E-learning: Current State of Art and Future Prospects

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Abstract

Adaptation of the E-learning system according to cognitive characteristics of the students is a relatively new direction of research on the conjunction of technical and pedagogical aspects. It is particularly important that the E-learning systems are able to integrate different paces of content and navigation in order to be able to respond to diverse needs of the students. The goal of this paper is to present the state of art in E-learning and thereafter to highlight some future aspects.

Keywords: *E-learning, Adaptive Learning, Personalized learning, User modeling, Intelligent tutoring system*

1. Introduction

E-learning has become an important part of our educational life. Different web-based Learning Management Systems (LMS) have been developed to support the learner in the learning process. Previous learning methods were restricted to access and assimilation of knowledge. A web-based system is a valuable support for face to-face communication as well as a way of transmitting the learning material to enhance the students own studies. The pedagogical techniques [4], which improves the learning efficiency and learner engagement in E-learning are creating and upgrading the course contents through good presentation styles, usage of themes and analogies in presenting certain key concepts, game based challenges in exercise, creating and management of customized course contents and disciplined use of a life cycle process for creating and upgrading the course.

Due to growth of E-learning in education and corporate training sector[7], interest in personalization of content delivery using multimedia for delivering E-learning, wider access to broadband, Wi-Fi and 3G mobile networks have derived the E-learning field towards the Ubiquitous learning.

User model [21] has important role in adaptive learning systems. User modeling is a modeling of the cognitive process of the human users and their skills and declarative knowledge. User modeling is used in adaptive hypermedia, web personalization and E-learning.

The entire contents in the paper are organized in following ways: Section 2 is discussing about adaptive learning approaches. Section 3 is for personalization methods and Section 4 for user modeling in an E-learning environment. Last section is discussing about conclusion and future aspects.

2. Adaptive Learning Approaches

Adaptive learning is an educational method which uses computer as interactive teaching devices. There are two forms of adaptation [21]:- Adaptive presentation and Adaptive navigation: Adaptive presentation refers the educational material display according to student's weaknesses, as indicated by their responses to questions which are based on educational material. Adaptive Navigation refers to manipulation of the links through link sorting, link hiding, disabling, removal, annotation, link generation, map adaptation and direct guidance. The various adaptive E-learning systems are:

2.1 Adaptation through intelligent tutoring systems

Intelligent tutoring system (ITS) [1] is training software which incorporates expert systems in order to monitor the performance of a learner and to personalize instruction on the basis of adaptation to learner's learning style, current knowledge level and appropriate teaching strategies in E-learning systems. Adaptive hypermedia. (AH) is another type of system which was also used in computer based instruction. After combining ITS and AH into adaptive intelligent tutoring system, the E-learning system becomes more adaptive. ITS assesses each learner's action within these interactive environment and develop a model of their knowledge, skills and expertise. ITS system is composed of three type of knowledge, organized into four separate modules for e.g. expert model, learner model, instructional model and interface model as shown in fig.1.

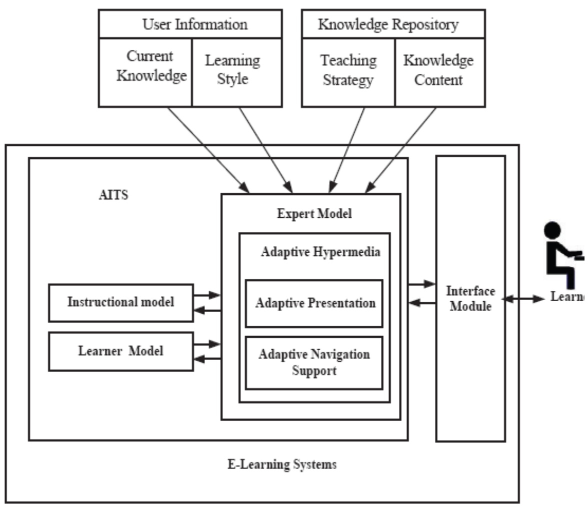

Fig. 1 Adaptive Intelligent Tutoring System [1]

Expert Model: The Expert Model is a computer representation of a domain expert's subject matter knowledge (declarative knowledge) and problem-solving ability (procedural knowledge). This knowledge enables the ITS to compare the learner's actions and selections with those of an expert in order to evaluate what he or she does and does not know.

Learner Model: Learner Model is a level of learner's knowledge while he/she interacts with the tutoring system. The model evaluates each learner's performance from his/her behavior during interacting with the tutoring system in order to determine his or her knowledge, perceptual abilities, and reasoning skills. The model generate evidence and uses inference to provide a number of relevant instructions to individual learner.

Instructional Model: Instructional Model contains knowledge for making decisions about instructional tactics. It relies on the diagnostic processes of the learner model for making decisions about what, when and how to present information to a leaner.

Interface Model: Interface Model is important for a communication medium and learning environment that can support learner in a task. It can also act as an external representation of the expert model and instructional model.

Adaptive hypermedia and intelligent tutoring system is used for E-learning systems to drive the connection and to personalize instruction on the basis of adaptation to learners learning style. ITS need to be designed and implemented to support modification of lecture content, the decision rules and the fact base of the expert model and the methods to measure performance of learning

2.2 Adaptation through Reflection

Adaptive hypermedia systems [2] are the system that uses a user model and a concept model with in the learning environment to decide the content and type of navigation present. Adaptive hypermedia combines with user modeling. A learner in an adaptive educational hypermedia system is given a presentation, adapted specifically to his/her knowledge for the subject and is suggested for a set of most relevant links to proceed further. To develop the adaptive system at the cognitive model requires a good taxonomy of learning styles to classify user, develop techniques in such a way that are adequate for the selected learning styles and implementation of the designed adaptation using suitable technologies on a computer.

In the selection of taxonomy of learning styles to classify the user, the user model has to be modeled with some parameters which can be determined by diagnosing the needs, interests, and difficulties of the user, and logically the system has to adapt accordingly. In order to get the classification of the user, some systems perform dynamic accommodations which analyze the individual behavior while interacting with the system in order to infer their learning style and accommodate to their needs.

Some systems use assessment tool to classify their learning styles. These tools can be questionnaires based on the different classifications of learning styles. In connection with the design of the adaptation, there are two different systems: Systems which uses learning styles to guide the design of the educational contents. They offer the users, the type of materials that are preferred by individuals classified in their specific learning style. Tangow, Inspire and Feijoo.net come under this category of systems. Other type of systems uses learning styles to guide the adaptation of the structure of the contents to the mental processes of each individual (particular styles of thinking, perceiving or remembering). AES-CS system is an example of this type of systems.

The standards are the instruments that give flexibility to the E-learning systems, in content as well as in structure. E-learning standards should also be used to support the pedagogical process. ADL (Advanced Distributed

Learning) SCORM is a set of specifications that apply to the development, packing, and delivery of educational materials and courses. IMS-LD adds new aspects related to communication and collaborative elements.

AJAX technology has been used to present and interact with the resources. AJAX relies on the reflection. When the software system runs them, the information in the Learning Object can be converted in run code through reflection. Reflection is defined as the capability of a computational system to reason about or act upon itself, adjusting itself to changing conditions. Reflection is also a mechanism that can facilitate the creation of rich interfaces and can also be used at the architectonic level to incorporate standards or guidelines of E-learning. This permits to achieve independence between representation and behavior. System with reflection is shown in fig. 2.

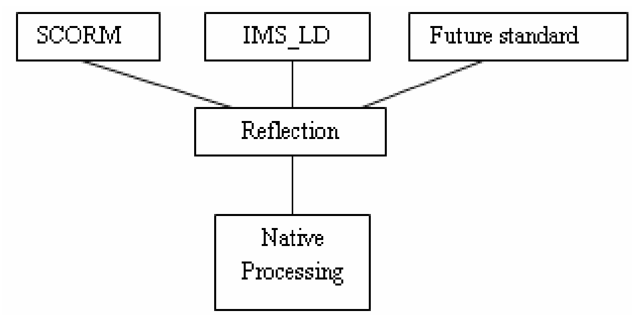

Fig. 2 System with Reflection [2]

The mechanism of reflection makes it possible to establish new forms for presenting and interacting with educational resources, and also facilitates the incorporation of new standards of E-learning in the educational systems, because it associates different representations to a one specific content.

2.3 Adaptation through fuzzy user modeling

Another approach is fuzzy user modeling [3] for an adaptive system which models the user knowledge (who the user is) and uses adaptation to adjust the method of teaching to the user (how to teach.). It also deals with uncertainty in the description of knowledge. It defines the adaptive system in three parts: user module, domain module, and adaptation module. To enable adaptation, the system has to be aware of the teaching domain, the individual users, and their knowledge; and has to monitor their learning progress.

Domain model, shown in fig. 3 are the entire teaching domain is represented as a finite set of domain concepts. Learning dependencies between these concepts can be represented by the ordered prerequisite relation R. When two domain concepts are related (Ci<Cj), the first concept (Ci) has to be known to understand the second one (Cj) or we can say that the concept Ci is a prerequisite of the concept Cj. These domain concepts forms an ordered acyclic graph described as $G_D = (C, R)$, where C is the set of domain concepts and R stands for prerequisite relation on the domain concept.

As the user model is an overlay over the domain model, the user knowledge is a subset of the domain knowledge. Then user knowledge of each domain concept can be described using a linguistic variable concept knowledge which takes three possible values: unknown, known and learned. The three fuzzy sets are represented with Cu, C_k, and C_l and their membership function with μ_u, μ_k, and μ_l respectively.

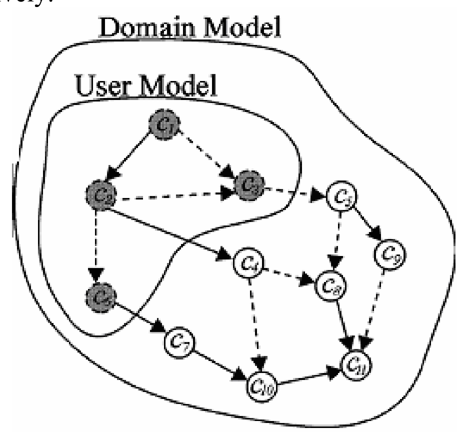

Fig.3 User Knowledge Representation in Concept Domain [3]

The three fuzzy sets of unknown, known, and learned concepts describe user knowledge of the domain concepts. User knowledge of a particular domain concept is therefore expressed by providing values of membership functions for the three fuzzy sets, which are described with a triple as follows.

$$(\mu_U(c), \mu_K(c), \mu_L(c)) \text{ or } (\mu_U, \mu_K, \mu_L) \qquad (1)$$

User knowledge representation can be associated with a graph as G^*_U which is a subgarph of domain concept graph:

$$G^*_U = (C, E, S, L) \qquad (2)$$

where, C is a set of domain concepts, E is an essential prerequisite relation on the domain concepts: defined as,

$$E = \left\{ \frac{\mu_E(Ci, C_j)}{(Ci, C_j)} \right\} \; Ci\; Cj \in C \qquad (3)$$

S is a supportive prerequisite relation on the domain concepts, and L is a set of labels, which is equal to the set of values of the linguistic variable concept knowledge.

To determine the knowledge of the user and updating, the user model is initialized using the results of a short pre-test. To update the user model, tests are used for checking how a particular concept is learned and a set of corresponding test question is provided for each learning unit. After the user passes the test on one domain concept, that concept becomes learned. If the test questions are not answered satisfactorily, the value of the variable concept knowledge does not change.

The main advantage of using fuzzy logic for user modeling is easier construction and updating of the model because of the use knowledge value propagation algorithm [3]. It also shows a positive influence of the adaptive system on user learning.

2.4 Adaptation based on learner profiling and learning resources

The majority of E-learning systems model the learner as an entity accompanied by a static predefined set of interests and options, without giving the appropriate attention to their needs [10].

Electronic questionnaires, designed by field experts aim to detect the learner's ICT level and learning preferences in prior, during and after the learning process. Learners' preferences are utilized for personalization of the multimedia educational content offering and retrieval process, aiming at suitable content delivery through the integrated E-learning system. For more accurate and reliable profile extraction, a novel clustering algorithm is also implemented within the profiling procedure. Taking into consideration learners' answers to the above mentioned questionnaires, statistical information is calculated and evaluated.

The general architecture of learner profiling and learning resources systems includes three main components i.e. the first entity is the Learner or in most cases the Group of Learners. The second entity is formed by the Group of Experts, which contains teachers both from general or special education, experts in the E-learning field, computer engineers, IT managers, data and statistical analysts, and psychologists. The last entity is formed by the Server System, including all hardware and software systems.

Adaptation is based on the usage of electronic questionnaires (e-questionnaires) designed by a group of experts. Through the automatic analysis of the learners' responses to the questionnaires, all learners are assigned to different learner profiles. According to these profiles they are served with learning material that best matches their educational needs.

This type of system can be extend to connect between semantic and statistical information. Furthermore, utilization of a fuzzy relational knowledge representation model in the weight estimation process could also provide a new direction to the adaptation.

2.5 Adaptation through AI techniques

Adaptive E-learning according to the individual student skills through AI techniques [13] has embedded instructional design theories as well as learning and cognition theories into E-learning environment. Today, most learning concepts are available synchronously and asynchronously in different ways of representation. To pick the most appropriate for a specific course which empowers students learning as well as teacher's course preparation and delivery, a smart E-learning vision is used. This helps student in their cognitive goals, developing skills for self monitoring, problem comprehension and organizing knowledge. It also guides teacher to set their course objectives, understand the student's cognitive models and present the concepts accordingly.

The model of the smart learning shown in fig. 4, focuses on the student, the teacher and the material. An individual student model must be maintained and learning materials must be composed of small granular multimedia objects referred to as learning objects. Student models should be used for tailoring the teaching strategy and dynamically adapting it according to the student's ability and previous knowledge. However learning objects must be designed to suit the specific individual student which must be drawn from learning object repositories. Learning object repositories (LOR) are specified using standard metadata formats, such as SCORM and IEEE LOM.

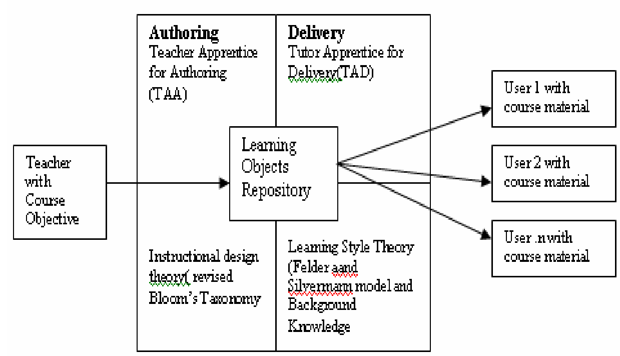

Fig.4 Smart E-learning environment.[13]

Smart E-learning can be achieved through extra attribute in the LO metadata standards which is required to support the concept of student model or the dimension of the learning styles. Smart E-learning environment is composed of two processes: teacher apprentice for authoring (TAA) and tutor apprentice for delivery (TAD). Bloom's instructional design theory is used to adjust the course objectives and organize course materials where as Felder and Silverman learning style theory is used for adapting course delivery according to each individual student model. Hypermedia domain ontology incorporates all the six level of bloom's taxonomy.

The extra attribute which is used to classify the learning objects (LO) in two categories are expositional and assessment objects. The learning object (LO) specify according to remembering level, understanding level and applying level. Remembering level consists of introduction, overview, definition, fact, remark, and remembering example. Understanding level consists of explanation, description, illustration, comparison, summary, conclusion, and understanding example. Applying level consist of theory, rule, procedure, algorithm, exercise, case study, real world problem and applying example. Teaching strategy is another attribute which is used for expository or inquisitor presentations. Last attribute is the instructional role, who's suggested values satisfy the effective strategies supporting the first three levels of revised bloom's levels. Smart E-learning learning object (LO) supports Felder and Silverman model.

AI techniques in E-learning promote learning from fourth to fifth generation, which employ the theories from cognition, education, and learning.

3. Personalized Learning

Personalized learning is the tailoring of pedagogy, curriculum and learning support to meet the needs and aspirations of individual learners. Data personalization [22] is to facilitate the expression of the need of a particular user to enable him to obtain relevant information when he accesses an information system. The data describing the user's interests and preference is often gathered in the form of profile. One can identify business and /or ordinary customers, and monitors their behavioural profile over different providers through intelligent techniques [23]. Personalization [24] can also be achieved through navigate the documents of data sources, so that content is extracted from the Learning object repository. Following are the few methods of personalization.

3.1 Knowledge driven model for personalization

E-learning solutions should be more than just a collection of technological solutions. Apart from sophisticated, stylish multimedia delivery, it should focus on enhancing the learning and intellectual interaction at the cognitive, behavioral, and physiological levels.

Another impediment to the successful adoption of E-learning is the lack of learning personalization. The learner-centric aspect of E-learning is often neglected. All the learner has to do is to simply follow the prescribed paths through the whole courseware (dictated SME's subject matter experts) right from pre-assessment to post-assessment. Another problem is that most of the courses are offered within the time frame of an academic semester, without consideration of the learners preferred pace and expertise.

The future direction of E-learning is shifting from a content-oriented approach to a knowledge synthesis approach. Knowledge model [11] and concept map approach are used to enrich the learning experience by creating a platform to provide continuous dialogue between the learners and the knowledge resources. Concept maps are used as the graphical representations of knowledge to depict both the learning concepts and the salient relationships between them with a human oriented approach.

The learning continuum models decide the type of knowledge structures and relationships within which E-learning content resources can be held. The system has been designed by using a modified concept map approach to model aspects of tacit knowledge into either business or technical processes or procedures. Tacit knowledge is highly subjective in nature, as it is developed by an individual based on his cognitive and conceptual models of external processes. Tacit knowledge exists randomly in society and is related to the context of a specific problem.

The Tacit(T)-model is used to capture the sequential set of steps, that a subject matter expert (SME) would treat to accomplish a task or to make a decision. Given a particular situation, the actions within a procedure are done the same way each time. A process T-model, on the other hand, is used to capture the "tacit" flow of events (seen through the eyes of the SME) that describes how something works. From the T-model, important conceptual structures among the data sets that are identified are restructured and formalized through the use of formal concept analysis (FCA).

Formal Concept Analysis (FCA) is a method of data analysis, knowledge representation, and information management, based on mathematical theory. FCA's rich mathematical semantics are coupled with the modified concept map approach, and extend its application to Formal Concept Analysis (FCA) is a method of data analysis, knowledge representation, and information management, based on mathematical theory. FCA's rich mathematical semantics are coupled with the modified

concept map approach, and extend its application to E-learning.

Explicit knowledge is the knowledge that is objective in nature, easily expressed and shared. Explicit knowledge is modeled in the subject domain master map (M-map) which can be hyper linked to each knowledge node in the T-map. The M-map is formulated on the concept of learning dependency, which is defined as a dynamic cognitive and pedagogical centered approach for the mapping of a course structure. It is devised from the fundamental principles underlying both cognitivist and constructivist theorems that place utmost emphasis on the internal mental processes of the learner's mind and how it can be utilized to promote effective learning.

The essence of methodology lies in first extracting the tacit knowledge (usually part of the SMEs' accumulated learning process) into a subjective T-map, where the proximity and connectivity of concepts provide the structure for effective ways of searching and viewing learning resources. The manifest of the T-map (nodes and relationships) is used to enable a more systematic and scientific understanding and learning process. With the T-map and the M-map manifests, learning personalization can be executed using agent technologies. The former generates the exact learning paths that the learner must take to master a particular concept. The learning continuum is used as a form of knowledge modeling. Although learning is more accurately depicted by its progress from: signals → data → information → knowledge → wisdom.

Data resources are defined as a collection of raw representations of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, and processing by humans and computational methods.

Information resources are defined as a collection of data in which no explicit semantics is assigned. It acts on the primitive set of RAOs to derive a meaningful flow of messages that can be organized to describe a situation or condition.

Knowledge elicitation subsystem (KES) is used to design knowledge model subsystem, a highly interactive program for the acquisition, development, and synthesis of knowledge on a conceptual level. Learning personalization is realized by this subsystem. Knowledge constraint module, knowledge representation module, conceptual model, and deductive inference module constitute the knowledge structure subsystem. This subsystem supports the specification and application of knowledge structures made of graphs of nodes and links and a wide variety of other domain-specific nodes and link types.

The knowledge query subsystem consists of the query language definition module, query analysis module, and graphic elicitation module. While the Ontology module serves only at the knowledge resources level in the learning continuum, the taxonomy structure and taxonomy view form the conceptual framework for organizing and structuring all the content in the knowledge system.

A concept map approach is adopted to visualize knowledge representation, as well as to illustrate how the personalization of learning can be achieved. The methodology on how to convert knowledge into learning resources is fully defined and modeled in a learning continuum. It also describes implementing knowledge management techniques to E-learning.

3.2 E-learning scenarios using two complementary personalization levels

Personalization in an E-learning system can be achieved through two levels of personalization. Level 1 allows the personalization of learning contents and structure of the course according to a given personalization strategy and level 2 defines the personalization strategy. Teacher has to choose and apply the personalization strategy [18] which matches the learner's characteristics and the specifics of the courses.

There are 16 personalization parameters of E-learning scenarios such as: Information seeking task, learner's level of knowledge, learning goals, language preference, kolb learning cycle, honey-mumford, Felder-Silverman learning style, La Garanderie learning style, participation balance, progress on task, waiting for feedback, motivation level, navigation preference, cognitive traits and pedagogical approach. Most of the systems use the personalization parameter i.e. learner's level of knowledge. This personalization parameter uses the linguistics values such as beginner, intermediate and advanced. The E-learning personalization level-2 allows teachers to specify the personalization strategy in two steps. First, the teacher selects a subset of personalization parameters for given courses and then, he combines the selected personalization parameters and decides how the learning material can be composed with respect to each possible value of the personalization parameters. The combination defined by the teacher is used by ELP1 to provide personalized courses.

Table1: Examples of values for the personalization[18]

Personalization Parameter	Set of Values
Information seeking task	{Learning the structure of SDP-TA, project planning, reverse engineering, following an activity}
Learner's level of knowledge	{Beginner, intermediate, advanced }
Learning goals	{Knowledge, Comprehension, Application }
Media preference	{Video, sound, simulation, text, image }
Language preference	{English, German }
Kolb learning cycle	{Converger, Diverger, Assimilator, Accommodator }
Honey-Mumford learning style	{Activist, reflector, theorist, pragmatist}
Felder- Silverman learning style	{sensing, intuiting }*{visual, verbal}* {active, reflective},* {sequential, global}
La Garanderie learning style	{Competitive, cooperative, access on the avoidance, participative, dependant, independent }
Participation balance	{Too much, not enough, acceptable}
Progress on task	{ small, large }
Waiting for feedback	{Significant, medium, low}
Motivation level	{Low, moderate, high}
Navigation Preference	{breadth-first, depth first }
Cognitive traits	{ low working memory capacity, high working memory capacity} * { low inductive reasoning ability, high inductive reasoning ability } * { low information processing speed, high information processing speed} * { low associative learning skill, high associative learning skill }
Pedagogical approach	{ objectivist, competencies based, collaborative}

The main function of ELP1 is the application of the personalization strategies specified with ELP2. If two learners have different level of knowledge, one being beginner and the other one having already prior knowledge, they receive different presentation of learning scenarios. In this case, for the learner who is beginner, more detailed content is presented than for the advanced learner. This has been measured on the personalization parameter learner's level of knowledge. When the subset contains more than one personalization parameters, these parameters have to be combined.

The main advantages of ELP1 + ELP2 include the ability of teachers to select the most suitable personalization parameters for their learning scenarios and the possibility of applying more than one personalization parameter according to the specifics of the learning scenarios.

The Two approaches for personalization of learning scenarios based on two levels works as: The first level allows the personalization of learning scenarios according to a predefined personalization strategy and the second level allows teachers to select personalization parameters and combine them flexibly to define different personalization strategies according to the specifics of courses.

4. User Modeling

User modeling is a modeling of the cognitive process of the human users and their skills and declarative knowledge. User modeling is used in adaptive hypermedia, web personalization and E-learning. Here are the numerous ways to model the user.

4.1 Ontology based user Knowledge requirement acquisition from behaviors in E-learning

Two approaches have been used for the user modeling. The first approach is based on the historical data accumulated by an interactive question-answering process and the second approach is based on user's reading behavior logs in the process of reading e-documents. Knowledge requirement of the user [15] can be captured through Q/A process. The course ontology is used to generate the corresponding board structure to hold relevant questions. Users can exchange their knowledge by posting their questions on the related boards, or browsing to find the most interesting or favourite questions to answer. The E-learning system can record all the historical data for each user during the Q/A process, including the browsing records, questions and answers. Another approach to capture the knowledge requirement of users is by analysing their reading behaviours in the reading process. The reading behaviours include actions such as underline, highlight, circle, annotation and bookmark. A behaviour table is used to record the behaviour. A behaviour matrix and weight matrix are used to obtain the relative quantity for each topic, which can be used to calculate the knowledge requirement of each user about the course ontology.

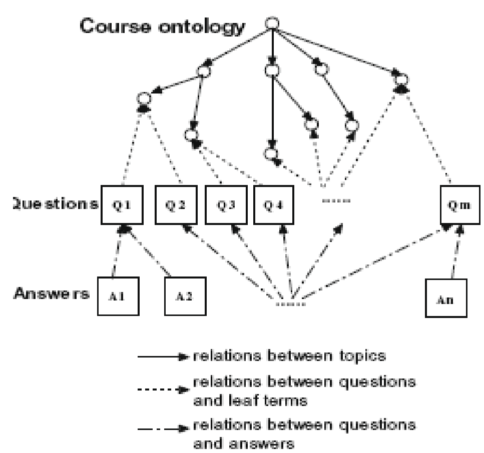

Fig.5 Sketch Map of an association space [15]

Course ontology can be defined as a directed graph in which term can be the title of a chapter and a section in the course, or the key concept of the course content shown in fig.5. It is defined by the instructor. Next the board structure is generated according to the course ontology topics to accumulate the interactive question and answers. For a single question, many answers can be generated. Then Q/A space can be constructed space in which each user posted and answered questions on the corresponding boards. After that the knowledge requirement is computed for each user on the basis of each question in the Q/A space, each term in the course ontology and the course content.

To compute the knowledge requirement of each user about the course ontology from reading behavior logs, the e-documents are classified according to read by user based on the course ontology. Reading behavior data for each user includes actions like the number of underlines (UDL), the number of highlights (HLT), the number of circles (CIR), the number of annotations (ANT) and the number of bookmarks (BMK), are store them in two dimensional tables. On the basis of this data weight matrix is constructed for each user. Likewise a behavior of each user with respect to every document is calculated.

As a result both the approaches used for user modeling lead to reflect user's real knowledge requirements accurately. Evaluative and Adaptive paradigms can make the system more flexible.

4.2 Automatic detection of learning styles

Automatic learner modeling [16] is differing based on the attributes used previously. In automatic learner modeling approach, the learner interest is collected explicitly using generic queries. Then, the learners profile is constructed using a conversion based on keyword mapping. The learner model is built by processing the learner profile over a clustering unit and then using a decision unit. There are different techniques used in learning modeling such as rule based methods, a fuzzy logic, case based reasoning, Bayesian networks, belief networks and decision trees.

Felder and Silverman learning style model (FSLSM) is used for detection of learning style of user. FSLSM has following four dimensions to distinguish between preferences of the learner, where each dimension has two scales.
Learners perceive information either by sensing via physical sensations, obvious facts or by intuition via theoretical (Sensing/Intuitive).
Learners like learning either using visual materials, illustrations or using verbal material like listening or narrative texts (Visual/Verbal).
Learners learn either actively via experiments or with collaboration or reflective by themselves, and without trying things (Active/ Reflective).
Learners get the concept either sequentially by following step by step or globally by starting from the overall picture of the concept and then going into details (Sequential/Global).

Automatic learner modeling shown in fig.6 has three parts namely conversion unit, clustering unit, and decision unit. Learner first submits the query for the topic he/she is interested in. Then using the conversion unit a profile table is generated. The profile table consists of four columns corresponding to attributes, i.e. the metadata names. The conversion unit is domain specific and composed of three stages: (1) domain-specific keyword finder, (2) keywords-to-attribute value mapper, and (3) learner profile table construction. The attributes of learner profile are row dependent. The aim of the clustering unit is to assign labels to each row of the learner profile table using the dimensions of the FSLSM. The clustering is done based on the predetermined classes obtained by NBTree classification in conjunction with binary relevance classifier from a trained data set. Decision is based on four dimensions of the learning style, where each dimension represents learner's most dominant characteristics for that dimension.

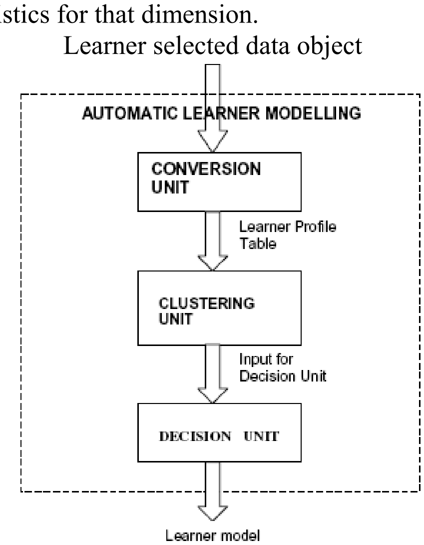

Fig.6.Automatic learner model [16]

Learner models can be extracted based on Felder–Silverman learning style model personality which consider the learning styles, behavioral factors like user's browsing history and knowledge factors like user's prior knowledge. The learner's are classified based on their interests by using NBTree classification algorithm in conjunction with binary relevance classifier. The keyword mapping part and profile table structure can be enhanced depending on the application area for a particular learner model.

4.3 Vector space models for user modeling

The user model [14] is one in which one collect a few specific facts about the person and then invoke knowledge about the groups to which the person belong. First user modeling system is the recommendation system. Another approach of user modeling is to use vector space models shown in fig.7, where an item is represented in an n-dimensional vector space. A student can be represented in an n- dimensional vector space as feature vector, where each feature corresponds to n individual concept associated with a given course.

A student's knowledge of the materials in the course can be represented as the feature vector, (knowledge_topic0; knowledge _ topic1; . . . ; knowledge _ topic n). The similarity between two users can be calculated by using the Euclidean distance between two points. K-means clustering or any other technique is used to maintain or update continuously based on new observations about the users.

For updating and maintaining the information in the stereotypes, the triggers attached to each stereotypes position within the hierarchy itself. In vector space models, the representation of individual user is adjusted when new information is reported or observed. Vector space models are easy to store in database tables. The database can be easily accessed, queried and manipulated using structured
query language statements and queries.

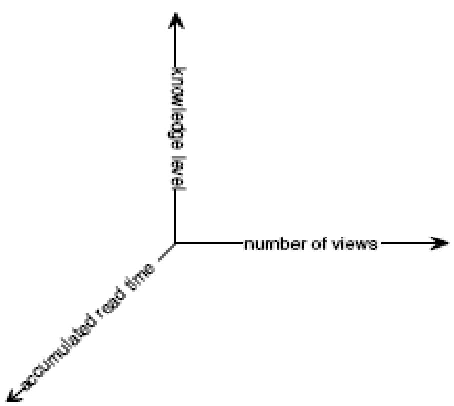

Fig. 7.User model attributes for each course item[14]

This user model has been implemented for the Moodle E-learning environment. Course items viewed, quiz and test attempts and scores, assignment submissions and results, updates and alterations to course items, times of log ins and log outs are used for every user interaction.

In each class of students a number of distinct student groups were identified to analyze the data retrieved by the user modeling component. The grouping system was developed by modeling each user as a vector model in an n- dimensional space and using a weighted n- dimensional Euclidean distance algorithm to calculate the distance between any two users. Vector space modeling is used to develop the student models in an E-learning system which enhances the effectiveness or usability of the software systems. New principles can be applied to the intelligent user interfaces, so that they provide repeatable and transparent interactions of the users with the system.

5. Conclusions

Now a day's offering E-learning courses are increasing at an unrestrainedly pace. However, the learning experience is often perceived by the user as a one-way highly constrained communication process, where the computer is only the mechanical device that conveys the content. Self regulated learning [19] help students to develop learning habits. In order to increase student's learning motivation and to develop practical skills, problem based learning is considered to be one of the most appropriate solution. The art of designing good E-learning systems is difficult and is of great challenge for the human mind. The way this is done is also dependent on the learning culture in each country. The key issue is to facilitate new learning modalities for younger generations. Future Investigating methods in an E-learning system are to support students with special needs such as super intelligent, retarded, etc. To develop that knowledge-.bases (ontologies and LORs) which are available automatically from instructor's submitted multimedia learning material

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