

Decision Support System Using for Learning Management Systems Personalization

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Abstract Among all electronic movements, electronic learning is rapidly increasing and has global popularity. One of the most important factors in these learning courses is regarding learners' personal differences and developing flexible and intelligent interaction with users through personalization techniques. Besides that, the researches results show the personalization approaches haven't been applied efficiently in these systems yet. One of the most beneficial technologies in this field is supporter decision system. In other words, unifying supporter decision tools and electronic learning system leads to intelligent learning facility and increases learning courses productivity. The current research, at first, has carried out the study about decision support systems applications in order to learning management system personalization and then as a research sample, identified some different requirements of learning management system users of electronic college of Shiraz university; and suggest some scenarios. Using decision support system capabilities, new scenarios suggested in follow based on suggesting environment personalization solution to improving function and increasing different learners efficiently learning.

Keywords: *electronic learning, personalization, learning management system (LMS), decision support system*

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1. Introduction

The technologies related to information technology have affected human life in various fields. One of the fields that have changed mainly is learning. In recent years, electronic learning because of its nature has distributed uniquely and improved learning system and overwhelming time, place, social and political barriers has developed new conditions of learning. As simple words "electronic learning is training delivered on digital devices such as a smart phone or a laptop computer that is designed to support individual learning or organizational performance goals" [1]. In other words "the goals of e-learning are to create the community of inquiry independent of time and location through the use of information and communication technology" [2]. In this type of learning, learning software provides various types of communications for learners. Knowing the learning software as an interaction system is significant for learning perception and interaction in a computer based environment. Learning management systems or LMS are applications that applied in order to developing communications between learners and teachers and learning managers. The systems must be able to register users and save the learners' personal information and define learning procedure for each user and save related data. One of the other LMS's task is rules regulating,

teachers determining, managing database and learning references and developing criteria reports [3]. However, in the most old electronic learning systems the courses and the learning materials were not enough dynamic, therefore they wouldn't able to fulfill the learners requirements efficiently; so it would lead to inappropriate experiences. In other words, how the designing electronic learning process makes it unique and useful. Thereby, there are various factors such as learning content, learning methods, media, learners' differences, learning environment and etc. that have to be noticed in designing electronic learning process. Today, thanks to the technologies such as intelligent agents, expert systems, multimedia tools and data mining, the electronic learning systems have been more interactive. In these systems it is necessary to identify various users learning requirements and provide users with learning processes and facilities in proportion to their personalities. Generally, "the personalized electronic learning provides a set of personalization functionalities, such as personalized learning plans, learning materials and tests, and initiating interactions with the learner by providing advice, necessary instant messages, etc" [4].

Regarding the problems due to the bulk of developed and saved data cause some problem in organizing, accessing and keeping the users requirements data, applying the methods that classify users intelligently and effectively help them with reaching to the required information and making the best decision. The decision

support systems can apply for the mentioned tasks. The decision support system is a general term for every computer based application that increase the manager ability in making decision and concentrates on the unique and changing rapidly issues [5]. Suggesting tools of the decision support systems contribute in more interactive electronic learning and designing personalized learning process according to each user's personality. One of the most important point must be regarded reaching to the personalized process is LMS. It means regarding each user characteristic and requirement, LMS have to be adapted. The system is the solution for traditional problem that is "single pattern for all" and suggests similar learning content to all.

2. Related Works

In recent years, electronic learning because of its nature has distributed uniquely and improved learning system and overwhelming time, place, social and political barriers has developed new conditions of learning. In other words, multimedia application, simulating and communicating tools has provided distant individual learning conditions. Synchronous and asynchronous learning are two common methods that today use in electronic learning. Learning virtual classes are samples of Synchronous e-learning while learning based on self-study web is sample of asynchronous e-learning [6].

Based on Gild research in 2006, electronic learning compared with learner's priorities and requirements has concentrated more on designing and structure of learning content. It means, learning content quality improvement has priority in proportion to the other goals. The second priority is the extension of global accessibility to the electronic content without regarding geographical borders' limitations. Although, a lot of work has been done about content management system, Chen and Chio argue that electronic learning systems are lack of appropriate learning content, interaction and participation feeling yet and learning problems are identified and removed difficultly [7]. Developing personalization processes by decision support systems is the mentioned issue solution. Traditional personalization approaches had contained two techniques based on content and user. The recommendation related to the former was based on content similarity with users personal characters, however the later concentrated on similarities with other users [8].

Internationally, there are personalized learning systems with compounding some techniques such as intelligent agent, data mining, expert systems and recommender systems, make the LMS base on users and fulfill their different requirements. As an example, Zorrilla et. al, describe a decision making system that contribute electronic learning teachers to know their students and how they work, how they use electronic courses and what is their problem. Thereby teachers are able to react the problem as soon as possible. e.g. suggest new activities, add new data, reorganize web content or develop discussion. Moreover, teachers are able to suggest some questions about student's favorites and improve learning process by data mining techniques and analyzing the data [9].

In other research, Abdol Rahim Ahmad et. al, suggest an adaptive user interfaces based on priorities, user

implicit and explicit favorites, restrictions, cognitive progress, decision making methods, learning goals and accessibility models. Their mean of adaptive is changing in the way of displaying navigation options and learning strategies and structures based on user's requirements. One thing that is noticed in Adaptive User Interfaces is output adaptability according to each user perception and favorites that take place by adaptive and dynamic interaction. In other words, an Adaptive User Interfaces changes dynamically in response to users requirements according to achieved experiences [10].

3. Current Condition of Learning Management System of Electronic College, Shiraz

In the learning systems, considering expenses and resources consuming, the time devoted by teachers and managers is very valuable. Moreover, increasing students' numbers rather than teachers caused decreasing in time devoted to each student and many teachers can't follow their students learning progress there for it leads to interactional problems. Generally, there are three interaction types, system-user, students-students, and students-teachers in electronic learning environment. Lack of attention to users' individual differences caused some problems in these interactions. As it mentioned before, one important point contributes improving users interaction is personalizing LMS based on users' differences. Thereby, revising LMS using in 2012 in electronic learning college of Shiraz university, we decided by modern technologies specially supporter decision tools improve users' interactions and personalize the system for different users with use of techniques such as intelligent agents, data mining, experts systems and recommender systems. In this research, with use of system analyzing and interview with some learners, their interactive problems identified the all three types. In the system the presented content includes the current term lessons. It means each student observes list of lessons taken in the term in the private main page. Selecting each lesson, the lesson characteristics, exercises, educational calendar, individual projects, announcements, lesson contents, scores, notes and uploaded files by teachers will be observable. In communication with related teacher section some facilities are accessible such as forum, help, chat, virtual classes, video conference and project management. Some other important options designed in the main page like digital library that included all text books, messages box that is communicating tools between students and teachers and forum for student's interactions [11]. Following, three existent interactions in the current condition of the system investigated and we are trying to improve the interactions with use of supporter decision tools.

3.1. The current scenario for using digital library in order to access reference

Each student has some courses in each term and the related text books exist in the college digital library. The student should enter to LMS then digital library and select his major then download his required files; So that,

depends on which page the intended reference is on, the student has to search it page by page. The reference may be, hold in common with other majors and it makes the user search other majors references too. If the user looks for certain subject in a text book, he has to download all PDFs one by one and searching all of them finds the intended subject. In case, the student would like to observe the other thesis related to some intended subjects it's required to search extensively the subjects. the other way to accessing the references in the system is using of advanced search by key words; the user may reach to his intended result quickly or may not reach to intended content at all, depends on the subject and user's skills. Therefore as you see, accessing intended reference is time consuming for each student. On the other hand, the existent text books don't vary for each lesson and the all text books presented only in PDF form; so if a student looks for Audio or video files or slides even, the library can't fulfill the requirements [11].

3.2. The Current Scenario for Students' Interaction with each other

Because of electronic learning in collage, there's less opportunity for students to interaction and they don't know each other as much as necessary. Moreover many professors hand their projects over to their students that require extensive interactions; it means students should choose the group members and work on common subject together. for this purpose it's necessary to group members know each other proportionally such as educational condition, former experience, team working character, being responsible, favorite fields; While in the current LMS, the forum is the only communicative tool among students and regarding existent limitation it's not useful actually and students look for the other communicative ways[11].

3.3. The Current Scenario for Students' Evaluation

In order to have a dynamic learning system, evaluating students is necessary and learning process should follow regarding their learning quality. In the current system the only evaluating tool are some exercises that some teachers upload in each lesson page and the student are supposed to answer them in a limited time. The student final score usually is sum total of final exam score, midterm score, projects and exercise scores (if any). Therefore the student learning doesn't affect teachers' method of teaching; and sometimes they have no idea about the students learning situation during the term; and there's no possibility for student evaluate themselves before the end of the term [11].

4. The Proposed Methods

Generally, by extracting students' personality, favorites, requirements, interaction type to the system and other user characteristics the electronic learning and LMS specifically, can be personalized. The recognition styles are able to personalize are the key factor in learning systems based on the Hyper media in a way that for different user's habits there are different appropriate

processing information and it's suggesting individual models for different perception and memorizing and solving problem for each user [12]. Our recommended model for personalization is based on Simon decision making model that has three phases. The first phase called intelligence; it's necessary to identify the problem and gathered required data. In the next phase called design the possible solutions is sought and after advancing criteria finally different models designed for the problem. The third phase is making decision that is take place by analyzing models based on achieved criteria [13]. In the following the relation of decision support system's tools associated with each of these phases are investigated and existent solutions for personalization are described.

4.1. Data Mining

Data mining are used as an important technology in computer based learning system usage analyzing, recommended to interaction with learning content specifically. In this method base on gathered data about user interaction with learning environment, by investigating about patterns and learners personalities in using web and association rules using to discover relations between learning content and learners' efficiency an appropriate learning content for each user can be recommended. In other words this technique can contribute in intelligence phase of Simon's model very much. With using of data mining and exploring users' behavior patterns, the students have similar behavior belong to the same cluster and in this way appropriate feedbacks are provided for teachers and suggested learning recommends to students [14].

Moreover, in electronic learning environments a data mining type is called web mining used and contributes to learners in experience improvement and to teachers in developing the better learning processes. In web mining, the data related to users' behaviors includes the accessibility type, accessibility time, requisitions; requested recourse is saved in database and analyzed. In other words by Web Usage Mining method, rules and patterns are extracted from access logs. in this field" sessions "can be implied as a user interactive behavior reflecting during a learning course. Generally a learner concentrates on one or two activities during a session. By viewpoint of classification the student's main purposes can be identified regarding his interaction with the system. For example an addresses collection lay in one class and each class is related to one type of interaction to system. If a learner spends remarkable time about a special activity it shows a special purpose. In this way, with each learner favorite's recognition and behavioral pattern extraction, the appropriate content and facility can be suggested. Definitely the web mining is limited to the activities done under control of web server so that the extra activities hasn't saved and can't be investigated [15].

4.2. Recommendation Systems

The recommender systems considered important in the middle of 1990s when the first article about collaborative filtering was presented. Generally recommendation systems are software tools and techniques that suggest usable items to users. These recommendations are related to all of decision making phases; thereby, some

researchers consider the recommendation systems a subset of decision support systems and define them information systems that can analyze the previous behaviors and recommend about the current issues. The systems use several recommendation techniques such as content-based filtering, collaborative filtering or knowledge-based filtering. Sometimes these techniques combine together and suggest compound recommendations to improve efficiency [16].

Collaborative filtering are the most well-known recommendation systems. They gather the rating and recommendations of objects; defines commonalities between users based on their rating and suggests new recommendations based on comparison among them. They suggest items well-proportioned to the users' priorities and tastes. The content-based recommendations use information about each user or item. They suggest similar items to users with the same priority. Sometimes it's impossible to reach to enough knowledge in order to define user priorities and giving them appropriate recommends. This issue causes specializing problem that the recommendations include too similar items that user already know them [17].

The knowledge based method is the third type of recommendation systems. This approach gathers knowledge about users and items and uses the knowledge for making recommendation. the recommendation systems

based on knowledge, doesn't develop long term generalizations for their users. But they prefer to offer some recommendations regarding user requirements and priorities adapt to existent items collections. The knowledge based recommendation systems can answer the questions that how the special items can fulfill the special requirement for each user. This technique can extract deep knowledge about the field and suggest the best solution using of knowledge based method, the relations between the users' requirement and recommended items can be model in a data base explicitly. These types of recommendation systems require knowledge engineering. Acquiring and gathering knowledge is an important issue in this method. The knowledge based system includes three knowledge types about users, items and about items and users requirements adaption. Thereby user's profile plays an important role [17].

For example, the designed system in Figure 1 contributes learning process improvement and learners gathering, processing and analyzing information through data mining and extracting association rules technologies and collaborating filtering. Using recommendation technologies is suggested for developing learning content system. It suggests some online learning activities or shortcuts in the web intelligently based on the previous students experiences to improve course content.

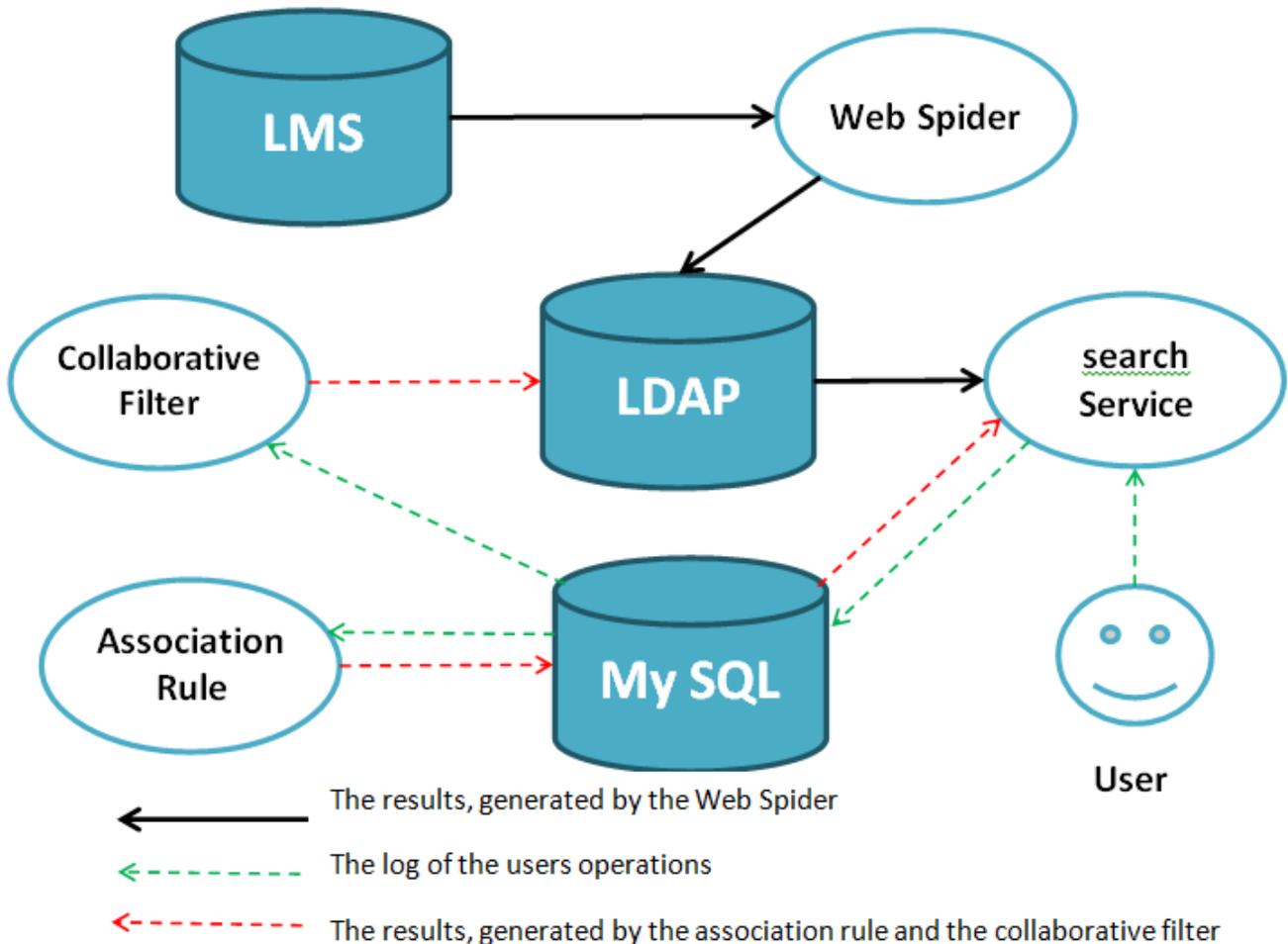


Figure 1. The data flow of the recommendation system [12]

The recommended system consists of three parts Recommendation server, web spider and LMS. Not only LMS provides and manages services and content, but also

registers URL content addresses in web spider. Web spider assesses and analyzes all contents in returning way by URLs and saves the results in LDAP server. This

program is feasible for all electronic learning contents that are accessible through HTTP protocol. As you see in Figure 2 when the teacher or content provider uploads learning material in LMS system, background processes saved in LMS, sends URL or loaded content rout to web

spider. Web spider has followed all linked documents of the course and analyzed them. There for when user requests a special content, it will be suggested a list of related contents.

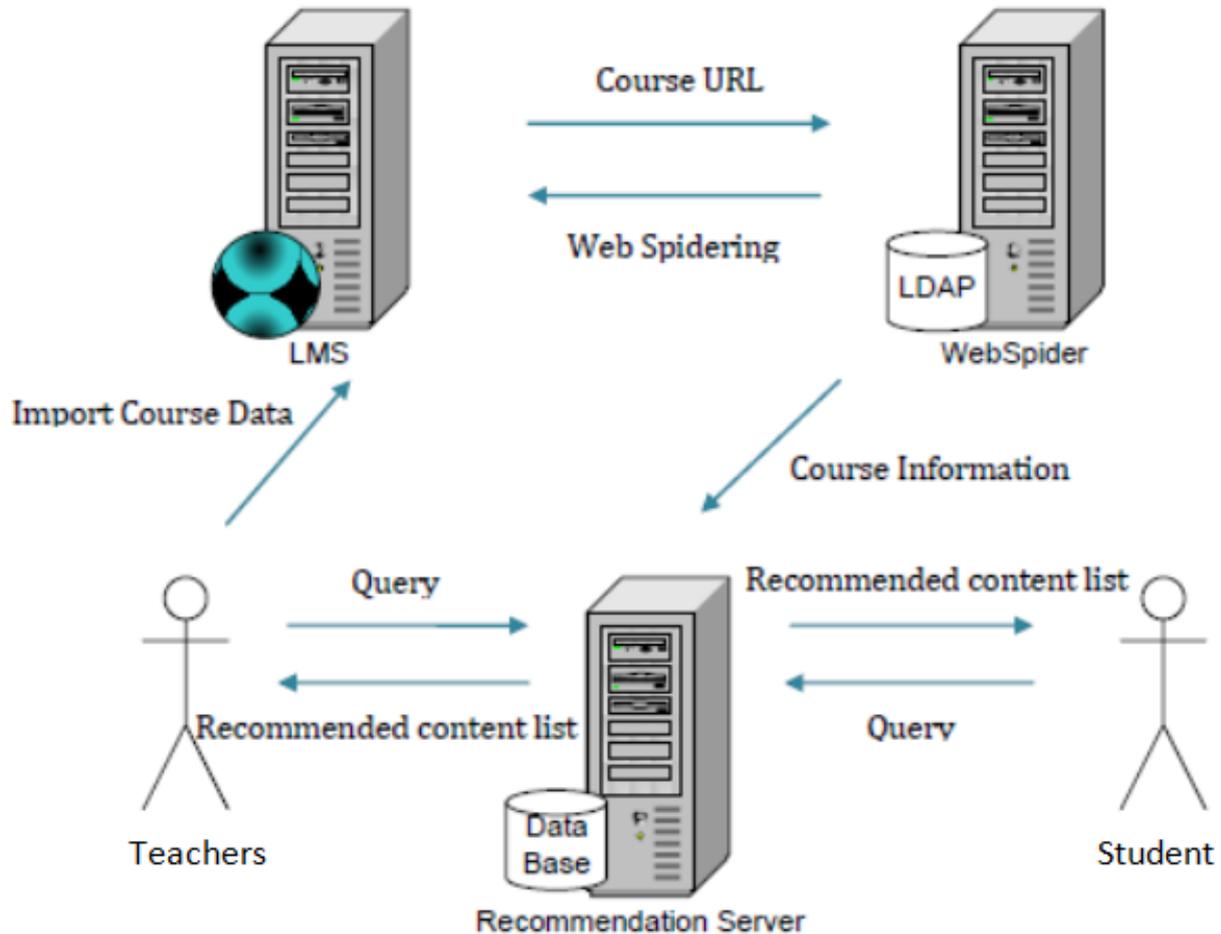


Figure 2. System architecture [12]

4.3. Intelligent Agents

One another recommended mechanism for personalizing can be intelligent agents. A computer program works independently in an environment to reach its purposes called intelligent agent. The intelligent agents used in much software in decision support process and identified as a main technique in electronic learning field. The agents use knowledge base and algorithms to do their tasks and; identifying various users' requirements through interaction with them they develop a profile or knowledge base for each learner. An intelligent agent is collection of purposes and has special abilities and a little knowledge about environment to develop and execute a program and to reach this purpose it should use its knowledge to reason environment and the other agents' behavior [18].

Using intelligent agents in electronic learning environment each learner are identified independently and provided special content and his progress is monitored. To use the intelligent agents it's recommended the intelligence, design and choice phases should pass as Simon model. In intelligence phase, decision makers gather some information about the situation and identify the problem. In other words the learners data gathered and

their profiles evaluated according to their personal information and priorities and their activities such as mouse action, learning duration on a particular task, test score, documents load/unload, etc. The design phase started with problematical situation assessing, the criteria developed and the solutions identified. Learning model developed and improved in design phase in order to determine and execute appropriate learning commitments. In choice phase regarding to the criteria the decision makers choose the best solution. Then the decision results and learning program revised to see how it executes. The previous process reflection can shape intelligence phase base in the future [4].

The follow Figure shows the internal interactions between agents and external interaction with learners and the agents' position in electronic learning environment. Personalizing achieve by collection of intelligent decision making agents that communicate with each through the internet. the agents works together autonomously and cooperatively in an multi agents environment, but each agent works concentrating on the defined task itself without external agents disturbance. As it mentioned intelligence phase includes a learner information collecting agent and two profiles agents.

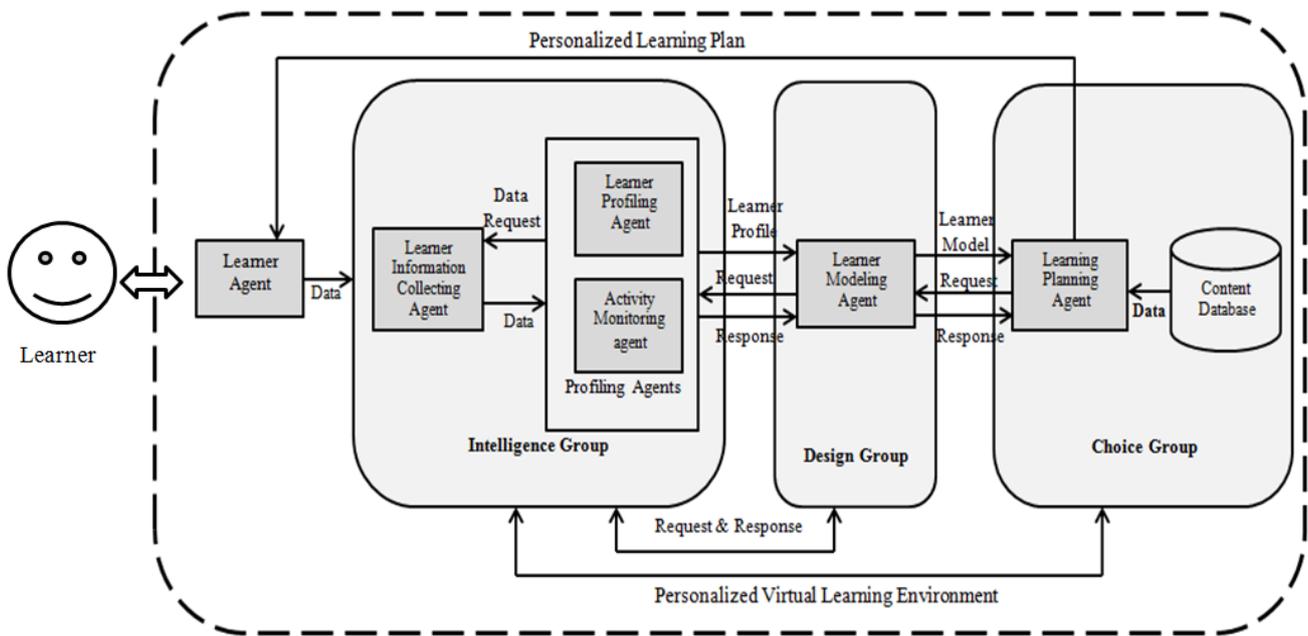


Figure 3. Intelligent Personalized Virtual Learning Environment Architecture [4]

Design and choice phases may need the intelligence phase information. The learner information collecting agent enables system to gather personal information, previous learning experiences and results by learner agent. Also register activities such as mouse movements, learning time period and exams scores. Learner profiling agent and activity monitoring agent are two kinds of profiling agents that applied for making and improving profiles. The Learner profiling agent assesses various partial information of learner and determines intelligence level, previous learning and learning preference of learners. The activity monitoring agent assess the learning time for each session, the exam results and exam spent time and in this way determines learner's learning path and knowledge level [4]. In next step, when the learner modeling agent receives learners information profile in designing phase, it starts learning modeling or improving. After this step the model automatically sent to learning planning agent in choice phase. The agent analyzes the current learning program regarding model and then update it. Finally the personalized learning plan is sent to learner agent. The agent provides personalized learning materials such as contents, exams, feedback for learners dynamically [4].

4.4. Expert System

The other approach that can be discussed is expert system. An expert system is a computer program that works in accordance with human expertise and based on knowledge and reasoning techniques and acts as an interactive system to response questions and recommend and contribute to decision making process generally. There for we can say an expert system is a decision maker, problems resolver and an analyzer and can use as a guidance in lack of experts. The system helps people in various decision making phases. Indeed, expert systems usage is rapidly increasing in learning environment to developing more interactive systems. One of its popular usages is information filtering agent for analyzing learner's web surfing habits and references. In this way the

requested information is separated from unrequested data exactly and leads to time saving and avoiding much amount of data. An expert system determines what data should be offered to learners [7].

One of the other important aspects in electronic learning is learners knowledge level evaluating and designing exams related to each learning course. In other words through evaluating learners' knowledge level and achieved feedbacks the appropriate content can be offered. In this case using expert systems will be profitable a lot. The system in making questions and exams in an organized method helps teachers and evaluated students and provides useful Statistics for teachers.

The following Figure shows a sample of expert system evaluating learners. The suggested system consists of 5 separated unit of Identification, student model, Tutoring unit, evaluation unit, virtual agent. At first applicants become members of the system through the identifying unit. At time of becoming membership some of personal settings saved then members can enter the system. The Student model consists of all information related to the students such as their priorities, favorites and their knowledge level and etc. in this structure with use of Stereotypes develop an initial profile to each student as the system can use that profile for adaptation. Tutoring unit is responsible for teaching process and each student can select a learning purpose from knowledge tree so that the correspondent content will be offered. In this way it's necessary to provide a tree structure about intended subject to teach. So that the root of tree can be the general topic, the branches are different parts of the topic and leaves are the intended concepts. The students use such classification and structure to their intended field and select appropriate concepts for learning. Thereby they enter learning pages that each page has its tests [19].

Students also can select an exam to evaluate themselves about everything they have already learned. After exam the system saved the score and if the achieved score isn't satisfying, restudying related subjects and some new exam about problematical parts will be recommended. The main purpose of evaluating unit is evaluating student progress

through his system interaction. On the other hand it helps the teacher to have the evaluation by exam results. Also the teacher can observe some statistical results related to concepts and some parts that students have taken exam. The system can provides statistical results from all students that have participated in a special exam. The expert system contributes making decision about students' knowledge level. The main purpose of the virtual agent is developing motivation and improving system efficiency; to reach this purpose, virtual agent takes information from student's Stereotypes and interacts with them as a human teacher [19].

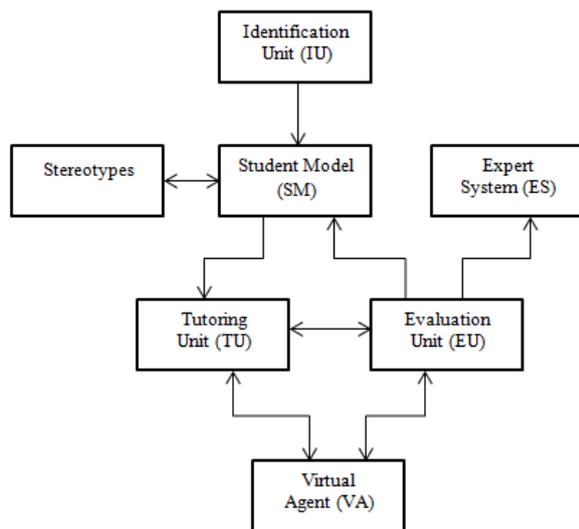


Figure 4. System Architecture of Personalized Learning System Based on Expert System [19]

5. The Improved Learning Management System of Electronic College of Shiraz University

As mentioned before the under discussion system is Shiraz university LMS, regarding the mentioned scenarios we realized there is no appropriate attention to learners differences and their data requirements. Based on suggested technologies, some improved scenarios recommended in follow.

5.1. The Improved Scenario for using Digital Library in order to Access References

In recommended model, student after entrance to LMS to access contents related to current course, it doesn't need to search digital library contents. In new approach the intelligent agents regarding to student's profile information, extract everyone content requirements in a way the student can download the references and thesis, text books in a tree structure chart. The tree structure updates new subjects automatically and displays new content of lessons specifically and reminds each learner. Moreover, it assesses behavioral students patterns and their activities data, offers their intended contents in an adaptive frame to their purpose and favorites. In other words it reserves the related text to the subject in different frame such as slide, PDF, DOC, audio or video files and recommend the appropriate frame to each student.

5.2. The improved scenario for students' interaction with each other

In this model students can see all registered in a lesson that this information can be extracted from their profiles. Each online user can be identified in the list and putting offline messages is possible. After learners knowing each other they commit to choose group members from the list. Also a recommender system can recommends appropriate group members regarding students favorites, the passed or current lessons, research fields, new findings, related recourse and the other student list have activities in the field. Moreover the teachers can observe the recommended groups lists of students.

5.3. The Improved Scenario for Students' Evaluation

In the improved situation at first the some theories about content is suggested then some example are offered and finally students are asked to answers some exercises. At the end each student can evaluate his knowledge level through some exams. The expert system contributes teachers in making questions and exams in a structured way, evaluates students and provides appropriate statistics and based on the evaluating gives some recommendations. For example based on the questions that students answer incorrectly, they are recommended to restudy those parts again. In this system teachers evaluate their teaching method and revise the parts students have problem in. In the system learning is more dynamic because everyone can evaluate learning quality and learning course efficiency and try to remove possible defections.

6. Conclusions

In order to personalizing learning management systems there are many approaches that we mentioned some of technologies related to decision support systems. Data mining, intelligent agents, recommendation systems and expert systems suggested as applicable and effective tools in personalizing process of learning management system and described each function.

But we emphasized more on the solutions about LMS improvement in electronic collage, Shiraz. In order to reach an effective learning, the existent problems and defects identified and regarding to the different users' needs we tried to offer a practical approach to remove them. We investigated the most important three problems of current system include how use of digital library, how the students interaction with each other and how evaluate students; and some approaches are suggested for each problem using discussed the technologies. It must be regarded that each suggested approach adds a special ability and increase the learning process efficiency. Of course the suggested approach adapted only to students requirements and it doesn't mention the teachers' requirements that can be the future research field.

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