

Chapter Seven

CONCLUSION

E-Learning is an important part of the future however it is facing challenges. Optimizing e-Learning is a need. Optimization is a continuous and iterative process that goes through different activities. Addressing and understanding problems and challenges is the first activity. One of the e-Learning challenges is the absence of current e-Learning systems that adaptively and intelligently touch students' capabilities. Adaptive e-Learning is the solution to exploit unlimited e-Learning advantages. Adaptive e-Learning that is supported by intelligent methods and techniques is a need to move e-Learning to the efficiency and effectiveness. Services based e-Learning systems are the third generation that supports integration, interoperability, and scalability. Services based e-Learning Systems is a need to fulfill e-Learning systems pedagogical, technical, and architectural requirements. Adaptive e-Learning that is supported by intelligent techniques is the solution to present efficient and effective learning.

This dissertation presented Adaptive e-Learning Model that blends instructor lead education with e-Learning capabilities to provide an enhanced e-Learning environment as the solution to current e-Learning challenges. Presenting adaptive and intelligent features in the form of services with standard interfaces allow different e-Learning systems to adopt them, so they will be reusable, and the newly introduced information systems will not have to reinvent the wheel again. Besides, wrapping adaptive and intelligent features with standard interfaces will present a separation of interests that help adaptive and intelligent features' researchers and developers to focus more on their target, and transfer the responsibility of utilizing these features in different information systems to information systems specialists.

This dissertation presented different intelligent features to improve students' habits and their performance through e-Learning and to empower the presented adaptive e-Learning model. Services' specifications and IT-Infrastructure architecture required to enable the proposed Adaptive e-Learning Models were presented, highlighting the different challenges and their solutions. Intelligent services were categorized into two categories based on the user of those services: Instructor, and Student Services.

The Instructor Intelligent Services are: *Intelligent Learning Object (LO) Classifier service*, *Intelligent Online Lecture LOs Advisor*, *Intelligent Student Performance Tracker*, and *Intelligent Cheating Depressor*. The Student Intelligent Services are: *Intelligent Time-to-Learn Topic Calculation*, *Intelligent Study Plan Advisor*, *Intelligent Agenda Study Time Planner*, and *Intelligent Meeting Manager for Suspended Students* and *Intelligent LOs Recommender*.

Services based adaptive and intelligent e-Learning systems face performance challenges, mainly because they rely heavily on messaging. Dissertation presented Optimization techniques for the entire presented Adaptive e-Learning Model and intelligent services solely. Optimizing the entire SOA model through increasing granularity level, presenting SOA between systems not within systems, and utilizing new data protocols presented on the web to enhance performance is addressed. Optimizing performance of Intelligent Learning Objects Recommender as one of the presented intelligent services is another aspect that is presented as optimizing SOA on service level.

This dissertation presented an Intelligent Learning Objects Recommender that uses Fuzzy Logic to intelligently determine the membership of a Learning Object with Course Objectives. Components of the presented Intelligent LOs Recommender are: *Crawler*, *Intelligent Recommender*, *Data repositories* that holds Course Specifications, Student Learning Preferences, and Approved

Learning Objects Lists. Proposed Intelligent LOs Recommender faced 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.

Presented Model is evaluated from different perspectives: User Satisfaction, Performance, and Information Retrieval. Users of the presented Model are: Instructors and Students. Both categories accept the presented model in general with the needs to further consider some of the presented functionalities. Performance measurements was addressed on service level focusing on the Intelligent LOs Recommender as it has to deal with tremendous amounts of data, showing enhancements in Intelligent LOs Recommender performance measures after adopting the presented optimization techniques. Intelligent LOs Recommender performance increased almost 10 times and is capable of analyzing presented LOs, extracting the relevant keywords, and expanding the queries based on course specifications. Information Retrieval (IR) measures of proposed Intelligent LOs Recommender shows an achievement in precision measure, with challenges at Recall and F-measure due to the increased number of relevant LOs as a result of including the course objectives at the crawling phase. That means, almost all of the Learning Objects stored in the database is already relevant. Intelligent LOs Classifier is evaluated showing high accuracy levels in classifying test set.

Future work includes the focus on what e-Learning would look like in a Web 3.0 world, and how it might differ from current e-Learning. E-Learning 3.0

is the e-Learning empowered by Web 3.0 technologies. e-Learning 3.0 will have four key drivers: Distributed computing, Extended smart mobile technology, Collaborative intelligent filtering, and 3D visualization and interaction. e-Learning 3.0 will cross the boundaries of traditional learning institutions, and there will be an increase in self-organized learning. With cloud computing and increased reliability of data storage and retrieval, the mashup is a viable replacement for the portal which will lead to less reliance on centralized provision. Mobiles will play a big part in the e-Learning 3.0. There will need to be ubiquitous access to tools, services and learning resources, including people - peer learning group, subject specialists and expert support. Collaborative e-Learning will be possible in all contexts. e-Learning 3.0 will make collaborating across distance much easier. 3D visualization will become more readily available.