Chapter

A Web-based Customized Virtual Learning Environment

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Abstract

Advances in multimedia technologies and Internet technologies lead to new types of teaching and learning. However, most distant -learning or virtual -learning sites are still limited to the dissemination of teaching materials. N either the strengths of Internet have been maximized nor the functions have been fully utilized, for instance, in supporting interactive, customized and collaborative learning. In this paper we propose and describe a web -based customized virtual learning e nvironment, which models a new collaborative learning process that can be widely accessible in the Internet with high user interactions.

Keywords: web-based education, customization, World Wide Web, virtual environment

1 Introduction

For a decent proportion of one's life span, learning activities, to most people, are packaged in certain kinds of defined subjects in a confined environment. Although such an environment provides a major education means to the public to satisfy the social and economic needs, it may not be an ideal education pattern for the mankind. In fact, Hutchison [1] describes the traditional education style as perverse unnaturalness. Envisaging the rapidly changing world, in which new technologies relentlessly redefine the way people work and live, he suggests that

> "It may not merely be an anachronism to continue to embrace the model of the traditional residential university as the primary locus of learning – it may arguably be an impediment to appropriate learning and ultimately a threat to growth, both economic and personal."

In other words, learning is an interactive, dynamic, and active feedback process with imagination driving action in exploring and interacting with an external environment [2]. This simply means that effective communication between the instructor and the students is crucial.

The World Wide Web (WWW) is being used as a strong educational technology. Since the WWW technology provides a transparent access to anywhere in the world for information dissemination, unbound by th e geographical separation. This penetrating power is adequate to enable on -line learning systems to deliver education to special learning sites where regular academic systems can hardly reach, for instance, adult education centers, company -training rooms, special schools for students with learning or physical disabilities, public libraries, or even prisons. Learners can easily connect to the Internet with their personal computers or using the computer laboratory facilities. Moreover, the Web provides a plat form for delivering not only the text material that a class might need, but also multimedia contents as well, including audio and video streams of instructor lectures.

The major difference between the Web -based education flow and the existing education fl ow is that in the Web-based environment, students can choose their own paces for learning. They can skip those materials that they have already learned or known and they can replay the course that they did not thoroughly understand. On the other hand, the Web-based education system needs to overcome the deficiency of lack of face -to-face feedback from students to instructors. In the traditional classroom learning, instructors can always look for

tiredness, lack of interest, understanding and distractions fr om the audience and alter the teaching pace and contents in accordance with the feedback [3].

Many learning institutes in North America and Asia understand that technology can be used to support education of the new era. They have started to use Internet and WWW (see Table 1). The abundant on -line courses attest the value of the Internet in enhancing distance learning. However, most of these programs lack the real-time interactivity of a classroom. They are essentially correspondence courses which use emai l and web pages in place of printed material. In other words, they only enable dissemination of teaching materials, and inadequate facilities are used to support students. Moreover, these Web -based courses are not "flexible": neither the teachers nor the d elivery systems can adapt the course presentation to different students for different needs [4].

Type of organization	Providing service
Grass-roots volunteer efforts	• Blue Web'n Library [10] • Netday [11]
Academic institutions	• SUNNY Virtual Classroom [12] • NovaNet of North Carolina State University [13] • The World Lecture Hall at University of Texas [14] • ElectronicCourse of The University of Connecticut [15] • The Virtual Collaborative University at The University of North Texas (UNT) [16] • The Virtual Classroom at New Jersey Institute of Technology [17] • The Virtual Classroom at The University of West Florida [18]
Commercial sector	• Zdnet University [19] • The Spectrum University [20]
Company (commercial product)	• The FirstClass [21] • WebCT [22] • Misk.edu [23]

Table 1. Examples of research on Internet-Based Learning

In particular, both teaching and learning are changing drastically these days, and instruction -based learning pattern is being challenged. New learning paradigms are being formed. A summary of the parad igm shift in education is (1) Educational focus is changing to student -centered from teacher -centered; (2) Teaching approach is shifting to autonomous and independent learning from monotonous lecturing; (3) Learning style is adapting to active and collaborative learning from passive learning.

In this paper we propose and describe a Web -based customized Virtual Learning Environment. The paper is organized as follows: Section 2 discusses the principle and design feature of the Virtual Learning Environment, Section 3 describes the architecture and components of the learning environment, and Section 4 gives the conclusion.

2 Principle and Design Feature of the Virtual Learning Environment

2.1 New Learning Process

We would like to discuss the new learning process that is different from the traditional one. First, customized learning strategy can be outlined to enhance the learning process. This is shown in Table 2. Moreover, in this new learning paradigm, the behaviors of each role would have significant differe nce compared with the traditional paradigm. This is shown in Table 3.

In the new learning environment, students are encouraged to engage in learning, as there are more opportunities for participation than in face -to-face group interaction. This facility h elps shy students to establish their confidence. Although they may still avoid social interactions in class, they can establish private communication with the instructor. Further consultation may be useful to follow up special needs.

Components of learning strategy		*Expected achievement*
Choice of individual/group learning	➔	Depend on personal style (selection of synchronized/ asynchronized lecturing mode)
+ Collaboration	➔	Learn to solve problems together (social interaction)
+ Customized learning progression	➔	Instructor/scheduler advises the pace (personal pace control)
+ Efficient personal support	➔	Establish closer relationship between an instructor and students
➔ ***Delivery of the right knowledge to the right people at the right time***		

Table 2. New learning strategy

Role	*Changes*	*Expected behavior*
Students	From passive to active	- State what they need and what they want - Decide which learning mode fits themselves - Encourage participation
Instructor	Instructor	- Present the material - Answer questions from the students about the material - Relatively less of a leading role - From "chalk-and-talk" role to "guide-on-the-side" role
	Personal Scheduler	- analyze the learning pattern of each student - give study advice to the student - listen to the student - personal consultant

Table 3. Changed behavior of roles

In order to reduce the load of an instructor, the role of instructor is split into two parts. The first one acts as the usual teacher i n classroom. The second one acts as a personal scheduler to support each student individually. Some argue that the Web -based educational applications are expected to be used by very different groups of users without the assistance of a human teacher. In ou r view, education is an interactive and dynamic process. Even with the advanced information system, the role of human teacher is crucial and cannot be eliminated.

There are mainly three roles in the traditional education: student, teacher and content provi der (teaching/learning material provider). Sometimes teacher and content provider may be the same person. In general, students and content provider do not have any direct communication and teachers act as a middleperson to present the material to students, whereas the material is prepared and selected by the provider. On the other hand, students have no choice to determine what material they are interested. If these students are mature, they can make reasonable decisions and know what they desire to learn. But often they are not.

The networked learning environment enhances the linkage of students, teachers, schedulers and content providers. In the past, the learning subjects are fixed and the material used is determined by the content providers. The situations of demand over supply always occur. In today's environment, however, technology can be used to balance the requirements between demand and supply.

Table 4 shows the relationship between demand and supply in an education system. Table 4, in particular, points out the independence of demand from supply is achieved by "switching" to a combination of resources that best meets current demand requirements.

Condition			Consequence	Status
Demand	>	Supply	Not fulfilling the enthusiasms of learning	Present
Demand	=	Supply	Just-in-time delivery	Ideal but hard to achieve
Demand	<	Supply	Customized switching of resource	Proposed

Table 4. The relationship between demand and supply in education

2.2 Students' needs

In order to facilitate customization, the learnin g environment should gather information of the students as much as possible, and provide guidance and help for them. The following area should be considered to implement the new learning environment:

1. Pre-entry educational and vocational guidance – Pre -test is given to each student to assess his/her present level and to re -schedule the material for him/her. After some time, another test may be given to evaluate the acceptability of the student. Rearrangement of material may be needed to optimize his/her learning efficiency.
2. Adaptation of learning methods – Enabling students to gain the maximum from the variety of available learning resources.
3. Preparation and development in learning skills – Enabling students to become independent (autonomous) learners.
4. Monitoring and support of student progress.
5. Planning and personal support throughout the study.
6. Personal counseling (support for students with special requirements).

So, before implementing the new learning environment, we have considered a baseline structure. This is described in Table 5.

Considered factor	***Motivation***	***Direction of implementation***
Orientation	Let the students understand the relationship between tasks and resources	Engage dynamic pointer structure of the course so that students always know what they should be doing, what needs to be done next [2], etc.
User-friendly	• Dynamic control of applications with respect to connections, interactions, and quality on demand combined with user-friendly and transparent human/machine interfaces [2] • Helpful guidelines, with quick and efficient access to relevant information [2]	Provide a friendly and consistent user interface designed according to strict ergonomic criteria. Such a user interface is necessary to present the required information in convenient and comprehensible formats [2]
Privacy	Give personal area to users	Preserve some separation between public and private workspaces [5]
Feedback	Provide some forms of feedback to the learners and the instructors	Provide at least one feedback channel

Table 5: The Baseline Structure for a Learning Environment

2.3 TheVirtual Learning Environment – An Ideal Learning Place

The Virtual Learning Environment models the new learning environment, which is a place that students can customize their study in their own pace. Providing up -to-date learning material and personal study guide, it is an ideal study environment for the 'life -long' learners. The main goal of the Virtual Learning Environment is to deliver the 'own-paced' material to the right person at any time.

In the Virtual Learning Environment, students can fully engage in the learning process through an interactive,

dynamic environment. The on -line material for each student is scheduled personally depending on his/her studying pace. Consequently, students wil l not waste their time learning irrelevant or already -known material, while other students may fail to understand the material. In addition, the Virtual Learning Environment supports group -paced learning. The collaborative facility allows students to accom plish group projects and discussions. The Web -based Virtual Learning Environment not only transmits information to the students, but also provides forums for exchange. When group members participate and share their knowledge, their knowledge base increase s and members continue to benefit [6]. This kind of real -time communication is not restricted to only peer interaction (student/student). It can also encourage active participation of students and the instructor in a shared task for understanding and apply ing the concepts and techniques that characterize a subject area [7].

In a traditional education system, customization is seldom realized. Most teaching material is planned in a non-dynamic order and delivered to a class of medium size (20 -40 people), in order to improve the effectiveness. However, "how to measure effectiveness" and "what constitutes a quality education" are subjects of much controversy. Effectiveness can be defined in terms of the extent to which a course achieves a set of learning goals for the learner [7]. In general, each person can have his/her own desired goal.

Furthermore, instructors/teachers may assume plenty of burdens and feel much pressure. They have to select the teaching material beforehand. The choice may be based on their e xperiences on the students or the scheduled syllabus that attempts to meet massive learning goals. It is difficult to provide customization for each student. After preparation, instructors/teachers present the material to all students at the same time and they receive responses and queries from the students. It is hard to handle all those questions immediately when the course is running. In most situations, the majority students just sit in class passively, and some may even be "tuned out".

The Virtual Lear ning Environment, on the other hand, tries to make the learning at a rate adjusted by the ability of the receiver (students) rather than by the sender (an instructor/teacher). In the meanwhile, the instructor/teacher may act as an individual supporter to t he students, giving advice and planning for each of them.

In summary, there are totally three characteristics for the Virtual Learning Environment:

1. Supported and customized individual learning – The Virtual Learning Environment provides a customized learni ng environment. It offers a clear orientation so that students always know what they should be doing, what needs to be done next, etc.

2. Real-time and non real -time group learning – By using the component MWPS (Multimedia Web Presentation System, described i n Section 3.3), students can attend a lecture in the Virtual Learning Environment similar to the traditional class lecture. Moreover, the lecture can be re -played at anytime to achieve the customization need.

3. Collaboration – By using the component JCE (Jav a Collaborative Environment, also described in Section 3.3), students can collaborate with others in a shared board. Moreover, it supports simple and useful audio communication.

3 The Architecture and Components of The Virtual Learning Environment

All the components in the Virtual Learning Environment can be distributed geographically, as shown in Fig. 1. For simplicity, the architecture is divided into two sides: the server side and the client side. The former can be viewed as "the school" and the latter can be regarded as individual students.

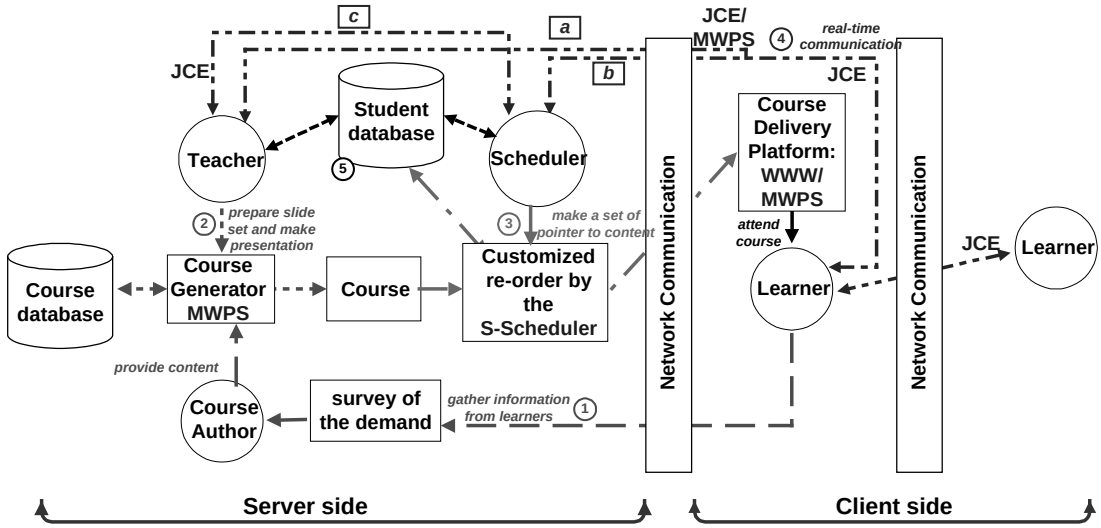

Fig. 1 The Architecture of the Virtual Learning Environment

3.1 The Server side

There are several processes in the server side. They are marked in Figure 1 and described as follows:

1. *Gathering of the course material based on the demand of students*

Learners pass learning requests to the server side, which are collected and analyzed by the course author before he/she prepares a new course material.

2. *Course generation and storage*

After the contents are gathered, teachers convert them into a presentable form that is understandable and clear to students. Making use of MWPS, the teacher can deliver the lecture in a real -time mode (learners can attend the lecture just like in a traditional classroom and ask questions as u sual) or in a playback mode (learners can replay the lecture at any time).

A course database is used for the storage and retrieval of the course material.

3. *Customized reorder of course material*

A personal scheduler rearranges the order of the material in or der to fit the pace of the learners depending on their learning ability and other factors. The scheduler sets the "content pointer" in each student profile and updates it periodically. The system will alert the scheduler to update the pointer before the st udent's next login-on.

4. *Real-time communication*

   a. *Interaction between learners and teachers*

      Learners can use MWPS to ask questions in a real -time lecture. They can also use JCE, a component adopted for the Virtual Learning Environment, to conduct a personal communication with the teacher individually.

   b. *Interaction between learners and the personal scheduler*

      Learners communicate with their personal scheduler by JCE.

   c. *Interaction between teaches and the personal scheduler*

      Teachers interact and collaborate with the scheduler, using JCE to for course activities.

5. *Student profile storage*

A student database is used for the storage and retrieval of the student's information. Privacy and security are the two most important implementing issues to consider.

3.2 The Client side

In the client side, learners plan their study according to their personal time scheduling. They receive the course delivery through the Web. Whenever learners log -on the Virtual Learning Environment, they can attend the lectures, study their course notes, work on their assignment, chat with others, negotiate with the personal scheduler for their learning progress, and send queries to the teacher about the course material.

On the other hand, learners can communicate with other learners using JCE. The y can work on group projects, perform collaboration, conduct brainstorming meetings, or simply chat informally. The flow in the client side highly depends on the preference of each learner.

3.3 Components in the Virtual Learning Environment

I. MWPS (Multimedia Web Presentation System)

MWPS (Multimedia Web Presentation System) [8] is a Chinese version of NCSU Web Lecture System (WLS, see http://renoir.csc.ncsu.edu/WLS), that supports construction, editing, and m anagement of Web -based presentations, as well as synchronous and asynchronous capture and delivery of classes and lessons. The presentations consist of HTML documents with streaming synchronized audio and video. The video can be of the low -bandwidth variet y or it can be based on MPEG -2. Low -bandwidth MWPS lesson can be received over ordinary modems and telephone lines. MWPS contains an on -line editor that allows instructors to prepare slides for delivery. The system captures audio and timing data during liv e presentations and automatically creates a Web -deliverable version of the presentation. All of the details of the underlying system are hidden from the users, including both instructors and students. MWPS allows users to view a presentation using a standa rd Web browser, such as Netscape, and watch/listen to the accompanying streams via a RealSystem player. The system also has the ability to deliver live presentations with student interaction. Its home page is (http://www.cse.cuhk.edu.hk/~lyu9804).

II. JCE (Java Collaborative Environment)

JCE (Java Collaborative Environment) [9], which is developed by the National Institute of Standards and Technologies Group (NIST) and in collaboration with Old Dominion Uni versity, uses Java -based collaboration mechanisms that provide solutions to overcome the platform -dependency problems for collaborative computing in heterogeneous systems. JCE intercepts, distributes and recreates the user events that allow Java applicatio ns to be shared transparently. Using the JCE, student or teacher can join any of the on-going conferences or to start a new conference. Available tools like whiteboard allows participants sharing a common writing place when they are in conferencing.

III. S-Scheduler (Smart Scheduler)

Applying knowledge base rules, the S -Scheduler (Smart Scheduler) acts as an intelligent advisor or consultant. It provides the human scheduler with a powerful tool to assist him/her in adjusting the studying plan for each stude nt objectively. The S-Scheduler gathers the pre-test results from each student and come up with a suggested individual study plan according to the knowledge heuristics and criteria in the knowledge base. The human scheduler uses the result as a reference a nd determines a customized study strategy, which is tailor-fitted to each student.

4 Conclusion and Future Work

Today we are facing tremendous challenges in applying information high-tech for education purpose. Current education and training facility is i n need of proper tools able to overcome limits on the space and time constraints and to meet various performance demands. This trend is clearly identified by the increasing number of geographical distribution of education and training centers. Moreover, co ntinuous updates are required for any technology -related advancement, while most educational users are naïve to modern

information technology. The integrated use of multiple forms of information, however, requires that the learning effectiveness be enhanced, not hindered.

The Virtual Learning Environment is designed to take on the current education challenges. In our Virtual Learning Environment, both learners and instructors do not need to be familiar with the high technology, while they can still communi cate with each other effectively, using the advanced Internet technology. Moreover, the Virtual Learning Environment provides its users with appropriate guidance and support, which help the learners to achieve an overall progress across all courses and stu dy programs. In short, the Virtual Learning Environment allows an interactive, dynamic, and active educational center to be developed and fulfilled in a modern studying environment.

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