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Web-based Asynchronous Synchronous Environment

A thesis presented in partial fulfillment of the requirements for the degree of

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Abstract

In the face of the coming of new information technology era of 21st century, web-based learning has become the major trend of future teaching and learning model. The web-based learning systems are created to simulate the real teaching-learning environment in the classroom using computer software and web-based tools. Learner can study web-based teaching materials according to their individual needs and instructional schedule. Although web-based learning has a lot of advantages over traditional face-to-face learning, the lack of the explanations and interpretation of teaching materials from human teacher in most existing web-based learning system is critical. This project proposed an innovative solution to the problem by combining the benefits of classroom learning in the web-based education.

In this project, a prototype Web-based Asynchronous Synchronous Environment (WASE) is developed that not only combines the benefits of tools such as WebCT and AudioGraph, but also integrates lectures given by the human teacher within the system. WASE provides simultaneous low-bandwidth streaming of lecture video and presentation, while facilitating students with presentation annotation facilities, and peer discussion on particular issues related to the topic.

The prototype system is built using a three-tier, client-server architecture. The client tier is a set of HTML frames embedded with RealPlayer running in the students' web browsers to provide course contents and navigation guide. The middle tier is an application server which consists of Java Sevlet, JSP engine, and application programs to receive the students' requests and send the corresponding course contents and navigation guide information to the client side. The third tier is the relational database for storing the course structure and contents, and for recording the interaction between students and teachers.

This project provides a solution where the off-campus students are able to enjoy the explanations and interpretation of course materials from human teacher just as normal on-

campus students do in the traditional face-to-face learning environment, while still reaping the benefits of web-based learning.

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Chapter 1 Introduction

1.1 Introduction

In the face of the coming of new information technology era of 21st century, web-based learning has become the major trend of future teaching and learning model. Most educational organizations are now using some sort of internet technologies in their distance education offerings. Many web-based learning systems are being created and implemented to simulate the classroom teaching environment, using various computer software packages and web-based tools (Chen & Shih, 2000). Learners can study web-based teaching materials according to individual needs and instructional schedule. Although web-based learning has a lot of advantages over traditional face-to-face learning, it lacks the explanations and interpretation of teaching materials from human teacher. In most cases, the learning just changes from books to web page (Chen & Shih, 2001).

The aim of this thesis is to design and implement a web-based learning system, where the off-campus student can get the explanations and interpretation of teaching materials from human teacher while enjoying the benefits coming from new web technology.

In the next section of this chapter, we shall discuss the types of learning environments. Then the limitations of current web-based learning systems are described by comparing traditional face-to-face learning and distance learning. Finally the objectives and methodology of this project are presented.

1.2 Types of learning environments

Learning can take place in variety of environments, which can be classified into four major types according to two critical dimensions: time and place as shown in table 1-1 (Aggarwal *et al.*, 2000).

Table 1-1 Time and place dimensions of learning environments

		TIME	
		SAME	**ANY**
PLACE	**SAME**	Type 1 Traditional Classrooms	Type2 Lab modules
	ANY	Type 3 Distance learning	Type 4 Correspondence Course

Type 1 represents the traditional face-to-face classroom, where students congregate at the same time, at the same place, to be taught simultaneously the same material by the same person. The interaction between students and faculty is "many-to-one" during class time and one-to-one during office hours. Students work individually or in a group during class time and/or in their own time.

Type 2 represents learning environments where students come at different times to receive modularized instruction at the same place, such as a lab, information center, or library.

Type 3 environments are distance learning programs where students from different geographic areas can be taught simultaneously through one-way or interactive audio and video technology.

Type 4 environments have traditionally been represented by correspondence courses, where students can learn on their own anywhere, anytime, and take exams as needed.

Type 1, Type 3 and Type 4 learning environment are focused on in this thesis. Most people are accustomed to learning in Type 1. However, with the advances of new web technology, more and more people begin to enjoy learning in Type 3, more so because it is flexible, time independent and place independent. These two types of learning environments are discussed in following sections.

1.3 Traditional classroom

The traditional classrooms facilitate face-to-face education. Teacher and students sit in the same classroom at same time. The teacher presents the necessary material in the class. The students look at the material and listen to the teacher's explanations to understand the lesson. This situation has a number of features (Bandoh *et al.*, 2000):

- The teacher is able to express his or her ideas naturally.
- All the students can look at what the teacher is writing or drawing, and can focus their attention on it.
- The teacher can see the students' faces and expressions. The teacher can therefore adjust the pace or the contents of the lesson according to the feedback received from the students.

This approach represents the industry-based model used for hundreds of years to provide university-level instruction in large lecture, mid-size, or even small classroom environments. It has three key components:

- ***Human teacher expression and explanation:*** the lecturer uses natural language and body language to explain the learning material in the classroom.

- ***Student note taking***: the students usually take notes during the lecture according the teacher's explanation.

- ***Peer communication***: in the classroom the teacher and students have possibility to exchange ideas by discussion and asking questions.

The greatest advantage of traditional face-to-face education is the personal interaction with students, and the opportunity for both students and instructors to take advantage of paralinguistic cues to make points and to verify that a point or a question has been understood (Rea *et al.*, 2000). There may be a wide variety of involvement levels based on the size of the class and the willingness of the instructor to facilitate communication. Certainly, large lectures with hundreds of students are not conducive to high involvement levels of an interpersonal nature. Rea *et al.* (2000) pointed out

that there are three kinds of strengths and weaknesses involved in the traditional face-to-face education. The strengths of traditional face-to-face education are as follows.

- *Interpersonal Involvement:* The traditional face-to-face education tends to lead to the greatest level of involvement between instructor and student. The personal interaction provides students with the opportunity for spontaneous discussions in a non-threatening manner. The interpersonal communication in this approach also provides the greatest opportunity for the instructor to perceive body language and other indications of understanding or confusion.

- *Familiarity:* The traditional face-to-face education may provide the most conformable environment for students and instructors, as it is the continuation of the approach used by most education facilities all over the world.

- *Flexibility*: The traditional face-to-face education provides the lowest cost for technology and allows for the lack of any technology skills on the part of the instructor. Likewise, the lack of technology allows for freedom to pursue many different approaches to the same course whether it is a laboratory exercise, a lecture, or a performance.

Rea *et al.* (2000) reviewed following weaknesses of the traditional education:

- *Lack of Convenience:* The traditional face-to-face education limits students in that they must be present locally, travel to campus, and utilize office hours. Dependency on time and location may eliminate certain students from the opportunity to study at the university and might also force students to progress through the course at a pace that is not comfortable for them.

- *Loss of Interpersonal Interaction:* As college enrollments increase, it may become difficult for universities to meet the demands of the growing population in the short run. This may drive administrations to implement larger class sizes and thereby promote less personal interaction with students.

- *Failure to Develop Real World Skills:* Students may fail to develop skills they need in the real world, such as sending e-mail, or interacting via telecommunications links. As larger numbers of corporations embrace technological solutions to management, students need to develop skills for survival in the technological workforce.

Due to these problems and advances in the internet technologies, the distance education is becoming popular. Many persons are enjoying this type of learning environment.

1.4 Distance education

Within the context of rapid technological change and shifting market conditions, the education system is challenged with providing increased educational opportunities without increasing budgets. Many educational institutions are answering this challenge by developing distance education programs. At its most basic level, distance education takes place when the teacher and students are separated by physical distance, and technology (i.e., voice, video, data, and print), often in concert with face-to-face communication, is used to bridge the instructional gap. These types of programs can provide students with a second chance at a college education, reach those disadvantaged by limited time, distance or physical disability, and update the knowledge base of workers at their places of employment.

Many educators ask if distant students learn as much as students receiving traditional face-to-face instruction. Research comparing distance education to traditional face-to-face instruction indicates that teaching and studying at a distance can be as effective as traditional instruction, when the method and technologies used are appropriate to the instructional tasks, there is student-to-student interaction, and when there is timely teacher-to-student feedback (Moore & Thompson, 1990; Verduin & Clark, 1991).

However, current off-campus students often feel isolated and lonely. Some of the characteristics experienced by off-campus students are as follows.

- ***No explanation and expression from human teachers*** – Off-campus students usually use printed material and learn by themselves. They do not have possibility to see human teacher's expressions and receive face-to-face explanations like internal students. This may prove very difficult for many students.

- ***No contextual discussion*** – Unlike internal students, off-campus students do not have possibility to discuss their questions with the lecturer and classmates within the context of that topic. Typically off-campus students use email or some sort of web discussion forum to discuss their problems, but these mediums work in isolation of any other resource used for the study, hence the queries do not remain in the context of their current study of topic.

- ***No regular channel to get help*** –There is generally no class time, no office hours, no laboratory exercise and no contextual discussion with classmates for off-campus students. So it is difficult to get help when they encounter some problems.

- ***No regular channel to give feedback*** – Internal students may give feedback to their teacher in class time, office hour or laboratory exercise. Then the teacher may adjust his/her teaching accordingly. But off-campus students do not have such possibilities.

- ***No Social Help*** – Since there is no real class for off-campus students, they do not have possibility to forge friendship and receive encouragement. They may feel isolated and lonely.

Although the new internet technologies make it possible to solve above problems, current web-based systems do not seem to solve them.

1.5 Problems of current web-based educational systems

The explosive growth in technology and the expanding access to the web has resulted in its increasing use for education and training. Web-based educational systems (WBES) refer to education delivered in whole or in part using Internet technologies. Existing web-based educational systems, how potential they might be, still exhibit a range of limitations for learning process. These limitations are described below.

- ***Lack of match between course material and its explanation*** – Current WBES are usually used as supporting tools in the courses. Students are expected to use them in conjunction with printed material. Since this is no integration of WBES with other learning resources, there is possibility of mismatch between the explanations provided in the WBES and any other learning material that student might use.

- ***Lack of contextual discussion*** – Existing WBES do not allow the integration of discussion with the domain content. Therefore the discussions do not take place in the context of a domain problem or example as they do in face-to-face tutorial environment.

- ***Lack of human teacher expression and explanation*** – Most existing WBESs are text and graphic based systems. The students do not get human teacher expressions and oral explanations. The students therefore miss out the impact of teacher's gestures in the learning process.

- ***Lack of human interaction*** – Most students have become conditioned to receiving instruction in a face-to-face mode. While some will adapt more easily than others, it will take some time for all to become accustomed to a computerized learning environment. Sometimes access to an instructor who can answer student queries is problematic, especially if the students attempt to access materials during non-business hours (in teacher's time zone). Learners can miss the support of a group or cohort of fellow learners.

- ***Lack of contextual understanding*** – Unlike in traditional classroom, the students in online learning do not have contextual discussion or explanation for certain concept. This leads to the lack of contextual understanding.

1.6 Objectives of the project

This project is funded by Massey University under the funds for Innovation in Education and Teaching. Current off-campus students at Massey University find it difficult to grasp the concepts without any explanations from a human expert. This project proposes an innovative solution to this problem by combining the benefits of classroom learning in the web-based education. A prototype Web-based Asynchronous Synchronous Environment (WASE) is developed that not only combines the benefits of learning management tools such as WebCT, but also integrates lectures given by the human teachers within the system. Using WASE, off-campus students can enjoy the benefits of face-to-face learning in asynchronous learning environment by:

- getting the expression (gestures) of the human lecturer;
- getting the explanations from the human lecturer;
- taking contextual notes during the learning process; and
- communicating with peers for contextual discussion.

1.7 Methodology of the project

In order to achieve above objectives, WASE provides simultaneous low-bandwidth streaming of lecture video and presentation slides, backward and forward play of the lecture videos (with synchronised presentation slides), annotation facilities, and peer discussion on particular issues related to the topic. The system includes the following components:

- Low-bandwidth streaming of lecture video and presentation – to get explanation from a human lecturer
- Low-bandwidth streaming of lecture video – to get human expression

- E-Note – to take contexture note for the lecture
- Discussion Board – for discussion among classmates
- Discussion Board – to get help from lecture and classmates
- Offering learning mode selection – to make the system flexible. This component provides an opportunity for the students to choose learning mode with different combination of lecture video and presentation, E-Note, and discussion board.

1.8 Outline of the thesis

This thesis describes the rational behind the development of WASE system, the methodology used in the project, the outcomes and the way forward. The outline of the thesis is shown in figure 1-1.

The thesis is largely divided into three sections:

- The first section presents the existing research in the field, which includes the two chapters (chapter 1 and 2) – introduction and literature review.

- The second section talks about the system design and implementation, which include two chapters (chapter 3 and 4) – system architecture and technology, and system design and implementation.

- The third and final section is the project results, which include two chapters (chapter 5 and 6) – prototype system, and evaluation, discussion, conclusion and future work.

The next chapter will discuss how existing web-based learning systems simulate the traditional face-to-face learning environment, what are the benefits by using web-based learning systems, and what kind of the technologies are being used in existing web-based learning systems.

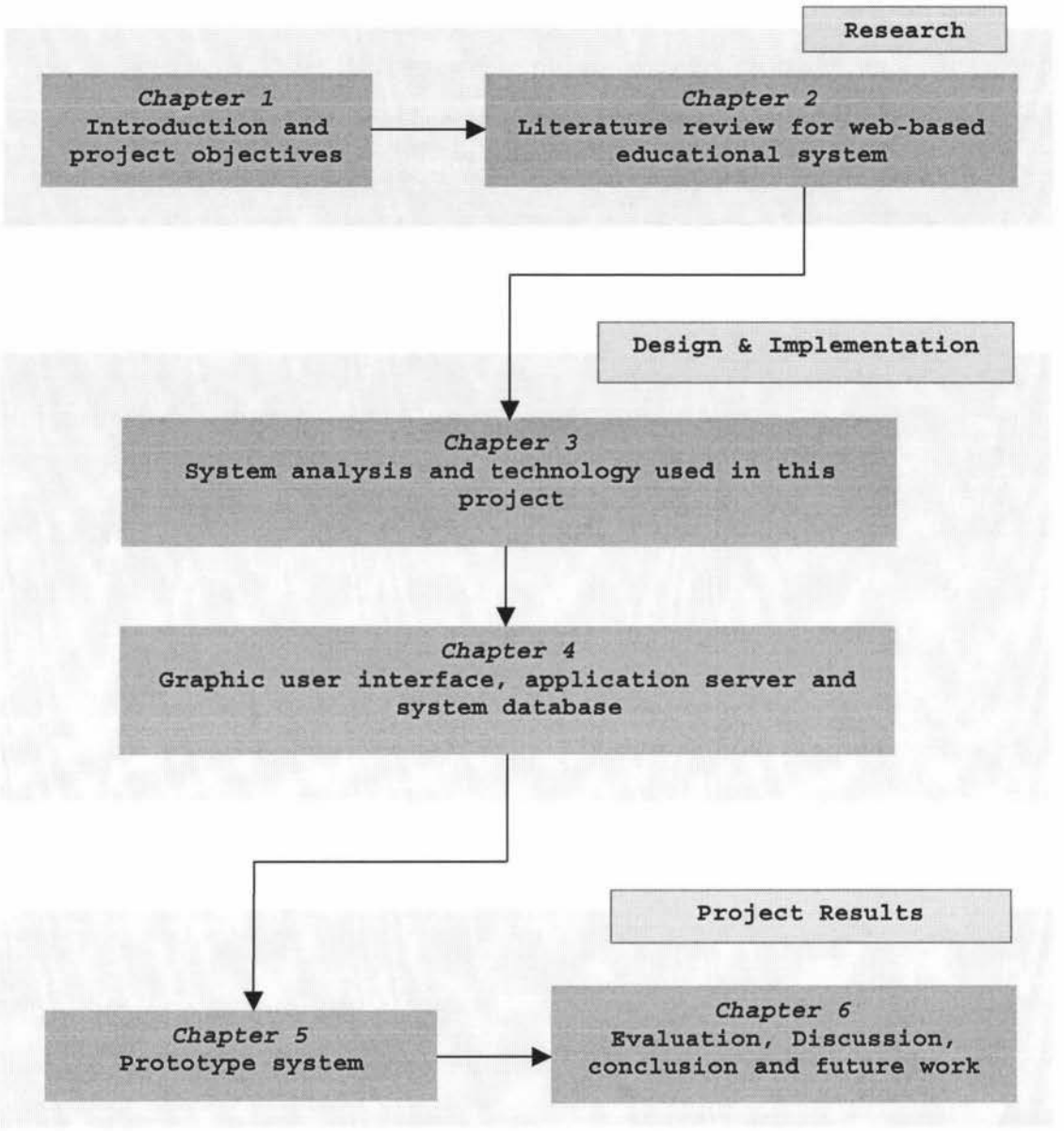

Figure 1-1 Outline of the Thesis