Chapter 1
Introduction

1.1. Research Overview

The role of the technology in education has been evolved and radical changes have occurred since the emergence of the Internet and World Wide Web (WWW). The Internet has provided various unexpected ways of learning where the web can be used as a medium for different new ways of learning such as Adaptive Hypermedia Systems (AHS), Intelligent Tutoring Systems (ITS), and Web-Based Learning (WBL) systems.

A large number of organizations have adopted e-learning programs, but far fewer have addressed all the benefits of e-learning applications. More research should be devoted to assure the gain of the most benefits of e-learning applications if organizations are to fully benefit from their investments.

To understand the problems addressed by this research, we will start by defining the main concepts. E-learning systems are an evolution of the original concept of distance learning, although distance learning has taken many forms over the years, it always follows a common definition of being education taking place where time and/or space separates the student and the teacher. E-Learning refers to learning that is delivered or enabled via electronic technology. It encompasses learning delivered via a range of technologies such as the Internet, videotapes, intelligent tutoring systems, and computer-based training [Wang 05]. In an e-learning system, information can be delivered in two different methods. The first is the asynchronous method where students are not bound to certain times or places; they can learn
at the time that best suits them. The most popular forms of asynchronous learning are instructional websites, email and message boards. The second are the synchronous method of delivery, which include real-time web chats, streamed audio and video of a live event and video conferences.

When e-learning first appeared, static web pages were used to present learning contents where the one-size fits all approach was applied. When e-learning became more popular, advanced techniques were used such as adaptive content presentation to adapt the learning content according to student performance. Moreover, Collaboration between the learners became available in some e-learning systems.

The intelligent tutoring system is broadly defined as educational software containing an artificial intelligence component. The software tracks students' work, tailoring feedback and hints along the way. By collecting information on a particular student's performance, the software can make inferences about strengths and weaknesses, and can suggest additional work [Hafner 04].

The benefits of individualized instruction are the essence of ITS [Ong 00]. Furthermore, the key benefits of web-based intelligent tutoring systems include:

- Adaptation: the ability to adapt learning content according to user performance.
- Personalization: the ability to serve dynamic response to the user based on personal profiles.
- Collaboration: the ability to communicate with other learners and exchange information.
- Sharing: the ability to re-use and share learning content with other e-learning systems over the network.

During the last few years, many e-learning systems were developed, such as Blackboard [Blackboard 06], WebCT [WebCT 06] by British Colombia University, Moodle [Moodle 06], Learning Space [Lotus 06], and TopClass [WBT systems 06]. These systems provide many functions and capabilities in one package. However, most of the existing e-learning systems are not able to provide adaptation nor collaboration.
In order to achieve interoperability and reusability in e-learning systems, standards must be developed and globally used. These standards are developed by many accredited bodies such as Institute of Electrical & Electronics Engineers Learning Technologies Standardization Committee (IEEE LTSC) [LTSC 01], European Committee for Standardization, Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE) [ARIADNE 00], and the US Department of Defence’s Advanced Distributed Learning (ADL) [ADL 97]. The focus on current standards is to provide standardized data structure for e-learning systems objects [Alotaiby 05].

One of the most accepted standards is the Sharable Content Object Reference Model (SCORM) [SCORM 04] developed by the White House Office of Science and Technology Policy (OSTP) and the Department of Defence’s ADL initiative. SCORM is the result of several standardization efforts of IEEE LTSC, Instructional Management System (IMS) [IMS 06] Global Learning Consortium, Dublin Core, and the Aviation Industries Computer-based training Committee (AICC) [AICC 02].

LTSA (Learning Technology Systems Architecture) is the result of another standardization efforts carried out by IEEE LTSC’s Architecture and Reference Model Working Group. It is a conceptual e-learning model that represents a common abstraction for various learning entities [LTSA 98].

Technology is not a panacea for educational problems [Popular Science 94], so if developers of the technologies don't keep in mind what psychologists and other experts have discovered about how people learn, there's a danger in going off the rails. For this reason, the research starts with exploring the pedagogical background of the problem.

In this thesis, a model is presented for e-learning that supports reusability and collaboration and provides intelligent and adaptive e-learning environment.

The architecture is proposed as a multi-agent system. It is composed of several cooperated agents that communicate together to form the system. Multi-agent approach to system development is chosen to allow easier system organization, scalability and growth of the system as well as the distribution of the system and the agent-mobility.
In the implementation stage, many promising technologies were used such as JavaServer Pages (JSP), Java Database Connectivity (JDBC), MySQL Database, eXtensible Mark-Up Language (XML), Java Agent DEvelopment Framework (JADE), and Java Remote Method Invocation (RMI).

1.2. Research Motivation

This research was motivated by the growing need and interest in e-learning systems either to serve as a solution for distance learning or as a solution for combating the problems of traditional education, such as growing enrolments and fewer instructors.

In recent years, many e-learning systems have been in the market. Educational organizations must make a decision to use one of these systems and if they decide to switch to another system they face problems with transferring already prepared educational materials that cost them time and money to prepare. This raises some issues about how to share learning resources from one system with another e-learning system. In this thesis, we explore the problem of sharing and reusing of content.

Another motivation of this research was the trend towards personalized instruction. Most of the existing e-learning systems present the learning resources in a unified presentation for different students with different abilities. Presentation should differ according to the assessment of the students and according to personal profiles that should be maintained and dynamically updated during the learning process.

Additional motivation for this research was the lack of collaboration in the existing e-learning systems. Research in collaboration showed that these new concepts of learning have some positive effects on the learning process and on learners [Haber 01], so they should not be ignored in e-learning systems. This research tried to present two different techniques of collaboration. The first is the collaboration between the learner and other real learners using the system. The second is the collaboration between the learner and virtual learners which are called learning companions.

1.3. Research Objectives

This research has two main objectives, as follows:

- Presenting a new e-learning model that combines between collaboration, personalization, adaptation, reusability and sharing.
• Developing a prototype system to test the functionality of the proposed model.

1.4. Research Methodology

In order to develop our proposed system, we will follow the following methodology:

• Studying the theoretical background of the problem to adopt a prototype model.
• Identifying the different model attributes.
• Identifying pedagogical strategy for course learning.
• Determining the learning objects metadata.
• Design a more elaborated system model.
• Implementing a prototype system.
• Testing the prototype system.

1.5. Thesis Organization

The rest of this thesis is organized as follows. Chapter 2 provides a pedagogical and technical background of the problem. Chapter 3 discusses the area of knowledge representation in e-learning systems. Chapter 4 explores the techniques of adaptation and collaboration. Chapter 5 describes the elaborated model proposed in this thesis. The implementation of the system is discussed in chapter 6. Finally, chapter 7 concludes this thesis and suggests some issues for future work.