

AN ADAPTIVE AND INTELLIGENT FRAMEWORK FOR VIRTUAL HIGHER EDUCATION IN IRAN

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Abstract - The subject under investigation has been Electronic Learning (e-learning) or Electronic Education (e-education), specifically concentrating on virtual university. Virtual university has been the subject of much debate in recent years. In short, the concept of virtual university denotes a learning/educational system/environment based on Internet where higher education is promoted using tools and techniques from information and communication technology domain. A number of virtual university projects have recently been launched in Iran. However, this subject area is currently under intense exploration at various governmental and academic levels in Iran. This paper presents a proposed adaptive and intelligent virtual university architectural system and places its emphasis on the national implementation of virtual education in Iran. Finally, comparative studies are presented and conclusions are drawn.

Keywords - Virtual Education, Iran Higher Education System, Intelligent System, Learning Management System, E-Learning.

INTRODUCTION

According to the annual survey carried out by the Institute of Research and Planning of Iran [27], more than 1.6 million people took part in the Iranian national examination for entering higher education (HE) to be eligible to attend HE institutions in 2002. Also, data shows that 177665 people were registered at HE institutions in the period 2000-2001 with a growth of 8.8 percent compared to the previous period. In the same period (2000-2001), a total of 46747 educational instructors were employed at HE institutions in Iran with a growth of 2.65 percent compared to the previous period. Based on the statistical data, the number of students at HE institutions rose from 67268 in the period 1949-1950 to 733527 in the period 2000-2001, which indicates an average annual growth of 7.75 percent. The seventy or so universities and HE institutions in Iran are incapable of accommodating the great number of demanding students wishing to pursue higher education in Iran. The following factors represent the great need for a revolution in e-learning in Iran:

- Classical universities can not grow at the same rate as the youth populations that require education. Many new universities of this type must be built to retain the current level of those who wish to continue their higher education.
- Developing countries such as Iran do not have sufficient numbers of qualified professionals to serve as teachers, faculty members and mentors.
- When studying in the same system, many students often see each other as supportive friends and educational collaborators. Teaching students via e-learning in a collaborative environment may enhance mutual understanding, and cooperation.
- Without some feasible system for educating the youth of developing nations, those countries are likely to fall further behind the developed world in terms of economic growth and prosperity.

The Internet-based education, specifically in the context of virtual university (VU), can considerably contribute not only to the promotion of higher education by advocating opportunities, but it can also release the burden of extensive academic and administrative tasks performed by traditional HE institutions.

This paper describes the concepts of virtual education in the form of VU and continues to discuss various implementation and development aspects of such cyber education approaches. The paper also sets forward a proposed modular VU architecture for Iran, placing emphasis on the adaptive, interactive and intelligent characteristics of the e-learning environment.

VIRTUAL EDUCATION

Virtual education, cyber education, electronic learning, electronic teaching, and similar terms usually refer to distance education through the Internet or the World Wide Web. The factors of time and location restrictions are reduced compared to the classical on-campus approach.

Virtual education may govern the future of education worldwide. It provides limitless and flexible access to knowledge and education, and yields economic growth for the country. On the other hand, the trend for educational system is being shifted from the traditional teacher-to-student approach (where teacher controls the classroom education) to learner-to-learner approach, where learners must seek education (knowledge) and interact with each other [17].

Virtual university, an adaptation of virtual education, in the context of universities, typically refers to off-site teaching, often termed virtual education. It should be based on all services provided by traditional higher education institutions using Information and Communication Technology (ICT) methods. A virtual university should support the following services:

- ▷ Administration (e.g. marketing, registration, student records, fee payments, etc.)
- ▷ Materials development, production and distribution
- ▷ Delivery and tuition
- ▷ Career counseling/advising, learning assessment and examinations

Some of the debates on the impact of new ICTs can take very narrow views on the challenges that HE institutions face today. There are many equally salient factors, e.g. increasing enrollment, the emergence of a knowledge society, the crisis of the state, internationalization or increasing social tensions with regard to the distribution of power and wealth. The spread of ICTs calls for substantial efforts of cooperation and communication not only within HE institutions but also among many other national elements. The impacts of new ICTs might vary substantially according to the social and cultural context [14]. However, ICTs are here to stay and as tools should be utilized in order to fulfill the society demands and to improve services, specifically in education by promoting knowledge.

The following factors may provide motivation towards adopting the virtual education approach based on ICT [24]:

- ▷ Reduction of HE institutions workload
- ▷ Promoting education, research and attaining skills
- ▷ Cost and time efficiency
- ▷ Creating opportunity for teachers to take more research and study challenges
- ▷ Enabling any time and anywhere capability for education
- ▷ Increasing educational efficiency
- ▷ Encouragement and presentation of educational opportunities
- ▷ Promoting educational justice
- ▷ “Pushing” rather than “pulling” (with students having greater control)
- ▷ Lifelong learning
- ▷ “Just-in-time” rather than “just-in-case” education
- ▷ Demonstrated skills versus certification
- ▷ Open competition and cooperation
- ▷ Simulation and interaction
- ▷ Collaboration between universities and business

Despite such motivations, it should be considered that building an infrastructure for e-learning primarily implies creating an environment where users can easily access the learning products whenever and wherever they need them. It also implies making the entire virtual education easier and more cost effective to manage. This can not be achieved by just putting a lot of e-learning stuff on an Internet server and hoping for the best [24]. Appropriate plans, strategies and extensive collaborations may be necessary when virtual education is considered.

VIRTUAL EDUCATIONAL MODELS

An important question before any implementation of VU is: to what extent the adoption of Web-based education is in line with the traditional educational models and approaches adopted thus far. There are a number of possible main issues to re-affirm some basic principles of good teaching and learning when opting for Web-based education:

1. The active engagement of the learner
2. The assessment of competencies of students based on a communication-oriented pedagogy
3. The scaffolding of learning processes
4. Variety in feedback and efficiency reasons (individual pace)
5. Providing professional and academic leadership
6. Promoting self-creativity and self-awareness

Educational institutes have a responsibility to model adequate methods of teaching and learning and, thus, give learners experience with new ways of dealing with knowledge. In this way, they themselves can rely on a richer repository of possible teaching and learning formats in the future.

A Web-based educational system should be devised based on appropriate educational standards and models formulated to allow a sustainable and flexible transfer and development of knowledge. Such systems are complex dynamic systems, which provide an easy to use and flexible environment while being highly self-organized. Web-based systems should promote knowledge while performing high standard evaluations by incorporating efficient self-assessment materials with accompanying guidance and solutions. The highly adaptive nature of such dynamic learning systems should allow comprehensive learning materials, examples and self-assessments in addition to intelligent guidance routines providing advice and directions. Throughout the self-assessment process, student progress should be traced by an intelligent constituent of virtual system, which provides optimum guidance for students in the development and enhancement of their learning.

VU IMPLEMENTATIONS METHODS

The development of a VU is normally based on a large-scale project that may require cultural, educational, governmental, economic and technological considerations. Primarily, three implementation approaches of VU may be considered as:

- ❑ Local Virtual University (LVU)
- ❑ National Virtual University (NVU)
- ❑ International (Multinational) Virtual University (IVU)

- LVU IMPLEMENTATION

The LVU implementation of virtual education at many universities may be based on two methodologies: the lone rangers (third-party software) and institutional methodologies [16]. Lone rangers are energetic, early adopters who implement and provide online teaching and learning platforms with the main aim of improving the accessibility while conforming to recognized international standards and codes of practice. The learning platforms offered by such lone rangers can generally be customized by the lone ranger based on popular demands. Those institutions opting for lone ranger approach may not have the freedom to change or control the learning platform or its corresponding infrastructure. The lone ranger approach to online teaching and learning has a number of possible problems:

- ◉ Variable quality and features (different innovators will produce different levels of quality).
- ◉ Absence of the lone ranger usually may result in the failure.
- ◉ Limited scalability (the lone-ranger approach to virtual education may not scale to an organizational level).
- ◉ Lack of support for courseware design and development.
- ◉ Emphasis on business aspects rather than on knowledge management.
- ◉ Insufficient authorization in platform customization and control.

Institutional approaches to online education commonly fall into one of three approaches:

- ◉ Buy or charter an online e-learning platform: The choice of one of the many available learning management systems (LMS) such as WebCT or Blackboard and the necessary infrastructure is setup to handle the conversion of existing practice to its use.
- ◉ Build a package: Some organizations choose to leverage the existing organizational experience with virtual education often in the form of a successful lone ranger and build an institutional specific package.
- ◉ Out source it: The development and production of virtual university is out sourced to an external organization.

- NVU IMPLEMENTATION

The NVU implementation concerns with the development of a single VU, which collaborates with a number of or all the HE institutions in a country to provide online education. The implementation of NVU is more complex than LVU as it requires extensive design and development strategies in addition to broad collaboration from various educational organizations and governmental groups. The advantages of NVU over LVU may include:

- ◉ Time efficiency in the re-engineering of VUs across HE institutions

- ◊ Cost efficiency in the development of multiple LVUs
- ◊ Consistency in national education and global standardization
- ◊ Centralization of administration, control, management, supervision and security
- ◊ Liberty of HE institutions lacking ICT resources to benefit from online education

The United Kingdom E-learning University (UKeU), and the Canadian Virtual University (CVU), are examples of national VU platforms. The CVU, for example, is a partnership of Canadian universities working together to offer complete university degrees, diplomas, and certificates over the Internet or via distance education. Partners of the CVU currently are Athabasca University, Brandon University, British Columbia Open University, Laurentian University, Memorial University of Newfoundland, Mount Saint Vincent University, Royal Roads University, Télé-université du Québec, Université de Moncton, University College of Cape Breton, The University of Manitoba, University of New Brunswick, and University of Victoria. All CVU partners are chartered under provincial legislation and are members of the Association of Universities and Colleges of Canada [12].

- IVU IMPLEMENTATION

The IVU implementation concerns with the development of a single VU, which considers the multinational collaborations towards a common educational flag. African Virtual University (AVU) is an example of IVU that uses modern information and communication technologies to increase access to educational resources throughout South Saharan Africa (SSA). The countries in SSA, which are participating in the pilot phase of AVU program, include: Ghana, Ethiopia, Kenya, Uganda, Tanzania and Zimbabwe. AVU also provides students with an access to an online digital library with over 1,000 full text journals. The AVU website receives more than 1 million hits per month [1].

AN OUTLOOK FOR IRANIAN VU IMPLEMENTATION

Despite a number of technological and cultural difficulties and limitations concerning resources in Iran, a small number of HE institutions have recently developed adaptations of virtual universities in the form of LVU implementation approach (Tarbiat Modarres University, Sharif University of Technology, Iran University of Science and Technology, Islamic Azad University and Isfahan University).

These HE institutions have developed online education frameworks where a user may access the VU by using an Internet browser connected to an institution's web-server or a third party Web-server running the institution's VU web-site. These LVUs currently are not offering virtual degree qualifications and the number of virtual courses offered is also very limited. Such LVU systems merely provide learning materials and registration utilities

at the present time while minimum learning interaction between the e-learning platform and the participating users has been considered in the VU design [3].

The increasing number of students wishing to pursue higher education in addition to the pressure from HE institutions to cope with the administration and management demands has compelled the authorities to press towards virtual education techniques [22]. Some HE institutions have already begun planning LVUs to fit their requirements. Although HE institutions in several countries have adopted for LVU implementations based on possible economic, preference, and time factors, the option of an NVU in Iran may be the most appropriate consideration both in the short and long terms while considering the deficiencies of ICT in Iran.

The NVU implementation should comply with the national and international governing educational rules and standards. The Ministry of Science, Research and Technology in Iran, for example, is the appropriate candidate for taking the responsibility of the coordination of the NVU project by setting up a special advisory team. A committee of HE institutions' experts should take the responsibility of reviewing the educational and pedagogical requirement issues. A team of ICT experts must take part in challenges of the technical implementation strategies and cooperate with all other collaborating organizations to design and develop the NVU.

A PROPOSED IRANIAN VU ARCHITECTURE

Countries, where the higher education system is administered under a single flag, usually prefer to opt for NVU implementation. However, some countries do not have a single educational governing body that administrates the national HE system. The HE system in Iran is governed under the umbrella of the Ministry of Science, Research and Technology. Consequently, the NVU implementation complies with such consistency and is therefore proposed in this paper.

The concept of e-learning models may differ broadly with the traditional educational systems. In e-learning, the emphasis is on self-learning (pull) rather than imposed instruction (push). Therefore, most aspects of the traditional education may not be suitable for the implementation of VU. The best workable long term solution to the establishment of virtual education platform is a modular, intelligent, adaptive, open standard-based design approach allowing complete separation of generic deliverable services from particular delivery mechanisms.

Figure 1 illustrates a proposed architecture for VU implementation, which may be adopted for LVU or NVU implementations.

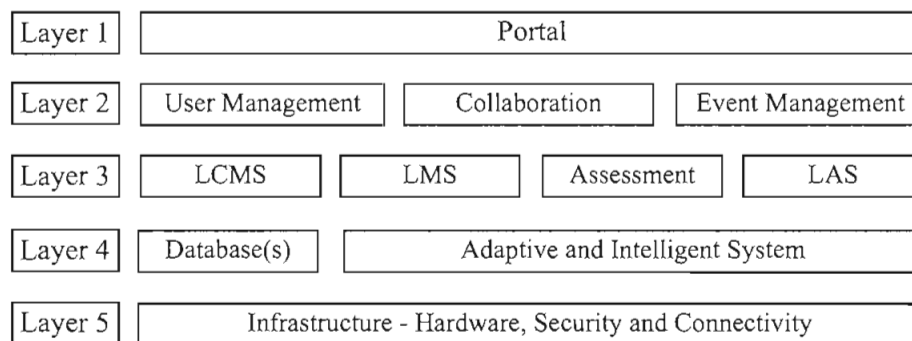


Figure 1: A proposed VU architecture for Iran.

- LAYER 1 – PORTAL

The Portal provides a single point of entry to the VU using any client computer capable of running a Web browser. The user's profile will dictate which services will be visible, while single sign-on ensures that credentials only need to be entered once, no matter how many services or systems the user interacts with. The portal can be tailored to every institution's guidelines and can easily integrate with an existing portal solution.

- LAYER 2 – COMMON SERVICES

Common services represent the services that everyone needs, regardless of role. They are not tied to, nor dependent on, any particular pedagogic function or specific language. Common services consist of user management, collaboration and even management services, which are described as follows.

-- User management

- ⦿ Identifies, tracks and assigns privileges to every individual user of the system.
- ⦿ Provides a single user-ID to every user, whatever their role and regardless of how often their role might change.
- ⦿ Provides a consistent, high-quality interface and user experience for all – again, irrespective of user roles (student, tutor, administrator, etc.).

-- Collaboration

Provides communication between all users of the system – both synchronous (whiteboard, chat rooms, web-casts, etc.) and asynchronous (email, discussion threads, etc.). The collaboration module should interact with the adaptive and intelligent system in creating optimal collaboration approach.

-- Event management

Provides calendar, scheduling and reminder functions for all users.

-- Layer 3 – learning services

These services provide the core functionality for the production and consumption of learning resources. They should allow maximum flexibility in the sourcing, packaging and presentation of content, the marking and assessment of student performance, and the integration of user records into corporate or other institutional administrative systems. Learning services consist of learning content management system (LCMS), learning management system (LMS), assessment, and learning administration system (LAS), which are described as follows: (Learning services should combine forces with the adaptive and intelligent system to provide maximum knowledge growth and management).

-- Learning content management system

“A software application that enables authors to register, store, assemble, manage, and publish learning content for delivery via Web, print, or CD” [19]. The LCMS uses a workflow-driven approach to the production of both online and traditional instructional material to support blended learning. Learning Objects (LO) [15,18,25] are discovered and assembled using a metadata language allowing flexible course construction. The learning material can be imported from other Content Systems (CS) using IMS/SCORM interoperability standards and specifications, and similarly exported to the LMS for learning delivery.

-- Learning management system

The LMS software automates the administration of training events. The LMS registers users, tracks courses in a catalog, records data from learners, and provides reports to management. An LMS is typically designed to handle courses by multiple publishers and providers. A learner’s development plan and job-related training can be stored and personalized to the individual [25].

As a delivery mechanism, an LMS should offer institutions the maximum possible choice in the way they source and distribute learning contents, and the closest possible tracking of the way the content is used. Some platforms combine the LMS function with the LCMS function, an approach in which the delivery vehicle places unnecessary restrictions on content creation. To fulfill its function properly, the LMS should impose minimal restrictions on where or how the content is authored, while at the same time offering direct and detailed feedback to assist course designers in improving the usability of their material.

-- Assessment system

This part of the platform measures student performance against specified goals, using a variety of tools ranging from multiple choice questions to complex assignment handling which covers multiple markers and so on. It should allow institutions to match the most

appropriate assessment tools, based on standards and specifications, to any given course and/or student and support secure assignment handling and support for accreditation processes.

- - Learning administration system

This acts as an interface between the learning platform and the existing host institution's billing or other back-office information systems, for the efficient management of enrolment, fee payment and related administrative functions. The LAS manages all reference data in support of the learning services as a series of domains specific to the individual education institution. A standard domain might include:

- ◉ Student applications
- ◉ Student records
- ◉ Student personal development plan
- ◉ Tutor records
- ◉ Learning programs
- ◉ Digital rights management

- LAYER 4 – INFORMATION MANAGEMENT SERVICES

The information management services function as information banks, controllers and manipulators. The services consist of databases and adaptive and intelligent educational systems.

- - Databases

The repositories contain libraries of digital resources for constructing learning material. Resources are discovered through an open search interface and are made available to both the LCMS, for sequence definition of courses, and the LMS for delivery.

- - Adaptive and intelligent system

The adaptive intelligent system (AIS) is perhaps the most influential part of the entire learning environment responsible for extensive adaptive and dynamic knowledge management. The use of AIS implementation for e-learning has been very limited because of the complexity involved in the development of such systems and the difficulties related to providing robust and flexible systems. A more detailed explanation of this system will be presented in the subsequent sections.

- LAYER 5 - INFRASTRUCTURE

Any public Web-based provider should have sound and flexible infra-structural competency. Flexibility of the infrastructure enables smooth access and interactivity to those who

participate in an online environment. Appropriate computing hardware must be selected to support Web-based applications and services. To allow efficient communication, suitable routers, bandwidth capabilities and switching must be considered. Performance and network optimization monitoring tools must be used to scrutinize network operation. Routers and switches enable network flow and consequently reduce the risk of congestion. In order to avoid information violation, reliable security measures must be established by means of hardware/software tools (e.g. firewalls, proxy servers, etc.).

ADAPTIVE AND INTELLIGENT SYSTEM

The area of AIS is relatively young and much research is needed in the combined areas of education and pedagogy, cognitive science, artificial intelligence and human-computer interaction in order to establish appropriate methodologies or development tools.

The AIS uses all adaptation technologies applied in Web-based adaptive educational system (AES), which are adopted from either the intelligent tutoring system (ITS) [10,23] area that deals with issues such as:

- ▷ Curriculum sequencing
- ▷ Intelligent analysis of students' solutions
- ▷ Interactive problem solving support
- ▷ Example-based problem solving support, and
- ▷ Collaboration support

or the adaptive hypermedia areas such as:

- ▷ Adaptive presentation, and
- ▷ Adaptive navigation support

The goal of the curriculum sequencing technology (also referred to as instructional planning technology) is to provide the student with the most suitable individually planned sequence of knowledge units to learn and sequencing of learning tasks (examples, questions, problems, etc.) to work with. In other words, it helps the learner to find an "optimal path" through the learning material. In the context of web-based education, curriculum sequencing technology becomes very important to guide the student through the hyperspace of available information. Currently, it is the oldest and the most popular technology for Web-based AES.

The Intelligent analysis of student solutions deals with students' final answers to educational problems (which can range from a simple question to a complex programming problem) no matter how these answers were obtained. Unlike non-intelligent checkers that can tell not more than whether the solution is correct, intelligent analyzers can tell what exactly is wrong or incomplete and which missing or incorrect knowledge may be responsible for the error. Intelligent analyzers can provide the student with extensive error feedback and update the student model.

The goal of interactive problem solving support is to provide the student with intelligent help on each step of problem solving – from giving a hint to executing the next step for the student. The systems which implement this technology can watch the actions of the student, understand them, and use this understanding to provide help and to update the student model. The classic example from the domain of teaching programming is the LISP-TUTOR [2], the ACT Programming Tutor [11] and GRACE [21]. Interactive problem solving support technology may not be so popular in Web-based systems as in standalone systems. Each interaction between browser and server may take a visible amount of time, and the requirement to perform it on each step may ruin the problem solving process. The situation will probably change when Java technology becomes more mature.

In an example-based problem solving context, students solve new problems with the help of examples from their earlier experience. In this context, an ITS helps students by suggesting them the most relevant cases (examples explained to them or problems solved by them earlier). An example from the domain of teaching programming is ELM-PE [28]. Example-based problem solving does not require extensive client-server interaction and can be naturally used in AES on the Web. The only system which uses this technology on the Web is ELM-ART [6].

Adaptive hypermedia systems [7] apply different forms of user models to adapt the content and the links of hypermedia pages to the user. Consequently, the goal of the adaptive presentation technology is to adapt the content of a hypermedia page to the user's goals, knowledge and other information stored in the user model. In a system with adaptive presentation, the pages are not static, but adaptively generated or assembled from pieces for each user. For example, with several adaptive presentation techniques, expert users receive more detailed and deep information, while novices receive additional explanation. An example from the domain of teaching programming is the "conditional text" technique applied in ITEM/IP [5]. Adaptive presentation is very important in web context where the same "page" has to suit to very different students.

The goal of adaptive collaboration support is to use system's knowledge about different users (stored in user models) to form a matching collaborating group. Existing examples include forming a group for collaborative problem solving at a proper moment of time [13], or finding the most competent colleague to answer a question about a topic (i.e. finding a person with a model showing good knowledge of this topic) [4,20].

The goal of the adaptive navigation support technology is to support the student in hyperspace orientation and navigation by changing the appearance of visible links. In particular, the system can adaptively sort, annotate, or partly hide the links of the current page making it easier to choose the next link to proceed. Adaptive navigation support can be considered as an extension of curriculum sequencing technology into a hypermedia context. It shares the same goal – to help students to find an "optimal path" through the learning material. In a web context where hypermedia is a basic organizational paradigm,

adaptive navigation support can be used very naturally and efficiently. The most popular form of ANS on the Web is annotation. It is implemented in ELM-ART [6], InterBook [9], WEST-KBNS [8], and AST [26]. Another popular technology is disabling, a variant of hiding which keeps a link visible but may not allow access to the page(s) behind the link, which is aimed for learning.

The AIS, in general, offers the advantage of individualized instruction and supervision while minimizing the expense of one-to-one human tutoring and interaction. AIS should use the knowledge about the domain, the use, and about teaching strategies to support flexible individualized learning and tutoring.

Adaptive and intelligent presentation can improve the usability of course material presentation. Adaptive navigation support and adaptive sequencing can be used for overall course control and for helping the student in selecting most relevant tests and assignments. Problem solving support and intelligent solution analysis can significantly improve the work with assignments providing both interactivity and intelligent feedback. Adaptive collaboration support opens new possibilities for communication and collaboration.

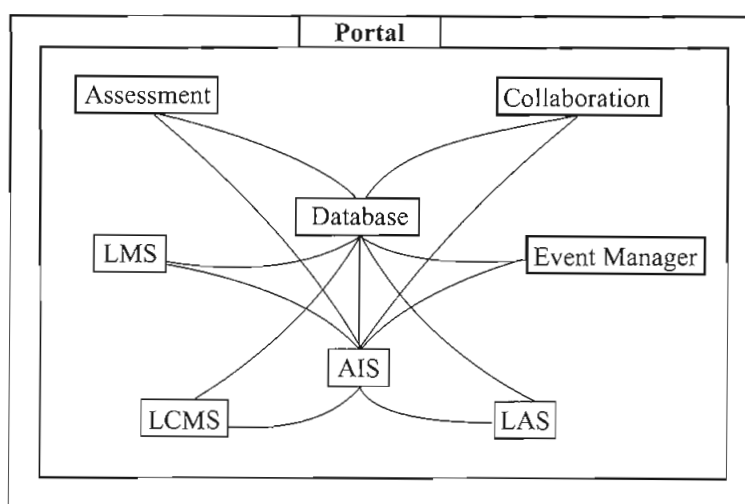


Figure 2: The communication scheme among various modules.

Figure 2 represents the communication mechanism among different systems in the proposed VU. The portal is a point of entry, which handles the environmental and communication issues. The database and AIS are the central information pools and manipulators that constantly interact with other learning and administrative systems in the framework. The user's data-models are maintained in the database. The AIS operation with other system modules in the framework may be defined as follows:

Collaboration: This module uses AIS to generate appropriate working groups based on learning subject, learner's potential, learner's geographical locations, etc. The AIS can also use the collaboration system to inform the learner about the most competent learner(s) to answer a question about a topic.

Event Management: The AIS can use the event manager to assign specific calendar for the students who require further learning. It can also notify the learner about certain events concerning his/her education, group activity events, workshops and seminars, and recreations.

LAS: The learning program can be adjusted dynamically by AIS according to the learner's level of cognition and grasp of information. The AIS can evaluate the learner's progress and offers directions or course of actions to actual tutors. If minority individual learners are consistently unwilling to progress, the AIS should adjust its pedagogical strategy to a more conservative teaching method using, for example, an example-based approach. If the duration of a certain instructional phase exceeds a certain threshold, the AIS should carry out diagnostic evaluations based on its interaction with the learner and provide appropriate reports and directions to actual tutors.

LCMS and Assessment: The learning content should be dynamically adjustable (forward-backward process) in conjunction with the assessment system to provide an adaptive learning environment. The LCMS system should allow full flexibility and comfort in attaining knowledge while intelligently provides assistance when the student faces difficulties. Based on the user model, which is constructed by the AIS, the system should receive student's problem and carry out initial evaluation based on its knowledge. The system provides the student with the solution(s) if it has the knowledge to respond to the presented problem. Otherwise, the system refers to an actual tutor via collaborative tools to receive an answer. The guidance and control of learning process may be carried out entirely or partially by the AIS system (i.e. the AIS acts as an intelligent virtual tutor).

The learner can be provided with a system that encourages him/her to learn by helping the learner to find the optimal route through the learning materials. The system also promotes creativity by indulging the user to seek information concerning specific questions or case studies. The interactive problem solving support, the example-based problem solving and the intelligent analyzers provide smart means for maximum learning approach.

LMS: The adaptive presentation technology of AIS works with LMS to adaptively change the content of a hypermedia page to the learner's goals, knowledge and other information stored in the learner model.

CONCLUSIONS

The concept of virtual education and e-learning is relatively new in Iran. Important issues such as cultural, political, economic, educational and technological factors should be taken into consideration for the design and development of virtual education systems. Such cases are under intense and careful investigations. However, this paper has described a number of issues concerned to virtual university (VU) implementations and offered a proposed architecture for VU implementation based on adaptive and intelligent approaches using

ICT techniques in Iran. The proposed system holds minimum dependency on cultural and environmental factors while the main emphasis has been placed on user requirements and system flexibility.

This paper placed emphasis on the adaptive and intelligent methods and their benefits for web-based education. So far, most company-based or institutional web-based education systems have been able to compete on the market with their simple non-adaptive systems. However, a number of research level systems have already clearly demonstrated the benefits of adaptive and intelligent technologies.

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