

**Title: Exploring Web-based learning based on the client-server architecture
approach**

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Abstract

The Internet and World Wide Web are incredibly popular at homes and schools alike. Indeed, they have provided unprecedented opportunities for conducting online learning and distance education. Based on client-server architecture, this article provides that the Web-based learning can be divided three different layers: the layer of browsing, the layer of learning activity, and the layer of instructional content. In addition, this article develops three different learning models that include client-based learning, distributed learning, and server-based learning. Indeed, Web client-based learning can easily create the learning model of direct instruction. Web distributed learning can develop the learning model of interdisciplinary learning. And Web server-based learning can construct the learning model of collaborative learning.

Topic Area: Distance Education, Educational Technology

Keywords: Web-based learning, client-server architecture, learning models

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Introduction

The public domain of the Internet and World Wide Web (WWW or Web) has provided unprecedented opportunities and challenges for conducting education online. Researchers and educators have already noted the potential of the Web in education, especially in distance learning. Development of Web-based learning (WBL) has started a revolution in content delivering and social communication. The WBL can be defined as an innovation approach for delivering instruction to remote learners using the Internet and Web as an instructional delivery system (Khan, 1997). Additionally, the WBL also can be defined as a hypermedia -based instructional program that utilizes the attributes and resources of the Web to create a meaningful learning environment where learning is fostered and supported (Ritchie & Hoffman, 1997). As Sherry and Wilson (1997) noted that a WBL environment should include various resources, provide group learning, implement Web-based activities as a part of learning framework, and support both novices and experts. Thus, the WBL has potential to create a wealth of online and distance learning to learners that is not readily available in textbooks and faculty lectures.

This article discusses the developing aspect of the WBL for distance education based on Web architecture. Due to the client-server architecture of the Web, Web

application for online learning will be presented at first. Additionally, learning models of the WBL will also be discussed. Furthermore, based on Web architecture, considerations of the WBL will be described in details.

Web applications for distance education

A Web application can be defined as any application program that runs on the Internet and/or intranets and/or extranets. Individuals use Web browsers (such as Internet Explorer or Netscape Communicator) on client computers (users' computers) to run programs residing on server computers. Client-server computing splits processing between "clients" and "servers" on networks. Generally speaking, in client-server computing, the definition of client computers means the user point-of-entry for the required function. Normally, a desktop computer, workstation, laptop computer, PDA (Personal Digital Assistant), or even cell phone can be used as a client computer. The definition of server computers means the component that satisfies the user's request for data and/or functionality and that performs back-end functions not visible to users. In client-server computing, distributed processing means the distribution of computer processing works among multiple computers linked by a communication network (Laudon & Laudon, 2000).

If almost the entire processing is done on the client computer, then we can name it as client-based processing. In contrast to client-based processing, if almost the

entire processing is done on the server, then we may name it as server-based processing. Furthermore, if some of the entire processing is done on the client computer and other processing is done on the server, then we may call it as distributed processing. Client-based processing has grown very popular in recent times because it improves the overall application's responsiveness and allows some resources of the Web server for other tasks. Applications that use server-based processing do all of the application's processing on the server and then send results only back to the client computer. A distributed processing, however, allows parts of the Web application to be located on separate computers, possibly in different locations. Based on system approach, a major benefit of a client-based processing is client computers share the loading of server computers. A major benefit of server-based processing is the server computer controls all processes of a Web application. A major benefit of a distributed processing is its adaptability in a changing environment.

Based on client-server architecture, the learning models of WBL programs can be divided three different types: client-based learning, distributed learning, and server-based learning. Generally speaking, in client-based learning, learning activities and course instructional content are usually operated in client computers; individuals do not need to interact with servers frequently. In distributed learning, some learning activities and instructional content are based on client computers and others are run in

servers. This means that client computers have whole opportunities to handle learning activities and contents. In server-based learning, both learning activities and course instructional content are usually run in servers, individual computers only are used as Web browsers. This means learners have more chances to communicate with other learners or instructors through server computers.

Layers of the Web-based learning

The client-server architecture of the Web allows the development of distributed online learning programs. Essentially, the WBL programs can be subdivided into three different layers: browsing, learning activity, and instructional content. The layers of the WBL are shown in Figure 1.

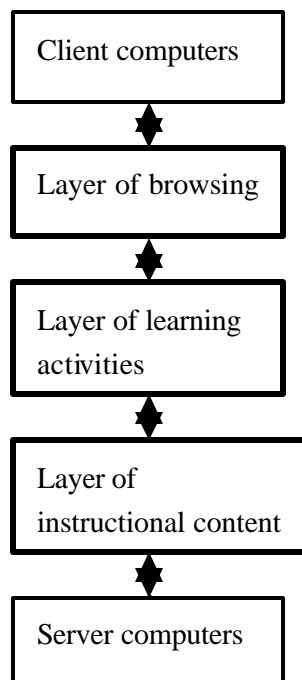


Figure 1: Layers of the Web-based learning.

The layer of browsing constitutes the interface between users (client computers) and the layer of learning. In the Web, the word “browsing” means learners can access data and information through browsers. In other words, learners use client browsers to communicate with servers. In general, Users communicate to other users through e-mail, online discussions or conferences with Web browsers. In Web browsers, hyperlinks are nonlinear tools that offer multi-linkages within, between, and among the nodes of a network. Hyperlinks permit individuals to jump directly to any Web pages they are interested in. In addition, the hypermedia environment of the WBL can be simultaneously represented in any combination of media formats, such as texts, images, sounds, and animations, for supporting multimedia instruction and interactive communications among learners.

The layer of learning activity constitutes the interface between the layer of browsing and the layer of instructional content. Based on characteristics of the Web, such as hyperlinks and random access, learning activities can be created from individual learning through group learning, from synchronous communication through asynchronous communication, and from content interaction through social interaction (Liaw & Huang, 2000). Based on learning aspects, behavioral learning usually focuses on individual learning and content interaction. On the other hands, constructivist learning generally focuses on knowledge exploration and social

communication.

The layer of instructional content constitutes the interface between the layer of learning activity and the server. In the layer of instructional content, the learning materials are the complete domain knowledge which represented in different ways (such as in databases or flat files). Additionally, the layer of instructional content also can include online discussions or conferences for social communication among users. Thus, instructional content may be well-structured or ill-structured learning instruction that depended on learning models.

Learning models of the WBL for distance learning

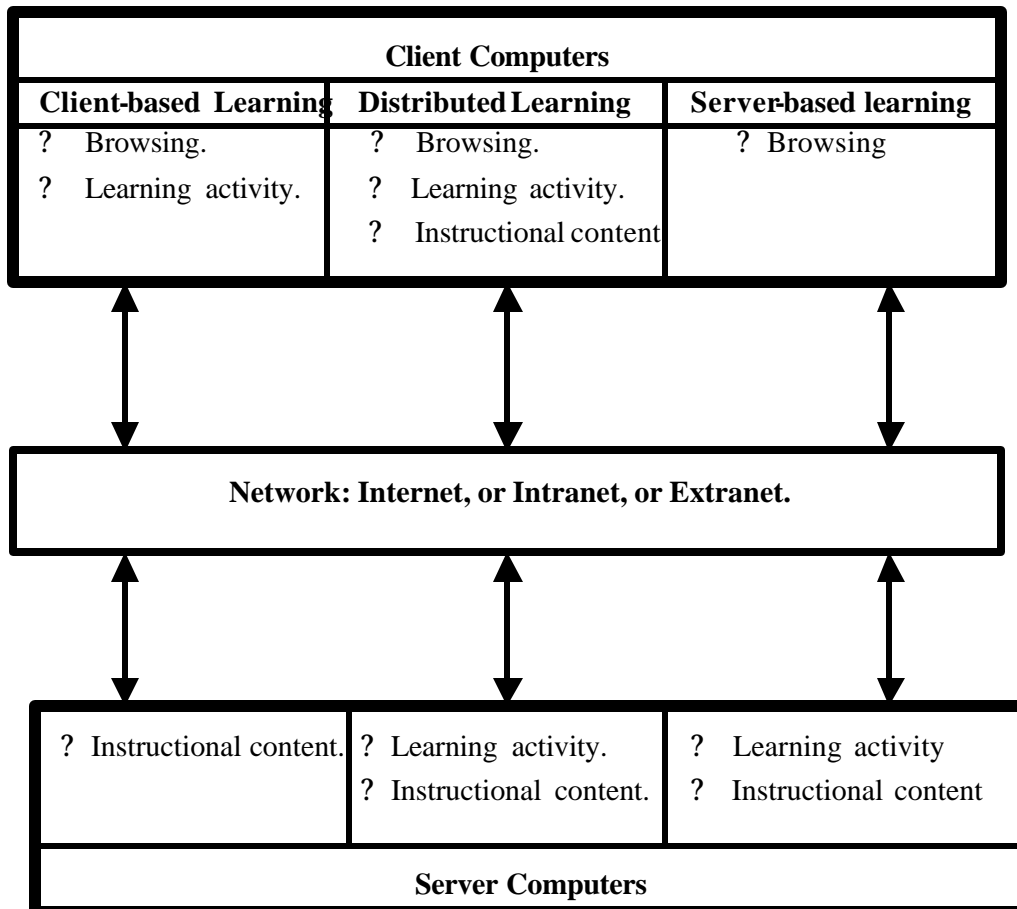


Figure 2. The Web-based learning based on Web architecture

From the point of view of learning models, client-based learning creates the model of direct instruction. Distributed learning establishes the model of interdisciplinary learning. Moreover, server-based learning sets up the model of collaborative learning. The architecture types of the WBL are presented in Figure 2.

Client-based learning for creating direct instruction

For client-based learning, learners' learning activities are run and operated in client computers. Therefore, the client-based learning can easily create the learning model of direct instruction. In general, various conventional computer assisted instruction (CAI) programs are direct instruction (such as tutoring programs and drill and practice programs). In direct instruction, the teacher controls instructional goals, chooses materials appropriate for the learner's ability, and passes the instructional episode (Darling-Hammond & Snyder, 1992). The direct instruction environment is where the predominant focuses on learning and where learners are engaged in academic tasks a large percentage of time to achieve a higher rate of success. The major goal of direct instruction is the maximization of individuals' learning time (Joyce & Weil, 1996).

Rosenshine (1986) stated that direct instruction included presenting materials in small steps so that one point can be mastered at a time; providing various

examples of the new skills or concepts; modeling of the learning task or giving narrated demonstrations; avoiding digressions; and re-explaining difficult points.

However, the use of this model should be preceded by effective diagnosis of students' knowledge or skills to be sure that they have the prerequisite knowledge or skills to achieve high levels with the instructional materials. Up to these points, Web characteristics of multiple information formats and multimedia presentation are all appropriate factors for creating direct instruction.

Distributed learning for creating interdisciplinary learning

In distributed learning, individual learning activities and course instructional content are processed in both client and server computers. The characteristics of the Web facilitate distributed learning through its massive information database, multiplicity, multiple linkages, multiple mixed media, and responsive interactive navigation tools. Indeed, this kind of distributed learning is interdisciplinary learning because it is easy to integrate various learning subjects on the Web. When hypermedia is integrated with the Internet, this Web-based hypermedia system allows all individuals with Web browsers or search engines to transfer files and information from thousands of possible real-life sources to themselves (Gilbert, & Moore, 1998). The WBL environment, search engines are major search information tools to encourage learners to explore related knowledge to

promote interdisciplinary learning activities.

From a constructivist aspect, the knowledge exploration should be connected to real life. In general, for school learners, there is too much information to be covered in the curriculum. Typically, in formal schooling, much content quickly becomes "inert" while processed and integrated (Gagne, Yekovich, & Yekovich, 1993), as it has little relevance to the life circumstance of the learners. Interdisciplinary instruction represents a philosophy of integrated subject matters, learner-center, local issues, real-life, and group activities (Ellis & Fouts, 1997). The capability of multiple representations in the Web provides learners across the various resources and content domains to facilitate their integration of knowledge. In addition, it allows learners to criss-cross the intellectual landscape in multiple dimensions, to traverse among these multiple routes for their understanding, and to induce information into their existing knowledge structures.

Server-based learning for creating collaborative learning

In server-based learning, individual learning activities and instructional content are all happened in server computers. Based on shared sources in server computers, learners are easy to interact and communicate to each other. In server-based learning, the Web offers interactive communication and creates a potentially collaborative learning environment. With hypermedia binding an online

system, this multi-user network provides enormous potential for collaborative learning (Yang, 1996). In this learning system, learners engage in side-by-side and online discussion, debate, or negotiation. In addition, this simultaneously synchronous and asynchronous nature provides a productive environment for group problem-solving activities to generate and test new ideas. Furthermore, this feature of the networking process for collaborative learning is a democratic environment where all learners have an equal opportunity to share their views.

The use of collaborative learning provides a mean to create more engaging and dynamic instructional settings (Skvin, 1992). Collaboration helps individuals to make progress through their ZPD activities in which they engage (Vygotsky, 1978). From the social constructivist point of view, learners are more interested in activities that engage them with others. In hypertext collaborative learning, learners have opportunities to develop complex cognitive skills, such as breaking a topic down into subtopics, organizing diverse information, and formulating a point of view (Turner & Dipinto, 1997). Moreover, these learning activities are effective in developing higher-order thinking skills, defining problems, judging information, solving problems, and drawing appropriate conclusions.

Considerations of WBL based on Web architecture

In consideration of client-based learning, learning activities are focused on

content interaction and individual learning. Instructional content is based on direct instruction of predominant areas where learners are engaged in academic tasks. In client-based learning, learning activities should be organized so that learners experience success in mastering the subject matter. This organization is based on step-by-step and structure methods. Additionally, teachers control instructional goals and choose appropriate materials for learners' ability.

For distributed learning, learning activities are focused on content interaction or social communication. In addition, asynchronous and synchronous communication both are available for learning activities. Instructional content can be designed for individuals or group interaction with instructional files or databases that based on the purpose of instructional goals. In the distributed WBL, based on nonlinear and interactive communication, encourages learners to explore related knowledge to promote learning activities and to enhance instructional databases.

In consideration of server-based learning, social communication based on asynchronous or synchronous communication is the major part for learning activities. Instructional content can be designed for group communications with instructional files or databases. Thus, the instructional files or databases are changed or improved by group learning activities. In other words, instructional content can be revised or modified through online learning activities. From social constructivist viewpoint,

learners are more interested in activities that engaged them with others. In hypermedia collaborative learning, learners have opportunities to develop complex cognitive skills (Turner & Dipinto, 1997). Table 1 shows the considerations of the WBL.

Table 1: Considerations of the Web-based learning

Web architecture	Browsing	Learning activities	Instructional content
Client-based	<ul style="list-style-type: none"> ● Individual browsing. ● Multimedia instructions. 	<ul style="list-style-type: none"> ● Content interaction. ● Individual learning. 	<ul style="list-style-type: none"> ● Direct instruction of predominant area. ● Subject matters. ● Step-by-step and well-structured instructions.
Distributed	<ul style="list-style-type: none"> ● Individual and/or group browsing. ● Multimedia instructions. ● Hyperlinks. 	<ul style="list-style-type: none"> ● Content interaction and/or social communication. ● Individual and/or group learning. ● Asynchronous and/or synchronous communication. . 	<ul style="list-style-type: none"> ● Distributed learning activities and instructional files or databases. ● Nonlinear or hyperlink environments. ● Interdisciplinary instructions.
Server-based	<ul style="list-style-type: none"> ● Group browsing. ● Hyperlinks. 	<ul style="list-style-type: none"> ● Social and group communication. ● Asynchronous and/or Synchronous 	<ul style="list-style-type: none"> ● Nonlinear or hyperlink environments. ● Ill-structured instructions.

	communication.	● Collaborative learning.
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Conclusions

Although distance education is not a new learning environment in education, online learning as a kind of distance education is expanding at a tremendous rate. In general, each medium has its own particular characteristics. The Web is a very flexible and powerful medium for assisting learning activities, but it is not easy to design and develop. However, it takes more time for preparation and maintenance than either past forms of distance education or traditional on-campus teaching. Indeed, this causes additional stress for instructors, especially if they put into action without proper training and support. Therefore, the assistance and advice of faculty development specialists are crucial for the success of novice distance educators.

References

- Darling-Hammond, L., & Snyder, J. (1992). Curriculum studies and traditions of inquiry: The scientific tradition. In P. W. Jackson, (Ed.). *Handbook of research on curriculum* (pp. 41-78). New York: Macmillan.
- Ellis, A. K., & Fouts, J. T. (1997). *Research on Educational Innovations* (2nd ed.). New York: Eye on Education.
- Gagne, E., Yekovich, C. W., & Yekovich, F. (1993). *The Cognitive Psychology of Schooling Learning* (2nd ed.). New York: HarperCollins.

Gillbert, L., & Moore, D. R. (1998). Building interactivity into Web courses: tools for social and instructional interaction. *Educational Technology*, 38(3), 29-35.

Joyce B., & Weil M. (1996). *Model of Teaching*. (5th ed.). Needham Heights, MA: Allyn & Bacon.

Khan, B. H. (ed.) (1997). *Web-Based Instruction*. Englewood Cliffs, NJ: Educational Technology Publications.

Laudon, K. C., and Laudon, J. P. (2000). *Management Information Systems, Organization and Technology in Networked Enterprise* (6th Edition). Prentice Hall Inc.

Liaw, S. S., and Huang, H. M. (2000). Enhancing interactivity in Web-based instruction: A review of the literature. *Educational Technology*, 40(3), 41-45.

Ritchie, D. C., & Hoffman, B. (1997). Incorporating instruction and the traditional classrooms: Similarities and differences. In Khan, B. B. (ed.), *Web-based Instruction* (pp.135-138). Englewood Cliffs, NJ: Educational Technology Publications.

Rosenshine, B. (1986). Synthesis of research on explicit teaching. *Educational Leadership*, 43(7). 60-69

Sherry, L. & Wilson, B. (1997). Transformative communication as a stimulus to Web innovations. In Khan, B. B. (ed.), *Web-based Instruction*. (pp.67-73). Englewood Cliffs, NJ: Educational Technology Publications.

Slavin, R. (1992). Cooperative learning. In M. C. Alkin (Ed.), *Encyclopedia of*

Educational Research (pp. 235-238). New York: Macmillan.

Turner, S. V. & Dipinto, V. M. (1997). Peer collaboration in a hypermedia learning environment. *Journal of Research on Computing in Education*, 29(4), 392-402.

Vygotsky, L. S. (1978). *Mind in Society*. Cambridge MA: Harvard University Press.