluate system performance, the following metrics were gathered and analyzed.

- The number of courses selected
  The number of courses of each department which were selected (steps 3 and 5).
- Questionnaire about learning attitudes
  The participants were asked to rate their own learning attitudes twice using 6 questionnaires with 4 point scales, before and after the experiment (steps 2 and 6).

4 RESULTS

4.1 Effect on Course Selection

The number of courses chosen during each experimental session is summarized in Figure 3. For the first session (without semantic web), most courses chosen were related to Control Engineering, the participants'

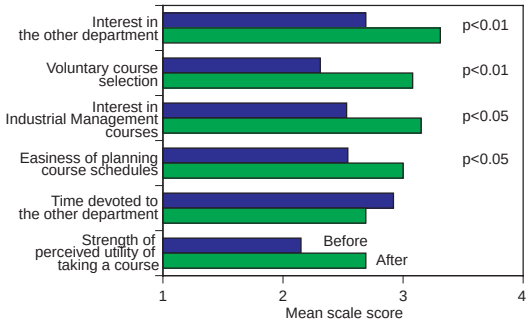

Figure 4: Mean score for learning attitude questionnaires.

own department. The number of courses for Industrial Management was less than 30% of total courses chosen.

When participants could refer to course information using a semantic web, the number of courses chosen for both departments were comparable. This suggests that the number of courses chosen for Control Engineering decreased significantly ($t(12)=3.4$, $p < 0.01$), while the number for Industrial Management increased significantly ($t(12)=3.1$, $p < 0.01$). The total number of courses chosen were comparable because there was a restriction for choosing courses.

This suggests that course selection shifts to an other department's courses when the semantic web shows detailed course information.

4.2 Attitude Change of Participants

The response for learning attitude questionnaires is summarized in Figure 4. At the beginning of the experiment, the means of all responses were distributed in the neutral range, between 2 and 3 on a 4 points scale. At the end of the experiment, the means for responses of 4 out of 6 questionnaires responses were higher than 3.0. The scores for 4 questionnaires were significantly higher than the previous scores. Therefore, this system may encourage participants' involvement, such as is shown in "Interest in the other department" ($t(12)=3.4$, $p < 0.01$), "Voluntary course selection" ($t(12)=3.3$, $p < 0.01$). For "Interest in Industrial Management department courses" ($t(12)=2.6$, $p < 0.05$) and "Easiness of planning course schedules" ($t(12)=2.5$, $p < 0.05$), the means for the responses after the experiment using semantic web technology were also significantly higher than were the means for the 1st responses.

This suggests that the system support may affect student's attitudes and actions regarding course selection. The participants had some interest in courses of the other departments, however, further study of this will be required.

5 CONCLUSIONS

To determine the effectiveness of a support system, which can provide course information including students' assessments and reviews, to help university students create their own course schedules using semantic web technology, a prototype system was developed for course selection support for two departments: Control Engineering and Industrial Management.

In the results, the number of courses in Industrial Management which participants in the Control Engineering department chose increased significantly, and subjective responses about their attitudes and interests were encouraged when they consulted a system which had semantic web functions.

REFERENCES

Baldoni, M., Baroglio, C., Brunkhorst, I., Marengo, E., and Patti, V. (2007). Reasoning-based curriculum sequencing and validation: Integration in a service-oriented architechture. In *EC-TEL*, Berlin Heidelberg, Germany. Springer Verlag.

Berners-Lee, T., Hendler, J., and Lassila, O. (2001). The semantic web. *Scientific American*, (May 17).

Kanzaki, M. (2005). *Introduction to RDF/OWL (RDF/OWL Nyuumon)*. Morikita shuppan, Tokyo, Japan.

Kasai, T., Yamaguchi, H., Nagano, K., and Mizoguchi, R. (2005a). Support for teachers of it/information education based on semantic web technology. *IEICE Technical report*, (ET2005-48):57–62.

Kasai, T., Yamaguchi, H., Nagano, K., and Mizoguchi, R. (2005b). Systematic description of the goal of it education based on ontology theory. *IEICE Transactions*, J88-D-I(1):3–15.

Melia, M. and Pahl, C. (2007). Pedagogical validation of courseware. In *EC-TEL*, Berlin Heidelberg, Germany. Springer Verlag.

Mizoguchi, R., editor (2006). *Introduction to Ontology (Ontorogi Koutiku Nyuumon)*. ohmusha, Tokyo, Japan.

Ossenbruggen, J., Hardman, L., and Rutledge, L. (2002). Hypermedia and the semantic web: A research agenda. *Journal of Digital Information*, 3(Issue 1).

Syushoku, M. N. (2002). Minna no kyampasu. URL http://campus.nikki.ne.jp.