Individual Syllabus for Personalized Learner-Centric E-Courses in E-Learning and M-Learning

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***Abstract*—Most of e-learning and m-learning systems are course-centric. These systems provided services that concentrated on course material and pedagogical. They did not take into account varieties of student levels, skills, interests or preferences. This paper provides a design of an approach for personalized and self-adapted agent-based learning systems for enhancing e-learning and mobile learning (m-learning) services to be learner-centric. It presents a modeling of goals of different learners of a corporate training in computer courses in an educational institute. It figures how to customize and personalize learning paths (course syllabus) for e-learning and m-learning platforms. The delivering of e-courses become personalized learner-centric, which improves learning outcome, satisfaction of learners and enhances education.**

Keywords*—AI; Agent; education; e-Learning; m-Learning; Semantic Net

I. Introduction

E-learning is nowadays recognized as one of the efficient methods to respond to the requirements of open and distance learning. In the e-learning system, several traditional learning styles should be combined with the learner-centered approach. It needs a good notation to represent the requirements of the e-learning system [1].

In the dynamic changes information environment without prior modeling, it can independently plan complex operation steps to solve practical problems, can independently discover and obtain the available resources the learners needed and then provide the corresponding services under the circumstance that the learners do not take part in [2].

Intelligent agents are task-oriented software components that have the ability to act intelligently. They may contain more knowledge about the needs, preferences and pattern of the behaviors of a person or a process as in [3].

The agent has to collect users' personal interests and give fast response according to the pre-specified demands of users. The personal agent can discover users' personal interests voluntarily without bothering the users. It is very suitable for personalized e-learning by voluntarily recommending learning materials [4].

Intelligent agents should have the ability of adaptive reasoning. They must have the capability to access information from other sources or agents and perform actions leading to the completion of some task. Also, they must control over their internal state and behavior and work together to perform useful and complex tasks. Thus, they should be able to examine the external environment and the success of previous actions taken under similar conditions and adapt their actions [5].

Educators, using Web-based learning environments, are in desperate need for non-instructive and automatic ways to get objective feedback from learner in order to better follow the learning process and appraise the online course structure effectiveness. On the learner side, it would be very useful if the system could automatically guide the learner's activities and intelligently recommend online activities and resources that would favour and improve the learning. The automatic recommendation could be based on the instructor's intended sequence of navigation in the course material, or, more interestingly, based on navigation patterns, of other successful learners [6].

A large proportion of university students are now part of the millennial generation. Mobile technology is now an integral part of their everyday life. The most educational use of mobiles by university students are calculator usage, text messaging, and English dictionary. Having a mobile with multiple capabilities, long battery life and good network coverage are the most influential factors in the educational use of mobiles [7].

The proposed design will bring learner-centric tailoring of materials according to the interest and goal of the learner. In this system, each time, objectives of a learner are changed, his category(Class of learner) is updated. Then, a new individual syllabus is created for building of a tailored and personalized learner-centric e-course. Learner can access e-services, anytime, anywhere, from any PC, laptop, tablet computer, pocket PC or any GSM mobile phones.

Section II will navigate through systems of e-learning and m-learning and gives a comparisons between them, while section III, will describe the structure of multi agents and system semantic net knowledge base. Section IV will explain the process of building a centric a customized e-course, while, section V will navigate through the process of creating individual syllabus for a special e-course . Finally, section VI will give a system conclusion and predicted future work.

II. E-Learning and M-Learning Systems

A. e-Learning vs. m-Learning

E-learning emerges as a solution to conventional learning methods. It has turned out that the learning process can significantly be improved if the learning content is specifically adapted to individual learners' preferences, learning progress and needs. An agent in e-learning application is situated in the

learning environment and performs the pedagogical tasks autonomously [8].

Most of the traditional e-learning systems are not learner-centric, and they often ignore the diversity of learner population; thus very often their service is not able to directly or effectively match the learner's goal [9].

Since the students and teachers are on different time and spare in an e-learning environment, the learning status of a student is difficult to be controlled by teachers. In current learning platforms, they neither analyze the causes of learning inefficiency of users, nor generate new learning material and testing. The former keeps the learners from not using these learning systems anymore because they are confusing; the latter leads to out-of-date materials and the learners could not get any new knowledge[10].

Mobile learning as a kind of learning model allowing learners to obtain learning materials anywhere and anytime using mobile technologies and the Internet. It is necessary that the elements of mobile learning are organized correctly and the interactions between the various elements are combined in an efficient and optimum way so that the mobile learning is successful and the implementation is efficient [11].

On the other hand mobile learning decreases the restrictions of learning environments by creating more flexibility, focusing on mobile technology and the mobility of learning environment. Therefore, the mobile learning is always concerned for its availability to different learning materials. Meanwhile this kind of learning is completely interactive and pleasurable and it simply creates more effective and amusable learning. The mobile learning is a developed kind of electronic learning that in relation to the other kinds of electronic learning provides learners with more facility to access the learning contents. It is evident that the mobile learning brings a communicative and interactive property for users. M-Learning is a kind of e-learning through mobile devices. Mobile learning is a compound facility that includes two fields: the computer aided mobiles and the Electronic learning [12].

With the support of today's mobile technologies to e-learning within d-learning (distance learning) concept, the notion of m-learning provided technological progress in education [13]. Saadiah and et al made a comparison of learning paradigms in [14]. Part of this comparison is shown Table 1.

B. *Samples of e-Learning and m-Learning Systems*

There are too much work done in the field of e-learning and e-teaching based on agent. Gascuena and Fernadez-Caballeroe introduced in [15] an Agent-based Intelligent Tutoring System for enhancing E-Learning/E-Teaching, where agents monitor the progress of the students and propose new tasks. De Antonio presented in [16] an architecture of intelligent virtual environment based on agent technology. Also, a similar one for nurse training is offered in [17]. Tang offered the implementation of a multi-agent intelligent tutoring system for learning the programming languages [18]. According to Java Agent for distance education (JADE) frame work, Silveira and Vicari carried out their system Electrotutor which is Electrodynamics distance teaching environment [19].

TABLE I. COMPARISON OF LEARNING PARADIGMS.

Criteria	e-learning	m-learning
Concept	Learn at the right time	Learn at the right place and time
Permanency	Learners can lose their work.	Learners may lose their work. Changes in learning devices or learning in moving will interrupt learning activities
Accessibility	System access via computer network	System access via wireless networks
Immediacy	Learners cannot get information immediately	Learners get information immediately in fixed environments with specified mobile learning devices
Interactivity	Learners' interaction is limited	Learners can interact \with peers, teachers, and experts in specified learning environment
Context-Awareness	The system cannot sense the learner's environment	The system understands the learner's situation by accessing the database

ElSayed proposed in [20] a multi-agent system that could get learner profile knowledge at his logging to the e-course. Then system can help users and advises them in their on line learning. It advised learners for better navigation through e-course contents by offering some links or jumping over course resources.

El Bouhdidi and et al., proposed in [21] a model of E-Learning based on a process of coupling of ontologies and multi-agent systems for a synergy of their strengths. Indeed, this model allows human agents (students, teachers and instructional designers) to cooperate with software agents to automatically build courses guided by relevant learning objectives. In addition, it allows learner to follow his training at his own space and according to his preferences, either individually or jointly with others (students or tutors).

Nordin proposed in [22] a conceptual framework for mobile learning applications that provides systematic support for mobile lifelong learning experience design. It concerns four perspectives: generic mobile environment issues, learning contexts, learning experiences and learning objectives. The paper also explores crucial factors and design requirements for the mobile learning environment. It also suggests how mobile learning applications can be designed with an understanding of these factors and requirements and further applied to lifelong learning.

III. CENTRIC-LEARNING SYSTEM

A. *Multi-Agent in Cenric-Learning Sysetm*

The multi-agent systems (MAS) are a society organized, constituted by semi autonomous agents, which interact with others, aiming to resolve collaboratively some problems, or to achieve some individuals or collectives goals. The agents may be homogeneous or heterogeneous and have common goals or

not, but still maintain a degree of communication between them [23].

The proposed system is an upgrading of the system in [20] from learner advising task to adaptive and learner-centric task. This is done to reason with learner requests and wishes, and target. It includes new additional agents. Its agents, shown in Fig. 1, can be explained as follows :

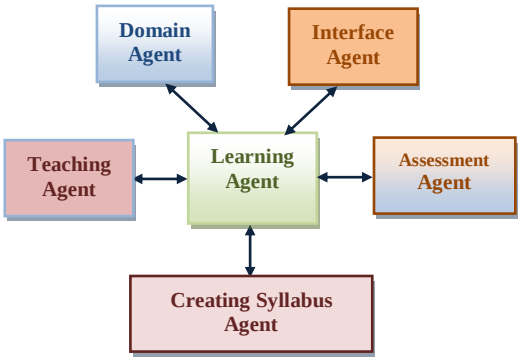

Fig. 1. Multi-Agent in the System

- Interface Agent (Iagent) is responsible of interaction with the learner to acquires his account personal information and profile knowledge. Then, it stores them in the learning profile Knowledge Database (KDB). Also, it consults the materials of tailored courses and assessments to the learner.
- *Learning Agent* (Lagent) is an important control agent, that is responsible of many tasks including managing the learning process. It controls all other agent in the system, initiate their work and collect their gains. Also, It Analyses profile knowledge of learners, and updates their profile record. As example, it receives assessment results from Aagent and evaluate learning efficiency of learner and update the learning KDB.
- Creating Syllabus Agent (CSagent) is the main player in the proposed system. It receives the profile knowledge of the learner and got materials and their pre-requisite, and finds out a classification for that learner. Finally, it generates a customized individual course syllabus relevant to learner classification.
- *Domain Agent* (Dagent) receives a learning path from Lagent and locates topics specified in the individual syllabus in the server of the educational institute. Finally, it creates a tailored individual e-course, customized for certain learner or a group (class) of learners.
- *Assessment Agent* (Aagent) which is an external agent system for creating an assessment (quiz or test) in [24]. It receives a request from Lagent to build an assessment to be conducted to the learner, under some conditions. This agent selects exercise or questions randomly to creates quizzes or tests with two level of difficulties for each topic(s) from the course material. It also grades the assessment and give the correct answers for each question.
- *Teaching Agent* (Tagent) retrieves the prerequisite of each topic or page in the course material page. It reviews if a course material is suitable to certain learner currently or not.

B. Object-Oriented Semantic Network

An object-oriented semantic net is designed to the proposed system. It include classes for Category of learner (class based on learner objectives), Case (represent a student to be classified), topic (main topics and sub topics), objective (main-objectives and sub-objective, syllabus (current learner syllabus, syllabus for Category, and syllabus for general courses). All of those classes are represented in nodes related to each other with links. Links represent relation between those classes as shown in Fig. 2.

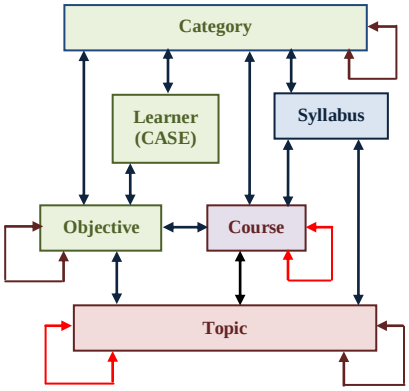

Fig. 2. Structure of Semantic Net of the System

Links are so important as usual in the semantic net. They might relate a node to itself (to represent a tree of objects related to that node from main topic to sub topic) as for category, objective, course, and topic. But topic class has another link with itself, to represent a link between certain topic and its prerequisite topic. Also, they can relate an object related to a node to another object from different node.

Training materials are prepared as isolated topics. Each topic is stored in a separate file, and has a class in the semantic net to store knowledge about it, as shown in Fig. 3.

Topic	Course	Perquisite Topic	Sub Objective	Question Bank

Fig. 3. Structures of Topic Class.

Each topic has its questions stored in a question bank to be used in assessment creations. Each topic has a sub objective, while each course has a main objective. All are consulted to learner o select his objectives from a list of objectives of all courses and topics in the server.

IV. Building Learner-Cenric E-Course

The suggested approach can automatically customize corporate training courses depending on learner objectives. It builds training courses with relative to knowledge level and skills (past), preferences (present), learning performance, and objectives (future). Fig. 4, presents the algorithm of building a personalized tailored e-course.

1. **READ learner Profile to get his objectives and skills.**
2. **IF the learner has a main objective**
   - **MOVE course name** of training course-of the same objective- **to variable CN.**
   - **FIND the Perquisite Course CNPRE.**
   - **CHECK learner profile,**
   - **IF learner finished CNPRE**
     MOVE the syllabus of CN course to the learner Syllabus
     ELSE MOVE the syllabus of CNPRE course to the Learner syllabus, GO to 6.
3. **ELSE GET all sub-objectives of the learner as attributes of a CASE.**
4. **IF there is a CLASS for CASE**
   - **MOVE syllabus of the CLASS to Learner Syllabus, GO to 6.**
5. **ELSE CALL CREATE Individual Syllabus**
6. **// creating tailored e-Course using the Individual Syllabus.**
   FOR each topic in the Syllabus table DO
   - **CONSULTE Topic pages to learner.**
   - **CONSULT an assessment in Topic Material to learner.**
   - **EVALUATE Learner Answers.**
   - **IF learner pass the assessment**
     UPDATE learner Profile,
     GO to next Topic in the Syllabus
   - **ELSE REPEATE Topic Again.**
7. **//After Navigating all topics in the Syllabus table**
   - **CONSULT an assessment in Course Material to learner.**
   - **EVALUTE Learner Answers.**
   - **IF learner pass the assessment**
     UPDATE learner Profile, Go to 1.

Fig. 4. Algorithm for tailoring an e-course

After the learner specified his objectives by selecting from consulted list, the system uses pre assessments to evaluate student knowledge before stating a new e-course. Also, at succeeding in assessment of an e-course, it evaluates learner by post an assessment. In both situations, it updates learner profile.

For each learner and similar (class of learner) there is a suitable learning path. The system classifies each learner according to his profile knowledge. It assigns him to a suitable class, if there is. If there is no suitable category, the approach will create new one. Class of learner is reviewed and updating after finishing any learning path and assessment evaluation.

V. Creating Individual Syllabus

When the system couldn't find a ready syllabus for the current learner, it calls an algorithm to create a new a tailored syllabus (customized learning path), specially for that learner. Fig. 5, present the entry structure of the requested individual syllabus table. While, Fig. 6, present the algorithm suggested for creating the individual syllabus for the current learner and next similar ones.

Topic Order	Topic Code	Perquisite Code

Fig. 5. Structure of Individual Syllabus Table

1. **FOR each sub-objective in learner objectives list DO**
   - **GET** topic(s) linked to objective.
   - **CREATE** new entry in the table of Individual Syllabus for each topic.
   - **INSERT** Topic Code (TC) and its Prerequisite Code (PC) in the new entry for each topic.
2. **FOR each entry(i) in the Syllabus table DO**
   - **READ** current PC_i from Syllabus entry.
   - **CHECK** learner profile for the prerequisite
   - **IF** learner didn't study the prerequisite
     a. **LOOK** up for an entry (j) in Syllabus table, where $TC_j = PC_i$.
     b. **IF** found, interchange the two entries (if $j > i$).
   - **ELSE**
     - **GET** new entry for the requested prerequisite Entry from the table of material topic.
     - **INSERT** the new entry in order i-1.
3. **CREATE** Category (CLASS) with the objectives of the current learner.
4. **UPDATE** semantic net links.
5. **RETURN with** the individual learner Syllabus.

Fig. 6. Algorithm for creating individual syllabus

VI. Conclusion

The presented paper provided a design for an approach used for personalized and learner-centric agent-base systems for enhancing e-learning and m-learning. The proposed system used to satisfy different wishes of learners of a corporate training in computer and English courses. It could customize and personalize learning paths by creating individual syllabus

for an e-course. It could build a tailored e-course for training in e-learning and m-learning platforms. The delivering of an e-courses became according to learner learner-centric, which improves learning outcome objectives, skills, and experience which resulted in satisfaction of learners and enhancing education. In future, this design will be improved to create more flexible individual syllabus that can be updated while learner is studying his special e-course, to meet his learning capabilities. Also, it will be upgraded to be applied over ubiquitous learning (u-learning) and using ubiquitous computing environment.

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