Design of an Effective Learning Evaluation Component in Web-Based Instruction

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Abstract

Taking advantages of the Internet and the widely available Web applications, Web Based Instruction(WBI) has been getting more attention from many researchers regarding the scope and capability for improving learning effectiveness. Reasons of the rapid growth of WBI can be seen from; it promotes distance learning economically, it enables learners to attend clasess at their homes or offices, and it provides delivery medium, content provider and subject matter in one package for the convenience of use. It is apparent that WBI can easily overcome the constraint of time and space more efficiently compared to the traditional learning method. The previous WBI system informed the results of study to students after lectures and tests are given. The uniform test didn't allow the teacher to recognize the student's evaluation according to the level of the student's ability and it couldn't be a reason to change a teaching method.

This paper discusses how WBI and Component Development Process can be integrated to design the Learning Evaluation(LE) component which assists instructors to choose an appropriate teaching method. The paper illustrates LE component for supporting instructors by demonstrating the test results of pre-test step by step including results of post-test after analyzing the evaluation of the tests. Component Development Process(CDP) is used in designing LE component for WBI.

Keywords*: Web-Based Instruction, LE (Learning Evaluation), CDP (Component Development Process)*

1. Introduction

Web Based Instruction(WBI) system is becoming more important in the field of the education as the education paradigm is changing, shifting the classroom initiatives from teachers to students. The paradigm shift requires new instruction methods which can effectively adopt the rapid change of the education environment. Not surprisingly, building and maintaining WBI systems are expensive while students are becoming more sophisticated in terms of the capability they expected from the systems. Component based development can be a promising solution to develop WBI systems more efficiently as well as other applications in many different domains, addressing system reusability and a productive software development resulting in more reliable software that can evolve over time.

This paper discusses the individual learning using various learning media and technology to provide an interactive learning. It also suggests the component development process to build LE (Learning Evaluation) component. The system is designed to support teachers to evaluate the effect of teaching methods or the contents based on the student's learning results.

Therefore, teachers can have the exact and rapid teaching evaluation. The LE component can be easily used for teachers to systematize the test method or change a paradigm of study. Furthermore, it is possible to reuse the WBI system in similar domains, increasing the possibilities of easiness, and transportation of use.

2. Related Work

2.1 WBI System

While the literature is concerned about being incongruous with the learning environment as well as the lack of system quality and the variety of functions, the traditional Computer Aided Instruction(CAI) system does not reflect the characteristics of students well. Recently, the popularity of the web brings new paradigm and perspectives which require more intelligent CAI system and consequently result in WBI systems. WBI has an activity transfer capability through the web to develop student's knowledge or learning capability, and provide wide channels of internet access to users.

Level learning is becoming an hot issue in WBI research, where the various teaching methods are provided according to the student's learning level. Suitable level learning is determined by the basic knowledge about students, progress of learning, and goals of learning triggered by level learning process. The learning process is parallel and this method is applied to individual learning as well. Figure 1[1] shows the parallel level learning.

However, in the previous WBI, students just learned the material which teachers provide and then their learned level are evaluated. In addition, teachers normally do not receive the methods of the teaching evaluation. Therefore, teachers couldn't recognize whether the teaching material or teaching methods were proper to students. Since the proper information about each student is necessary to provide an appropriate individual learning, there have been a lot of criticisms. The demand for the solution of this problem has stimulated new approaches to provide the effective method in identifying goods and bads of teaching method [2].

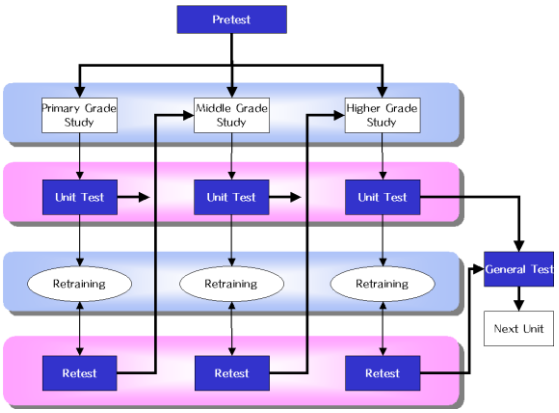

Figure 1. Parallel Level Learning

2.2 Component

According to Szyperski[12], component is "a binary unit of independent production,

acquisition, and deployment that interact to form a functioning system." It is an independently deliverable package of a society of classes which encapsulates design decisions and which will be composed with other components as part of a larger system. The connection of a particular component to the other component is accomplished by the interface.

As shown in figure 2, component consists of function, format, domain, delivery unit, and technology. Component has a merit which is possible to reuse without languages or development tools through brokers such as CORBA IDL or COM[4].

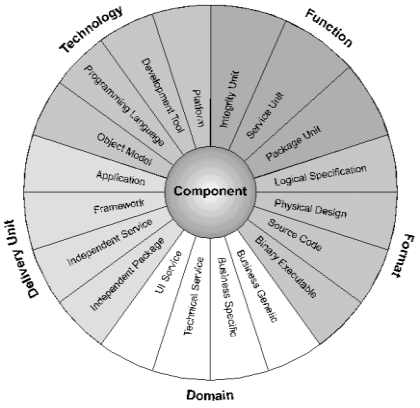

Figure 2. Component Structure

Component based development is the hjghlight of the effort to control the complexity and the cost of software development. It allows the reuse of software component and increase the productivity and software quality while decreasing the burden of maintenance problems. There would be a variety of components with different applications and the question is to choose the right component for the specific application and to interface them together.

3. CDP(Component Development Process)

Component development process can be divided into 4 stages such as component identification, component development, component creation, and component reuse[5],[6]. Component development process for WBI is described in figure 3.

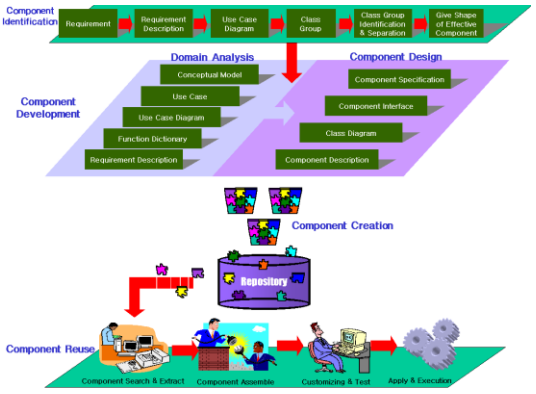

Figure 3. Component Development Process

In order to provide an effective learning for students and utilize the learning result for teacher supports, the process should be designed by the idea that is systematizing with the component concepts. The process is needed to fulfill user's requirements through the domain analysis, design, and implementation of a specific component. In this paper, the emphasis is given to the domain analysis and component design for an interactive relationship of teacher component and system component.

3.1 Domain Analysis

Domain analysis is the technological beginning to develop a component by understanding the application area of interest. Domain analysis process consists of several stages such as requirement description, function dictionary, use case diagram, and the conceptual model.

The requirement description defines all sectors such as users and the system that are evolved in a particular domain. The function dictionary defines the name of object and function. It also determines the type of function that is identified in the requirement description and the quality level to be achieved. The use case diagram is used for the requirement analysis process of users and the system. It illustrates the interactive relation between the actor and use cases The system user is presented as the actor and the use case describes the related activity performed by the actor. Use case diagram indicates the name and function of use cases and demonstrates the relationship between the actors and the functions. Finally, the conceptual model explains the quality of class that is constructed by the use case, eliminating unrelated classes and defining the quality. In addition, it provides a list of classes based on use cases and presents the conceptual class diagram.

3.2 Component Design

Based on the information gathered in domain analysis, development of component is possible through definitions of description related to the interface. First, component description reanalyzes the result of domain analysis model and identifies the certain part of the class that lets the component remains independently. Next, class diagram presents the communication of message between class methods. Component interface defines an interactive relation of components, giving and receiving services between them. Lastly, component specification is helpful to develop a proper component that satisfies domain requirements. It also distinguishes the information of component analysis and design from information of functional or nonfunctional component with specification.

4. Design of LE Component

4.1 Component Identification

This step is designed to identify how to use a specific case for components. Users compare requirements of real world with use cases. Then users can determine whether the component is suitable for a certain specification. Figure 4 shows the use case diagram of teacher supporting component. In this paper, the main focus is on the design of Learning Evaluation(LE) component that is a part of Teacher Supporting component.

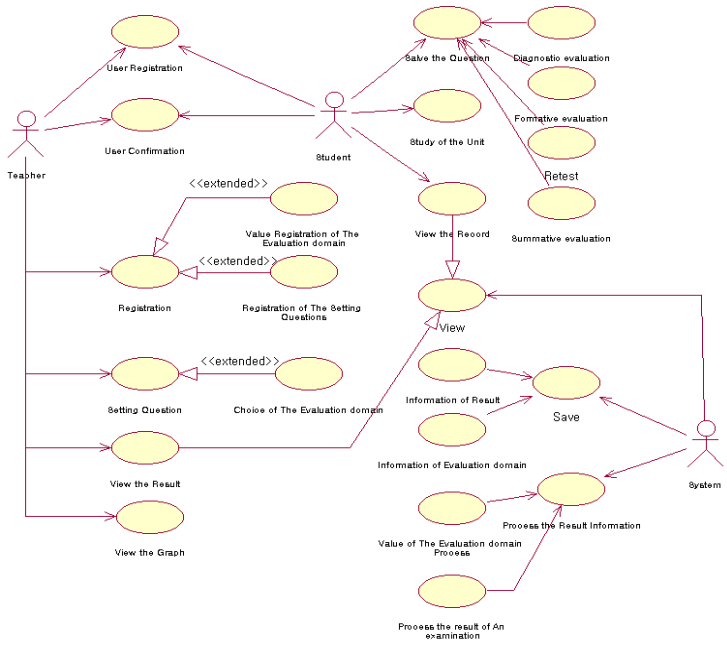

Figure 4. Use Case Diagram of Instructor Supporting Component

4.2 Domain Analysis

Functions of LE component include setting unit contents for a learning session, viewing the graphs for teacher support, and solving questions and displaying the results. For the pilot purposes, an exploitation is limited to developing registration of the evaluation domain and viewing graphs modules. The first step of domain analysis is to compose the requirement description and understand the purpose and details of this process.

<Table 1> Requirement Description

D: Requirement Description
D1: Registration of Evaluation domain value **D2**: Registration of the question D2.1: Fill up the subject name, and number of question for setting question by teacher D2.2: Choice the Evaluation domain D2.3: Setting question and Making the correction **D3**: Save the questions

4.2.1 Function Dictionary

Function dictionary explains the details of functions the component possesses. As shown in table 2, function dictionary consists of function name, function description, and category.

<Table 2> Function Dictionary

Function Name	Function Description	Category
Registration of the Evaluation domain value	Registration of the Evaluation domain value for Level learning	Registration of the Evaluation domain
Registration of the subject	Choice the subject for setting question	Registration the setting question
Registration of The number of question	Registration the number of question	Registration the setting question
Setting question	Setting question for evaluation	Registration the setting question
Choice The Evaluation domain	Choice the Evaluation domain(knowledge, application etc.) for teacher supporting and distinguish the question's character	Registration the setting question
Modify the question	Modify the question	Registration the setting question
Read the result	Read the result from answers	View

4.2.2 Use Case Diagram

Use case diagram, based on the requirement description and the information from function dictionary, is used to conduct the requirement analysis of users and the system. Figure 5 demonstrates the use case diagram in which teachers and system users are referred as actors.

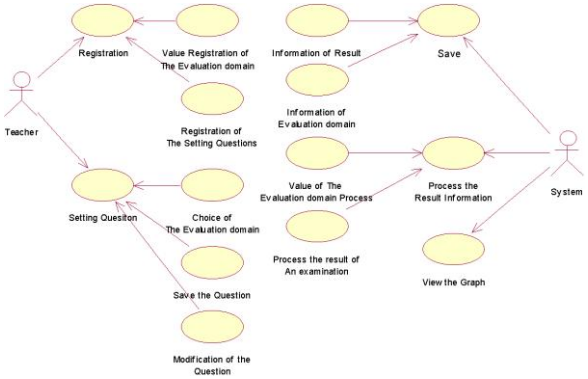

Figure 5. Use Case Diagram

4.2.3 Use Case Specification

Use case specification is designed to explain the name of description and summary in terms of a teacher's point of view for utilizing the examples of use case diagram. The registration and setting example related to teacher supports are illustrated in table 3. This is recognized as the main action and determines the quality of learning evaluation component.

<Table 3 > Use Case Specification

Name: Teacher supporting **Short description**: Registration of the Evaluation domain and value, after the test, view the graph, and describe the part of Teacher Supporting. **Main Flow** 1. Teacher choice the subject to setting question 2. Registration of the number of question 3. Registration of the Evaluation domain for Teacher support and distinguish the question's character 4. Setting question 5. Choice of the Evaluation domain(knowledge, application etc.) for distinguish the question's character 6. Modify the setting question 7. View the graph from the study

4.2.4 Conceptual Model

Conceptual model is established by summarizing the common example from the use cases and the function dictionary. It also eliminates the redundancy of the use cases and functions. The model, as shown in figure 6, represents the conceptual relationship of each element in the component. It presents an associate relation of classes and can be used as a candidate list to construct a component.

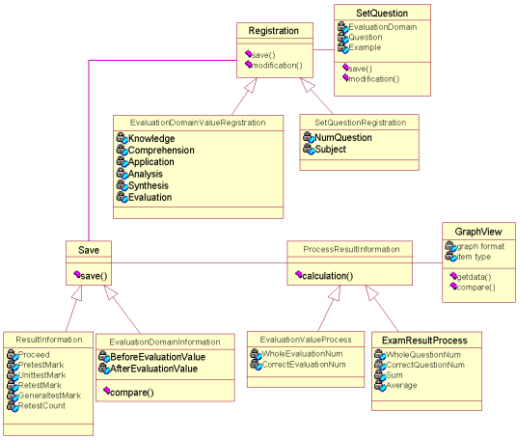

Figure 6. Conceptual Model

4.3 Component Design

The basic idea for the component design in this paper is to distinguish the resources necessary for real development from user's requirement in domain analysis. The design process can be initiated by utilizing the information from the function dictionary and a candidate list from the conceptual model.

4.3.1 Component Specification

Table 4 shows the component specification that can be used to define an operation part of component. It is based on the candidate lists in the conceptual model. The specification is written by focusing on the evaluation component that is to be implemented to satisfy the requirements.

<Table 4> Component Specification

1.Component Names : Learning Evaluation Component 2.Description : Teacher Supporting Component that is flexible enough to provide a level learning based on students learning ability and teaching methods. .3. Message How : Teacher registration the item to identity an appropriate level learning and display the graphs which can assist the leaning process. 4.Class Name : Registration, view the graph, Teacher Support. 5.Reference use Cases : Problem Registration, level learning Standard Item, Registration of learning level, Graph Type, etc. 6. Related Component : Student Component.

4.3.2 Class Diagram

Class diagram is drawn to define the associative relations among the classes before developing a component based on the conceptual model. The class diagram, as illustrated in figure 7, consists of the user management service class for a teacher and student evaluation, and the question processing class for students.

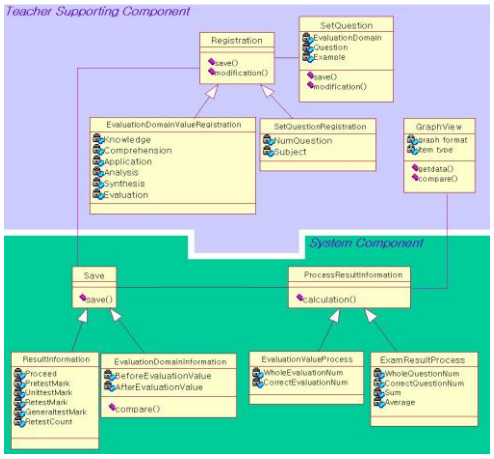

Figure 7. Class Diagram

4.3.3 Component Diagram

Component diagram is organized to explain what consist of LE component. As shown in figure 8, LE component include the registration of items for teacher supports and the system to provide a realistic supports based on the items registered. The diagram also demonstrates the interfaces for the services and its relationship between them.

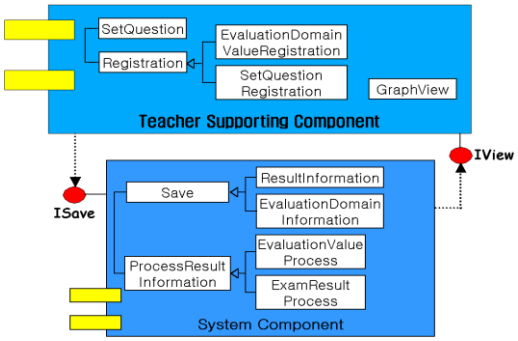

Figure 8. Component Diagram

5. Implementation

5.1 Implementation Concepts

The general functions of LE component support a teacher to evaluate the result of learning and give him/her a chance to change the teaching method and contents. Teachers can access to the evaluation domain registration form and see the graph based on learning results of the students after registration. This paper illustrates the UI service based on domain, system units that give services through interfaces and the type of binary executable codes. JBuilder 3.5 is used as a basic embodied environment. The figure 9 shows the configuration of web-based environment of LE component. It is realized as the type of server side component. There are several UIs, such as evaluation UI, authoring UI and learning UI. User information and contents in the resource control are also included in the component.

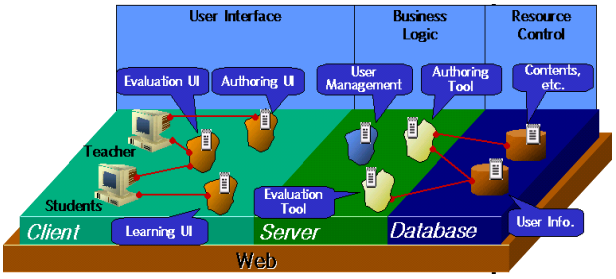

Figure 9. Web-based environment of Instructor supporting component

5.2. Architecture of WBI Systems

Figure 10 demonstrates the basic architecture of WBI system. JavaBeans Component can be utilized for those system developers who are willing to develop reusable software components. The internal sides of JSP and JavaBean components are called to retrieve and update data from databases. JDBC (Java Database Connectivity) is an API that enables Java Programming Languages to get an access to a certain tabular data source.

JSP page generates dynamic HTML pages to respond requests from the clients while the system maintains a robust connection through SQL to the database. JavaBeans contains the data logic and business logic for the main application. The figure 14 shows the system structure of WBI.

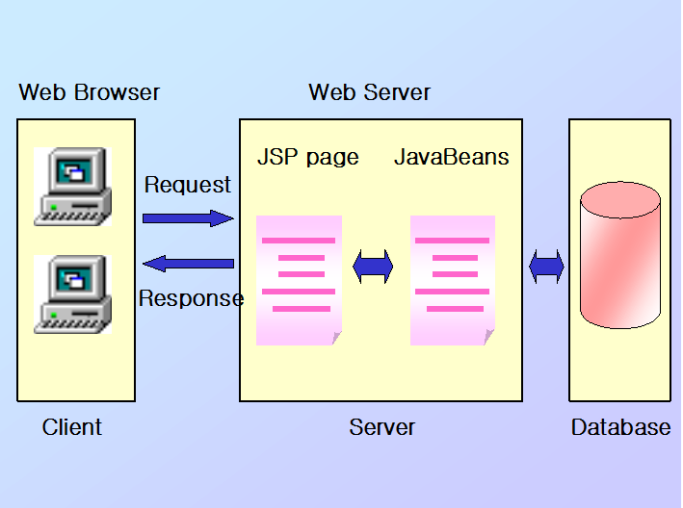

Figure 1. The WBI System Structure

5.3 Evaluation

Registration form is organized with the necessary function for beginners and realized for anybody to get an easy access. Figure 10 shows details of the evaluation form. Evaluation values are in the left frame and the level of learning steps is in the upper frame.

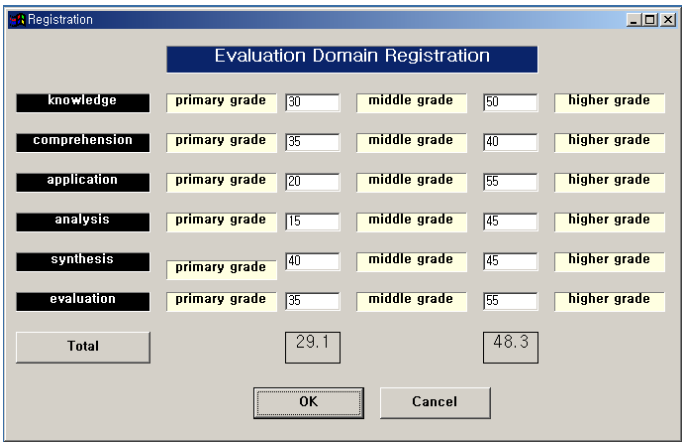

Figure 11. Evaluation Domain Registration Form

5.4 LE Example

Figure 11 contains the visual data of LE component learner's results. It adds the results of level learning steps and provides comments according to the pretest, general test and the results of level learning. It is possible for a teacher to evaluate a teaching result and change the contents or teaching method accordingly.

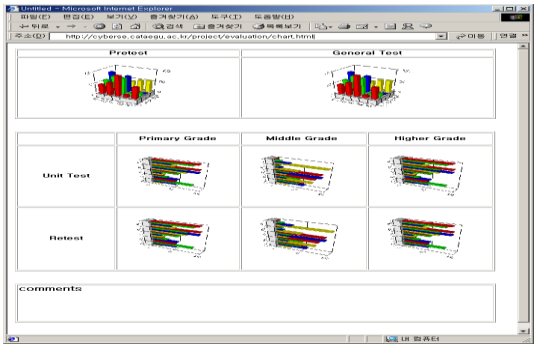

Figure 12. Instructor Supporting Form

6. Conclusion

The traditional computer assisted education is facing a challenge with the dominant presence of the Web applications and in the internet. Students can be free from restrictions of time and space through WBI. Effectiveness of learning in WBI can be significantly improved compared to the previous computer teaching methods. In other words, the traditional paradigm of learning in fixed time and space can be changed to the new environment where teachers, schools, students, parents and the public can have dynamic interactions over the flexible time and space.

The literature supports the assertion that WBI is a rapidly growing trend and also indicates that a critical factor to the success of WBI is the incorporation of usability design into the development process. The design issues gleaned from the literature review include: transfer of existing course material, as is, to WBI, without considering using the medium's capabilities, such as graphics or communications, like list servers; ignore the forms and styles required by the medium, such as using the structure of a traditional lecture course as the structure for a WBI course and use existing course material and while ignoring features without restructuring existing material to fit the features, which can lead to the student learning less.

This paper discusses the design of LE component and demonstrates the implementation of LE component in the context of WBI to maximize the students' learning ability. This component can be used to overcome the problem of traditional teaching process and learning method. It can also be useful to provide teachers with new teaching paradigm and more effective teaching method. The study shows that LE component can be integrated to build WBI with the capability of plug and play in the area of teacher supporting.

For future research, this study needs to be extended to more interactive use of LE component, reflecting the findings of this paper. The reorganization and categorization of component must be accomplished in the field of WBI with the common standard. This paper only attempts to review one aspect of WBI design, which is basically user interface design. Other issues, such as determining what content is more appropriate for WBI and incorporating learning styles into WBI design needs to be addressed.

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