Chapter One

Overview

1.1 Introduction

Adaptive e-Learning that is supported by intelligent techniques and methods is one of the ways to support personalized e-Learning, and so it is the way to overcome many of the limitations and solve today's e-Learning challenges. Different adaptive and intelligent e-Learning systems proposed over a long e-Learning research will be reviewed, highlighting the importance of adaptive and intelligent features in e-Learning, and the attempt to introduce services based e-Learning systems in order to overcome many of the technical e-Learning challenges, like reusability, scalability, integration, and interoperability. There is a need to present a new learning model that attempts to solve different challenges. Though there's no single unified learning model that can be the only right model, hopefully this work will be a step towards a better learning model supported with the appropriate adaptive and intelligent features, methods, and Service Oriented Architecture (SOA) technologies.

Integrating UMIS and LMS is a need to achieve better e-Learning systems. Different software architecture patterns can be utilized in integrating both systems. Studying and analyzing many of the available software architectures has led to the realization of efficiency and effectiveness of utilizing SOA, however it has led to challenges. Challenges include lack of performance when transmitting large amount of data. Web Service Software Factory design pattern as an example of SOA design patterns that builds everything within systems as Web services will yield to big performance degradation to proposed integrated e-Learning systems.

Most of the AI applications have not yet been expanded to or adopted in widely used e-Learning systems, especially open-source systems such as Moodle and Sakai. Current intelligent LMS systems are still in their early stage, while AI applications need to handle some problems or to be modified before applying them into the LMS systems, and AI technology also needs to be brought to open source communities. Presented Adaptive e-Learning Model integrates different intelligent features within the system to empower the presented model.

1.2 Research Motivations

Optimization begins with addressing pedagogical and technical problems in hand. Pedagogical problems are addressed and optimized through the presented adaptive e-Learning models. Technical problems are addressed and enhanced through combining Business Process Management (BPM) and Service Oriented Architecture (SOA) in a layered model to overcome technical, composition, and integration challenges. With the maturity of presented Adaptive e-Learning Models, it came the time to implement them. However, performance challenges appeared, mainly with the Intelligent LOs Recommender, as it deals with tremendous amount of updatable data and LOs on the internet. Intelligent LOs Recommender lacked some performance challenges in the first place due to the tremendous amount of generated keywords that affect processing and insertion times. Including Course Objectives as an input parameter in the keywords Term Frequency processing optimizes the performance by focusing on the important and needed keywords instead of wasting the processing time and storage spaces for non-important keywords.

Pedagogical and technical problems are the basis of this dissertation. Pedagogical problems are touched by the researcher through a pilot study, and technical problems are identified through evaluation of previous SOA based LMS.

1.2.1 Pedagogical Problems

Later in the year 2008, pilot study for fourth year Information Systems department students at the faculty of Computers and Information Sciences in Mansoura University, Egypt was conducted by the researcher. Although the 57 students who conducted the questionnaire answered that they heard about e-Learning, and they all believe it is effective, almost 25% of the participating students don't use Internet as their main source of information. This is considered weird when compared to the 100% e-Learning efficiency commit.

Table 1.1 provides the following information:

- 83% of students classified themselves as good Internet users, while 72% of them do not even know what “tutorials” are. Web based tutorials is one of the main sources for teaching students.
- Although 83% of participants believe they can learn via e-Learning, and almost the same percentage agree to participate in an e-Learning, only 68% of students appeared to be accepting the idea of using mobile in learning purposes.
- Though Mobile Learning (M-Learning) is an important e-Learning research field, the study shows that only 28% of students access Internet via their mobile phones, and only 46% of students are willing to participate in a free of charge mobile learning experience when asked to.
- 61% of the students said that they will not participate in a mobile assessment experience when they are asked to.
- 58% of the students believe that M-Learning will not become popular.
- Finally, all students participated in the pilot study agreed that the authors’ faculty utilizes different forms of e-Learning.

Though the faculty of the researcher does not provide an official site for e-Learning, any online courses, assessment site or any other form of

e-Learning other than the researcher's attempts, students still believe that e-Learning is efficient - even if they have not experienced it at all. Students believe that e-Learning is effective without trying it, and are not excited about M-Learning regardless to the researches that the e-Learning researchers provide. There are lots of contradictions in students' responses that forces the researcher believe that students haven't experienced real e-Learning experience due to backgrounds issues, lack of personalization and flexibility, and lack of Internet access in many scenarios.

Table 1.1: Pilot Study for Fourth Year Students

	Strongly Agree	Agree	Disagree	Strongly Disagree
Internet is main source of Information	38%	38%	24%	
Good Internet User	25%	58%	17%	
Familiar with Tutorials	14%	14%	53%	19%
Students Can Learn via e-Learning	23%	60%	17%	
Participate in e-Learning	18%	68%	14%	
Use Mobile Learning	12%	56%	32%	
Access Internet via Mobile Phones	7%	16%	49%	28%
Participate in M-Learning Experience	9%	37%	54%	
Participate in M-Assessment Experience	7%	32%	61%	
M-Learning will become Popular	5%	37%	58%	

1.2.2 Technical Problems

Mansoura University runs its in house developed and deployed University Management Information System (UMIS) for more than a decade. UMIS has reached a stable and mature state when compared to the newly introduced LMS. To adopt LMS functionalities in the University without making LMS and UMIS isolated, both need to interoperate to enable university achieve managerial and educational tasks. Researcher designed, tested, deployed, and evaluated such a solution and came out with noticeable evaluation results. From technical

perspective, quality parameters like performance shall be addressed. SOA based systems rely heavily on messaging and add extra headers to manage requests and responses in standard format. Headers affect directly the amount of data transferred over the network. Headers sizes differ according to the number of records to be handled, and differ from application to another, so network performance differs. However, the comparative study yielded the fact that network delay is highly affected by the header size and such delay cannot be neglected. Network delay differences in range exceed 400% between both implementations. Optimization of SOA utilization in e-Learning systems is needed to address and overcome those challenges.

1.3 Dissertation Objectives

Dissertation objectives focus on optimizing e-Learning through an iterative and recursive optimization process that starts by identifying different types of problems, presenting solutions, evaluating presented solutions, optimizing presented solution, and applying the optimized solution. Objectives include:

- Address Pedagogical Problems facing e-Learning.
- Track e-Learning Systems evolution.
- Evaluate the importance of Services based e-Learning Systems and the role of Service Oriented Architecture (SOA) for such systems.
- Address Technical Problems resulting from adopting SOA in e-Learning
- Address both students and instructors' needs from e-Learning
- Present Adaptive e-Learning Models for both students and instructors as a solution to current pedagogical problems
- Design and build the presented Adaptive e-Learning Models
- Present innovative ways of utilizing intelligent techniques in e-Learning
- Empower Adaptive e-Learning Models with Intelligent Services
- Address the bottlenecks of the presented built Models

- Optimize presented solutions to overcome identified bottlenecks
- Evaluate optimized solution from different perspectives

1.4 Contribution of Dissertation

Dissertation combines pedagogical and technical aspects of e-Learning to achieve enhanced e-Learning. Focusing either on pedagogical or technical issues alone will not present the full screen of e-Learning. Besides, researcher addressed real world e-Learning problems that affect students and touches instructors, and presented solutions to current challenges. Dissertation presents a new Adaptive e-Learning Model that blends instructor lead education with e-Learning capabilities. Presented Model focuses on the two elements of the e-Learning: Students, and Instructors.

Dissertation presents innovative new intelligent features to improve students' and instructors' performance and enhance presented Adaptive e-Learning Model. Fuzzy Logic utilization in different services as a technique to present intelligent features is highlighted in different aspects. SOA is the architecture used all over the system. Presenting adaptive and intelligent features as services with standard interfaces will allow different e-Learning systems to adopt them, so they will be reusable.

Dissertation presents optimization and evaluation techniques of presented Adaptive e-Learning Model and Intelligent Services, highlighting the effects of optimization decisions taken, and opens the door for future work related to e-Learning.

1.5 Dissertation Structure

Chapter One: Presented an overview of the dissertation, objectives, contribution, and addressed the research problems.

Chapter Two: Introduces a closer look on e-Learning challenges through reviewing current e-Learning status; the shift from traditional e-Learning systems to Services based Adaptive and Intelligent e-Learning systems. This chapter also focuses on highlighting the importance of utilizing SOA in e-Learning Systems and presenting the technical challenges facing this utilization. This part presents results from SOA utilization systems.

Chapter Three: Introduces the Proposed Adaptive e-Learning Model, raising the importance of SOA in integrating different e-Learning systems and components. Desktop applications are used to overcome Internet access challenges. Pedagogical solutions focus on introducing adaptive and intelligent features in e-Learning to reach personalized environment.

Chapter Four: Introduces the Intelligent e-Learning services that empower presented Adaptive e-Learning Models using fuzzy logic as one of intelligent techniques. Nine intelligent services are presented. Intelligent services are grouped into *Instructor Services* and *Student Services*.

Chapter Five: Presents closer look on implementation details of developing, building, and deploying the presented Adaptive e-Learning Models and composing services. Technical details include database tables, class diagrams, packages, and interface design.

Chapter Six: Highlights evaluation of the proposed Adaptive and Intelligent e-Learning Model Components and Services. Presenting adaptive and intelligent features as services with standard interfaces will allow different e-Learning systems to adopt them, so they will be reusable.

Chapter Seven: Presents Conclusion and Future work.

Dissertation ends with References.