Development of an Exploratory Learning Engine for SCORM 2004 LMS

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Abstract: It is of utmost importance that adaptive e-Learning systems provide students with both a curriculum-based learning environment and an exploratory-based learning environment. However, it is difficult to implement the exploratory-base learning environment in SCORM 2004 LMS. In order to overcome this issue, we developed an exploratory-based learning environment as a Web application which is called ELE (Exploratory Learning Engine). This engine can be used with any SCORM 2004 LMS. We have developed two courses using a framework of the adaptive e-Learning systems called POLITE ("Portfolio Oriented e-Learning for IT Education") which is designed with our proposal.

Introduction

Nowadays at almost all Japanese universities there are students who have higher levels of understanding and skill as well as students who have lower levels of understanding and skill. Therefore, it is important to provide an adaptive learning environment for students of all levels.

Many e-learning systems which provide a curriculum-based learning environment were developed by using a LMS (Learning Management System) which certified SCORM (Sharable Content Object Reference Model) standard [ADL]. However, these systems are not sufficient to respond to all students' interests/needs and to keep their concentration focused on computer learning. It is very effective to add an exploratory-based learning environment to these systems in order to overcome the above mentioned shortcoming.

One of the functions that play an important role in the environment is to provide students with suitable frequently asked questions (FAQs) from among the database. Another typical example is a function whereby students can browse Internet web pages. This function also improves the power and efficiency of the exploratory-based learning environment.

Therefore, the adaptive learning environment which we intend to achieve must provide not only the curriculum-based learning environment, but also the exploratory-based learning environment for each student. In this integrated environment, students can use the functions which are supported by the exploratory-based learning environment while they are learning in the curriculum-based learning environment.

We have developed a framework of the adaptive e-learning systems called POLITE (Portfolio Oriented e-Learning for IT Education) [Fuji et al. 2007]. POLITE has both the curriculum-based learning environment based on SCORM 2004 and the exploratory-based learning environment which includes the function of interactive Q&As, and the web page browsing function. In order to implement this framework, it is necessary to improve the ordinary LMS which

supports only the curriculum-based learning environment.

Adaptive e-Learning system (POLITE)

We developed an adaptive e-Learning system which provides a curriculum-based learning environment and an exploratory-based learning environment. In order to adapt to student knowledge or skill levels in a curriculum-based learning, a sequence function is required. SCROM 2004 standard provides a sequencing function, so we developed a curriculum-based learning environment by using SCORM 2004 LMS provided by eLC (e-Learning Consortium Japan) and NTT-X[NTT]. On the other hand, in an exploratory-based learning environment, students can refer to contents of other SCO (Sharable Content Object) or internet sites. In SCORM 2004 standards, the pages which can be referred to in an SCO are limited to the same SCO. Thus, we cannot develop an exploratory-based learning environment according to the SCORM 2004 standard. Consequently, we developed an exploratory-based learning environment as a Web application by using PHP and MySQL. This Web Application is called ELE (Exploratory Learning Engine). In order to provide a curriculum-based and an exploratory-based learning environment, our developed Exploratory Learning System includes SCORM 2004 LMS (Figure 1).

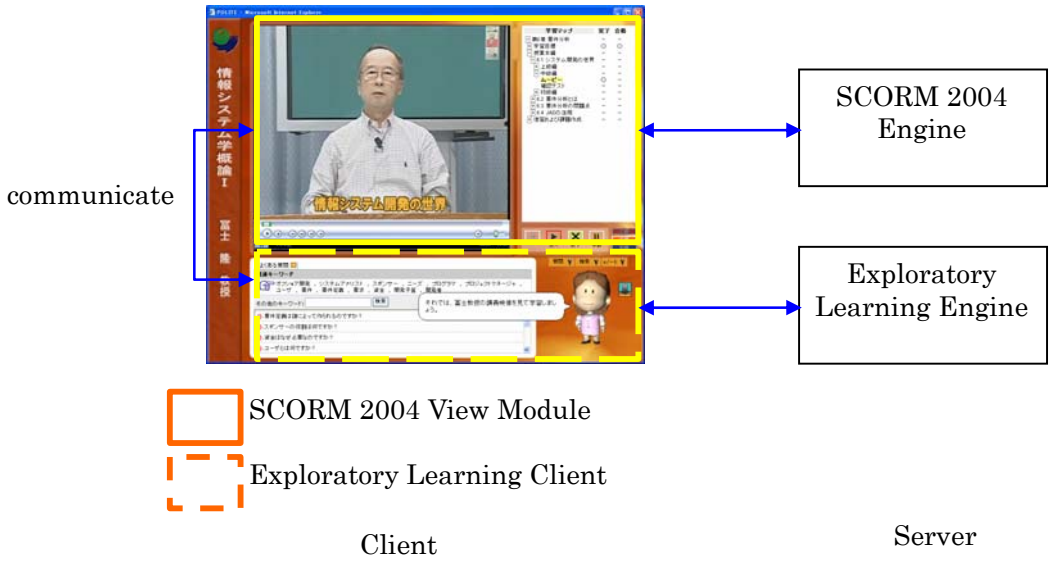

Figure 1: Configuration of Adaptive e-Learning System (POLITE)

In an exploratory-based learning environment, for providing FAQs or relational suitable topic items according to a topic item in curriculum-based learning, we modified the SCORM 2004 view module to inform to Exploratory Learning Client when the page is changed. But, we did not modify the SCORM 2004 Engine, so our developed system can be used with another SCORM 2004 engine.

The program of SCORM 2004 View, especially Java Script code, is dependent on Internet Explorer. For multi-browser support, we rewrote Java Script codes in SCORM 2004 View module. We confirmed that our system can be used in the Internet Explorer and Firefox on Windows XP, and also Firefox on Mac X.

We also developed virtual systems development tool for data modeling and programming (Figure 2 and Figure 3). Each learner can describe entity-relationship diagram with the tool, and also he/she can create a Java program with the Java simulator. A tool for data modeling is written by Flash and a tool for programming is written by PHP. A tool for programming uses Java compiler and virtual machine in server.

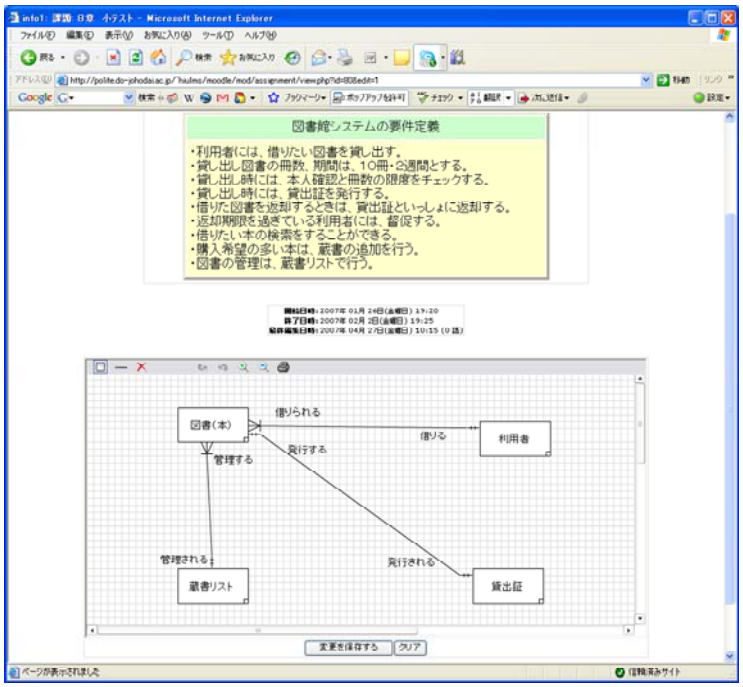

Figure 2: Screen sample of the tool for data modeling

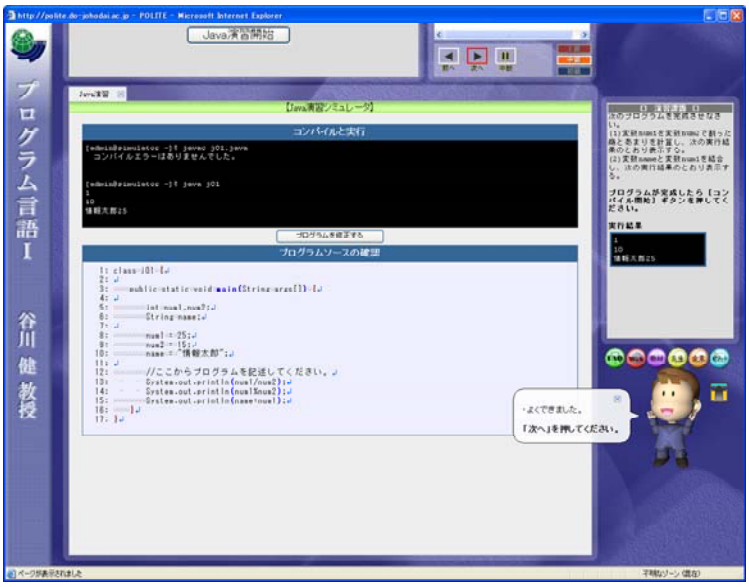

Figure 3: Screen sample of the tool for programming

Case studies and Considerations

In the past year, we carried out some case studies for IT education using POLITE systems. In this paper, we refer to the results of two of those case studies.

These case studies are standard lecture courses entitled “Foundations of Information Systems I” and “Foundations of Information Systems II,” respectively. Each class meets 13 times to 14 times during the term. Each class carried

out the case study in two chapters.

Table 1. Summary of the Case studies.

	Foundations of Information Systems I		Foundations of Information Systems II	
	Chapter 6	Chapter 8	Chapter 5	Chapter 10
total # of Students	49	41	33	31
# of Students referring to FAQ	30 (61.2%)	30 (73.2%)	19 (57.6%)	16 (51.2%)
average frequency per chapter	17.6	21.1	18.8	24.9
# of Students referring to Web page	1	5	3	2

After those case studies, we analyzed data logs of each student's activity (learning logs) which were recorded in the system. Table 1 presents the summary of the case studies. The learning logs show that the students of over 50% of the "Foundations of Information Systems I" and "Foundations of Information Systems II" classes used the FAQs that POLITE recommended to them dynamically.

In addition, the logs indicate that those students referred to the FAQs about 20 times per chapter on average. The result of the above analysis suggests that the exploratory-based learning environment is useful for the students who learn in the curriculum-based learning environment.

On the other hand, most students did not use the web page browsing function. The current system provides them only the hyperlink which is connected with Google as an entrance to the Internet. It seems that this is one of the reasons why most students did not use the web page browsing function. It may be necessary to add some advanced functions (for example, a web page recommendation function) to our system in the future.

Conclusions

In this paper, we introduced our advanced framework of the adaptive e-learning system called "POLITE". In particular, we explained the mechanism designed to offer the functions in order to support the exploratory-based learning environment to the ordinary LMS which certified SCORM 2004 standard. The Exploratory Learning Engine based on our proposal mechanism can be used with any SCORM 2004 LMS.

References

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