An Advanced E-learning System based on Knowledge Management and Networking

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Abstract

A dynamic and strong economy is based on brainpower, skills and experience. In Islamic Republic of Iran young talented students are the main source of brainpower. It is a fact that in Iran the number of students is growing faster than the number of state universities and institutes. Therefore, the quantity of offered educational facilities does not satisfy the students’ demands and a large number of potential brilliant, future Iranian professionals cannot reach higher education.

This paper illustrates an Advanced E-learning System (AES) based on Knowledge Management and Networking, which will extend the Higher Education System of I.R. Iran to a flexible e-learning and knowledge sharing environment. AES is proposed to facilitate distant and cooperative learning and to make the knowledge and skills in scholarly communities more easily accessible, applicable, developed, secured and distributed. AES integrates cooperative work, learning, knowledge management and knowledge networking by means of modern information and communication technology. By using AES, Iran can tailor all potential source of brainpower (e.g. overflow Konkoo’ students) to the industry and keep its competitive economy secure.

1. Goals and benefits

Iran, with a great scientific and cultural background for centuries, is a nation that is rapidly developing towards an industrialized country in all dimensions. Iran’s educational, cultural, and economical policies have reached a significant success. Therefore, it is time for Iran to expand and strengthen its activities through out the world.

In today’s world of industry and business, knowledge is the most crucial factor of production. Continuous learning becomes an essential requirement, which secures employment, optimizes innovation and gives a competitive edge to industries as well as companies. In future, globalization and specialization cause up-to-date knowledge to be distributed geographically as well as socially.

It is a fact that the marketplace is increasingly competitive and the rate of innovation is rising, so that knowledge must evolve at a faster rate. Therefore e-learning will be of increasing importance in education and training, especially with respect to geographically distributed communities.

Iran is a big country having vast educated personnel and potential future professionals who are key assets of the country. Therefore, AES will provide an environment for not only thousands overflow Konkoo’ students, but also for engineers, individuals, knowledge workers, project managers and researchers to acquire and manage the appropriate knowledge they need. The proposed AES is based on solid research results at Fraunhofer Integrated Publication and Information Systems Institute, the Institute for Software Technology and Interactive Systems of Technology University of Vienna and Computer Science Department of Shahid Bahonar University of Kerman [1,2,3] and it will benefit:

• Governmental and private universities and institutes who are interested in attracting and enrolling a large number of young students who could not get a chance to enter Iranian universities and want to continue their formal or informal higher educations.

1 There are two projects (Provincial Information and Communication Infrastructure, International Information and Communication Technology Institute) complementing AES and already proposed to relevant authorities

2 Konkoo is an examination for the high school graduates to enter Iranian universities.
Industry-oriented organizations that intend to teach and train their current and future professionals and to provide life-long learning to them.

Managers and educated personnel of any organization, who would like to manage their explicit and tacit knowledge and task-oriented skill profiles for their business.

Enterprises, who would like to have an environment to provide life-long learning and training services relevant to the needs of the market.

From the Iran government point of view, all these would conclude into deploying learning faster to more people, standardizing learning across dispersed organizations, allowing staff to learn at work and their place, strengthening relations between industry and academia and finally building assets and competences. Therefore almost all ministries and various governmental organizations would benefit from AES, especially: the Ministry of Science, Research and Technology, the Ministry of Health, Treatment and Medical Training, the Ministry of Islamic Culture and Guidance, the Ministry of Education, the Ministry of Commerce, the Minister of Industries and Mines, the Ministry of Agriculture Jihad, the Ministry of Labor and Social Affairs, the Supreme Council for Cultural Revolution, the I.R.I.B. (Sada-Va-Sima) Organization, the Academy of Persian Language and Literature, the Islamic teaching associations and centers, the International Center for Dialogue Among Civilizations, and the State Administration centers.

2. The AES Architecture

The Web-based AES is planned to support individual learning, cooperative learning, co-located learning, distributed learning, asymmetric (e.g. presentation) and symmetric (e.g. group discussion) learning with respect to accessing and adapting educational knowledge. Therefore, AES will be designed to include seven modules that are fully integrated and will cover all activities required for all types of learning mentioned above. The modules are: Knowledge Management and Networking Module, E-learning and Training Module, Scientific Workplace (SWP) Module, Administration Module, Scholastic Management Module, Financial Management Module, and Security Module. In addition to the basic modules, AES includes some sub-modules that are going to be briefly discussed in the following sections.

2.1. Knowledge Management and Networking Module

The advances in the 21st century will be based on knowledge management and knowledge networks. This module is responsible to generate, manage, and control the distribution of two types of knowledge: explicit knowledge that can be articulated and is expressible and tacit knowledge, which is hard to articulate and embedded in individual experience. The module fosters the growth of knowledge communities and learning communities and manages the intellectual assets of universities, institutes and research centers.

In brief, a knowledge network is a directed graph \( G_k \) (\( N, A, L, D \)) consisting of nodes, arcs, labels and certainty degrees. Each node represents a concept (university, research center, scientist, …) and each arc between two nodes has a label \( L \) and a certainty degree \( D \). The label \( L \) indicates a relationship between the nodes and \( D \) shows to which degree the relationship is certain in the network. \( D \) values are, in the interval \([0,1]\), used to enable intelligent processing and fuzzy reasoning. \( L \) can pick the following relations:

- R1: Who knows who (universities, scientists, instructors, …).
- R2: Who knows what (skills, expertise, work flows, activities, …).
- R3: Who knows who, who knows who (R1, R1).
- R4: Who knows who, who knows what (R1, R2).

A tuple with a set of nodes, a set of arcs, a set of labels and a set of certainty degrees will represent the knowledge in a knowledge network. The module will provide a knowledge Sub-Language (KSL) consisting of some operators for defining, manipulating (create, add, delete, join, union, intersect, …) and sharing knowledge in knowledge networks. Note that a visual graphical knowledge query language can be embedded into the module.

This module includes a highly efficient search engine, which enables users to search for any material. It enables users to access and upload information according to their security clearance.

There exist a sub-module, which is responsible to organize interesting information (URL, date,…) found in the internet or intranet, so that the information can be used and shared with others. The information can appear in any format including video, sound, text and so on. This module has the following characteristics: Allowing workers and partners, who join the system in any kind of learning cooperation, to more easily export and import explicit and tacit knowledge; Gathering and formalizing explicit knowledge to monitor cooperative processes;
Managing knowledge flows and optimizing the access to the knowledge base of the system; Effective identifying of collaboration partners, who intend to join the knowledge network; Having, a common knowledge management repository to eliminate redundancy and to ensure that the information posted is the most relevant; Enabling the assignment of contacts to content.

2.2. eLearning and Training Module

This module offers full eLearning capabilities for instructors to create and post asynchronous courses, or to incorporate existing courses that are developed by a third party and for students to access a library of asynchronous eLearning courses, or to participate in synchronous eLearning sessions. Synchronous sessions will allow instructor and students to interact with each other alive (e.g. via voice chat and video).

There exist a tutoring sub-module that enables students to take the role of both tutor and tutee during their learning experience. Acting as both tutor and tutee through interactions with different peers encourages students to learn better. This module is responsible for the following functions:

- Providing personalized access to learning materials, courses, courselets according to the learner’s previous knowledge and his or her progress in mastering the material.
- Creating personalized access to large text materials and media archives.
- Sharing and reusing learning material among students and teachers and across geographical and organizational boundaries.
- Allowing users to fully control the eLearning sessions.
- Providing a tool for content management, which supports workflows and versioning.
- Making the metadata for learning resources available.
- Facilitating automatic extraction of metadata and ontological information.
- Providing exchange facilities and interchange protocols to facilitate interoperability and reusability of educational resources.
- Enabling researches to give demonstration of an ongoing research in their laboratories over the Internet or Intranet.
- Enabling users to record all synchronous eLearning sessions so that they can be viewed at a later date.
- Enabling faculty members to send email assignments to a specific class, or announce an event.
- Allowing students to access lessons, surveys and exam databases online.
- Providing a personalized search engine for learning objects.
- Providing shared calendar bulletin boards for faculty, students and staff members to post events announcements and advertisements.
- Supporting curricular activities and handling the process of archiving, managing, allocating and distributing the modular content in distributed learning environments.
- Personalizing and adapting existing learning material to a particular learning situation.
- Providing personalized interfaces and access to educational media.
- Assisting the learners to perform work-related tasks such as answering questions, solving problems, writing reports, etc.
- Supporting accountability awareness, showing how the training raises the appropriate skill sets of an organization.

2.3. Scientific Workplace (SWP) Module

This module provides an integrated infrastructure that will enable instructors, researchers and tutors to define, manage and monitor project teams, class projects and project tasks, where members and resources are distributed.

As a “proof of concept”, the module was designed as a joint project between Iran and Austria\(^1\). The project was successfully finished and has produced a reliable prototype. SWP [2] uses open source software and has been tested on the Linux operating system with the Interbase relational database management system, the Enhydra application server and object-relational mapping tools, XML libraries, Apache Tomcat Servlet engine, Apache SOAP servlet and client library. SWP is rather complex and leads to Web-based groupware platform. For further development of SWP, the next version (SWPII) has been proposed and approved.

2.4. Administration Module

This module covers all aspects of student administration via Intranet and Internet including, student application, admission, class registration, tuition payment

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\(^1\) The project was funded by Iran Technology Cooperation Office of Presidency and Austria Ministry of Science and implemented by Computer Science Department of Kerman Shahid Bahonar University and the Institute for Software Technology and Interactive Systems of Vienna University.
and record management. Some typical abilities of the module are as follows:

- Enabling students to have on-line access to all necessary application forms, pre-requisites and other required materials.
- Easy management of courses and related functionalities
- Allowing students to build their schedules on their own time, based on rules.
- Ability to automatically assign the students to appropriate classrooms, according to their choices and classroom availability.
- Ability to organize all resume-based information relevant to each student.

2.5. Scholastic Management Module

This module covers all areas of planning, organizing and managing the academic program and has the following abilities.

- Planning of time schedules, resources and rooms for the entire academic program.
- Analyzing resources, requirements and availability.
- Organizing courses and exams.
- Enabling instructors to measure student and class progress through online assessments (system and instructor defined questions- multiple choice questions, fill in blank, essay and etc.). The exams can include any attachment (e.g. sound, image, etc.).
- Preparing details of the students' status to eventually determine their eligibility to receive the desired degree.

Note that a non Web-based system has already been implemented at Shahid Bahonar University, which covers almost all functions of this module as well as Administration module. The components of this system can be plugged into AES.

2.6. Financial Management Module

This module will be designed specifically for managing and controlling all budgetary and financial aspects involved in an elearning organization. It provides the ability to handle accounting, revenue and budget management. The main responsibilities of the module are:

- To do the accounting automatically.
- To facilitate the preparation, management and control of the budget.
- To generate periodic reports on the budget status at any given moment.

- To support budget planning in advance.
- To support automatic billing based on special conditions.
- To handle equipment purchasing.
- To provide discount tables for specific students.
- To manages bank account income and expense sheets as well as advance payments and any other payment method.
- To support tuition calculation and payments by any means according to a set of rules.
- To calculate all types of taxes automatically.
- To manage all items in the inventory and all aspects of fund raising.

2.7. Security Module

This module will support the flexible security standards, high security for classified knowledge and core competences, maximum security for users at all levels and protection of the educational data and applications. The module also controls the entire flow of revenues and expenses.

The information can be accessed based on a personal security clearance via Intranet and Internet. For example, the instructor can send messages to any or all of the students. He may decide if the messages will be viewed by a particular student or by the entire group and if students can download the session's messages.

3. The AES typical characteristics

The AES characteristics can be summarized as follows:

- Providing facilities to create virtual universities, institutes, conferences and workshops [5].
- Enabling professional trainers and trainees to utilize virtual enterprise modelling and configuration functions to set up and simulate virtual enterprise training scenarios.
- Supporting professional authors and learners to publish and learn from the collections of professional communities and organizations (universities, research institutes etc), where potential future professionals can learn traditionally published as well as ad hoc acquired knowledge.
- Supporting information retrieval, searching, filtering, and browsing activities on both the semantical and the syntactical level. This means professional authors, teachers, trainers, and learners will be enabled to utilize content-oriented subject classifications, thesauri, and ontology to search and browse the content of professional publications and
learning materials.

- Support bi-lingual (Farsi and English) and semantic access \[6\] to collection materials. This means professional authors and learners will be enabled to utilize their familiar native language as well as the semantic to search and browse the content of professional publications and learning materials.

- Fully scalable solution and platform independence, which can be fit in any configuration for universities, small and medium enterprises, networks, and all the way up to the Ministries.

- Providing high quality peer reviewed professional business publishing and education process support.

- Utilizing existing explicitly published professional materials, textbooks, tutorials and etc.

- Capable of being installed in an n-tier environment divided among servers to achieve the best performance and maximum tolerance.

4. Available techniques and technologies

With respect to the mentioned features of AES, it is planed to exploit some techniques and technologies such as:

- Knowledge acquisition, reviewing, annotation, indexing, publishing distribution and reuse techniques.

- Machine learning techniques.

- Digital library technologies.

- Data mining techniques.

- Artificial Intelligent and Text Understanding techniques to have intelligent search engines.

- Semantic Web and ontology-searching techniques to better access, retrieve and filter information from the Web.

- XML technology for content and knowledge management, and for implementing metadata repositories.

- Information agents to retrieve information intelligently.

- Advanced information visualization techniques.

- Automated document processing and image indexing techniques.

5. Conclusion

This paper has proposed an Advanced E-learning System (AES) with all required features that will help the higher education authorities to establish virtual educational organizations for attracting and tailoring brainpower and talented students in Iran to the economy.

With the integration of cooperative work, learning, knowledge management and knowledge networking, AES will give greater openness in knowledge exchange and will streamline the knowledge seeker and knowledge provider demand and supply relationships. It will facilitate the transfer of technology to improve the productivity of society and will offer research opportunities through which the faculty members can make a contribution to knowledge. In addition AES will manage all administrative needs ranging from student registration to human resources and finances.

AES will foster the process of establishing a scientific and progressive society, a society that is innovative, a society in which development of human resources is the center of consideration, and a society in which one is not only a consumer of technology but also a contributor to the scientific and technological civilization of the future.

6. References


