ULEARN: Personalized course Learning Objects based on Hybrid Recommendation approach

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ABSTRACT

Adaptive e-learning recommender system is observed one of the exciting research discipline in the education and teaching throughout the past few decades, since, the learning style is specific for each student In reality from the knowledge of his/ her learning style; matching teaching strategy with the most appropriate learning object is present to   better return on learner academic level. This work focuses on the design of a personalized e-learning environment based on hybrid recommender system based on collaborative filtering and item content filtering as well as architecture of ULEARN system.   ULEARN recommended adaptive teaching strategy by choosing and sequencing learning objects fitting with the learners' learning styles. The proposed system can be used to rearrange learning object priority that matches student adaptive profile and teaching strategy in order to improve the quality of learning.

Keywords
Course content, Recommender system, learning object, learner profile, teaching strategy.

1. INTRODUCTION
The popularity of e-learning has created huge amounts of educational resources. Hence, locating the suitable learning object that match students learning style as well as teaching strategies has become a big challenge. One way to address this challenge is the use of recommender systems. A recommender system is a tool that helps learner to rate course learning object from a large pool of items. Furthermore, to recommend quality learning materials, it is needed to devise a new approach that is not solely random recommendation of learning object within teaching strategies ,but one that takes into account the student's opinion as input for ranking learning object priority . Moreover, it is extremely difficult for a teacher to determine the best learning strategy for each learner and to apply it in a real classroom [1, 2]. One way to address this issue is to use recommender system (RS) techniques to personalize learning process according to the interests and goals of each learner.

However, the focus of recent efforts in research has been more on the recommender systems based on the learning content, neglecting the student's input. This work aims to fill that gap through incorporating learners' ratings in the content. Recommender systems can help e-learning by automatically recommending the most relevant learning resources to the learners according to their personalized preferences and profile. In this paper, we propose e-learning course content from the combination of two types of recommendation systems collaborative filtering teaching strategies that match personalized learner profile and content filtering learning objects recommendation based on learner ratting.

The originalities of proposed model ULEARN are twofold: (1) match student teaching strategy with the appropriate learning objects automatically taking into account the learners. (2) Hybrid recommendation is used for selecting from learning object repositories a list of the most appropriate learning objects and adapted to sequence that match adaptive student profile.

The remaining part of this paper is organized as follows. The existing work on e-learning recommender systems is presented in Section 2. Section 3 presents research background learning style, learning object and mapping teaching strategy with learning object .Section 4 presents Proposed model introduces the overall system architecture and describes the proposed method which includes the recommendation framework. The concluding are given in Section 5.

2. REALTED WORK
In this section, we give summarizes and compares e-learning recommendation approach as shown in table 1:

Table 1: The comparison of e-learning recommender approaches

Author	Recommend Approach	Learner's Context	Items Recommended
[3]	Content based recommendation	Good learners' average rating on the viewing learning object.	Recommend similar learning object to the Viewing item.
[4]	profile-based filtering recommendation	giving learners the possibility to add new materials and to rate them	adapt suitable sequencing learning content to learners
[5]	user-item- based recommendation	learners' average rating and analysis students' behavior	Recommend learning material based on difficultly level since the knowledge level of a user continuously

The over survey demonstrates that the major purpose of E-learning recommender systems is to deliver personalized course content in order to meet learner needs such as their learning style , preferences and knowledge level etc. In spite of the fact that CF [6] is one of the most popular recommendation algorithm [7]. Hybrid approach is getting popular in recent publications because it is improve e-learning recommendation accuracy [8].

3. BACKGROUND KNOWLEDGE
3.1 Learning Style
The learning style of the learner has been identified as an important factor that impacts the learning process. Learning style is the most significant parameter for personalization. Learners differ in the ways of perceiving, processing and receiving the information. Based on the means of processing and organizing the information, learners are considered to possess their own style of learning. Figure 1 shows five dimensions that relate to perception, process of information, Information input and understanding information. Currently, FSLSM is considered as the most stable and appropriate learning style model for adaptive hypermedia learning system [9]. According to this description, the ILS questionnaire proposes a list of items effective in identify the style of each learner. Each dimension has 11 questions and For each question 2 possible answers are available, the one with value +1, the other with value -1.

To assign a dimension to a learner [10], using the questionnaire of Felder-Silverman, it is sufficient to count the number of answers "a" and the number of answers "b" on the 11 questions corresponding to the dimension and calculate the difference between these two numbers. This measurement is between 11 (all the answers of the learner are equal to a) and -11 (all responses are equal to b). The learner may be close to the end (b) if he has obtained a negative number and vice versa. As an example, when answering a question with an visual preference, the learners score is incremented by +1 while for verbal preference the score is decreased by 1.
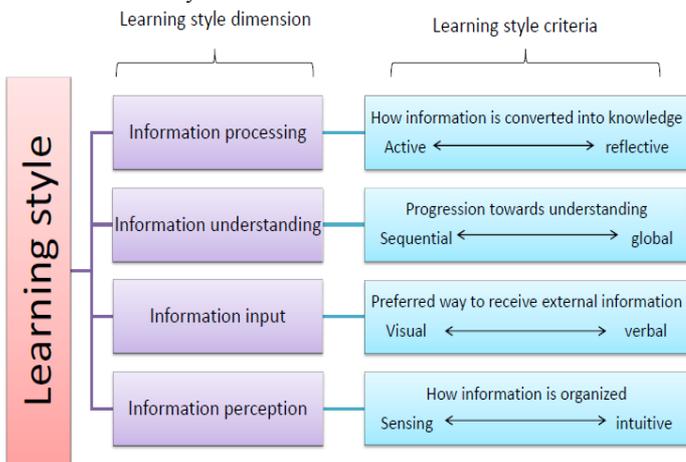

Figure 1 FSLSM learning style

3.2 Learning Object
Learning objects are a new way of thinking about learning content design, development and reuse. Instead of providing all of the material for an entire course or lecture, a learning object only seeks to provide material for a single lesson or lesson-topic within a larger course. Examples of learning objects include simulations, interactive data sets, exercises, assessments, annotated texts, and adaptive learning component. In general, learning objects have the following characteristics; self-contained, reusable, can be aggregated, tagged with metadata, just enough [11]. Learning objects can use many ways to express knowledge, such as text, video and audio etc.

International efforts have been made on developing standards and specifications about learning objects since late 1990's. IEEE Learning Technology Standards Committee, IMS Global Learning Consortium, Inc., and CanCore Initiative [12] are organizations active in this area. IEEE LOM Standard is a multipart standard, which is composed of Standard for Learning Object.

3.3 Mapping teaching strategies to learning objects
Teaching strategies (TS) are the essential element given to the students by the teachers to encourage a more profound understanding of the new information. Teaching strategies must be designed in a way that students are encouraged to observe, analyze and search for discover new knowledge by themselves. Teaching strategy refers to a composed and systematized activities sequence as well as resources that use while teaching. The main objective is to facilitate the students learning [13]. Table 2 shows a relationship between appropriate teaching strategy and material for each learner based on their adaptive profile [14]. For example Visual student the content must use visual representations, images must be used and the teacher can use Simulations and games in order to make it easier for the students to remember the contents. Learning objects displaying the Based on the recommended teaching strategies that match learner profile. Once the teaching strategies are obtained the Dynamic Learning Objects will be recommended) and the most appropriate electronic media.

Table 2. Mapping teaching strategies to learning objects

Teaching strategies	learning object
Games and simulations	Electronic Presentations, Videos , Animations
Learning based on problem solving	Forums
Role playing	Electronic Presentations, Digital Magazines, Digital Newspapers
Presentation	audio conference
Discussion panel	Forums ,Wikis ,E-mail
Brainstorming	Chats, blog, Forums
Case study	E-books
Question and answer method	Higher Order Thinking Questions Simplify the Question MCQ , Essay
Project design method	Internet research

4. Proposed Recommender Model (ULEARN)
ULEARN recommender system is to recommend useful and interesting learning resources to learners based on their preferences in e-learning context. The system was organized using three basic components: Learner Model, course content Model, learning object rating and adaptive engine. These four
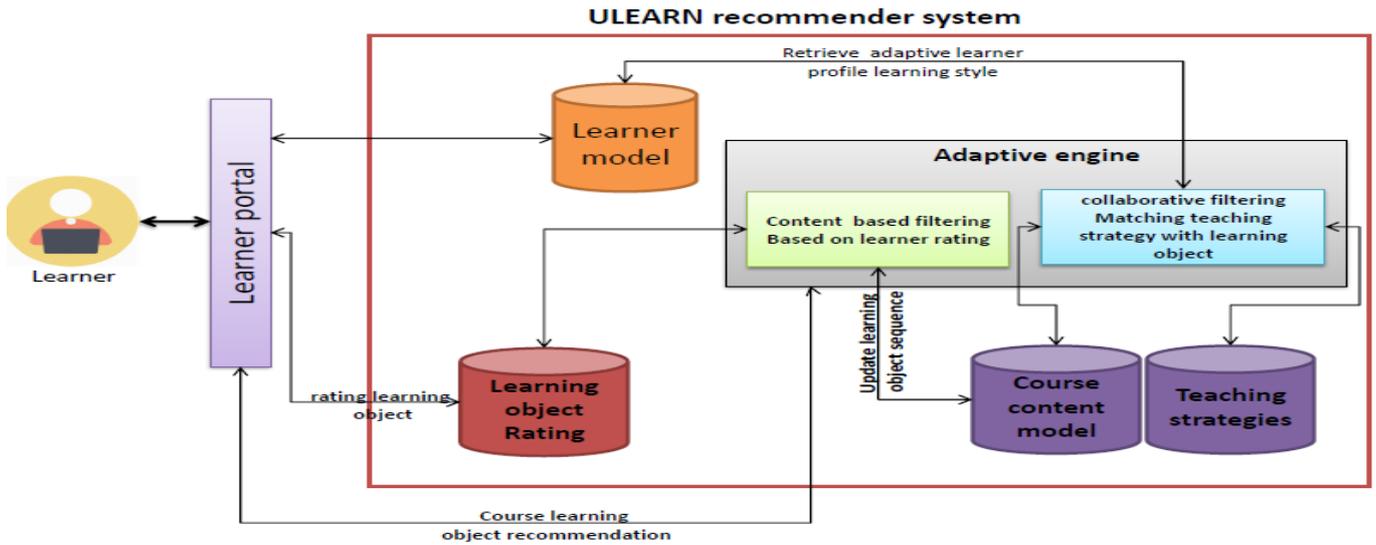
Figure 2 ULEARN recommender System

components interact to adapt with learner to achieve a relevant instructional process. Figure 2 illustrates ULEARN course content architecture. The following subsections will briefly explain the framework.

A. Learner Model

The profile is a generic term that organizes the learner in several categories. This is an individual characteristic that plays an important role in the success of learning. Learner profile of a learner describes how the learner learns best. It is practically the normal representational of Learner's data that can be gathered in two ways: from the student or by analyzing his behavior through a learning management system. First ULEARN initialized student profile based on FSLSM questionnaire after-that system start to update learner profile based on their behavior .For learner with (V,A,S,Seq) update their profile and generate course content based on their adaptive profile for learner with Information Input visual generated condition is visual etc. Figure 3 shows the structure of the learner's profile according to FSLSM model.
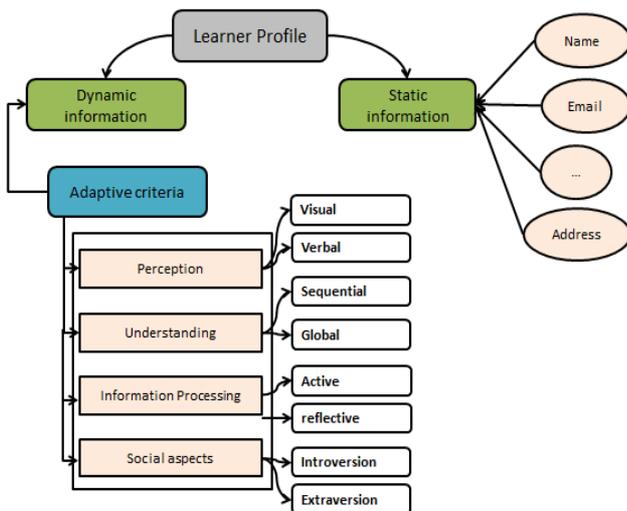

Figure 3 FSLSM learning style

B. Course content model

Course content model contains all the knowledge for a particular course. Course content model involves three layers, the first each course is divided on several topics, and each topic is presented by a set of Lessons. Finally each Lesson is associated with different learning objects as shown in figure 4.
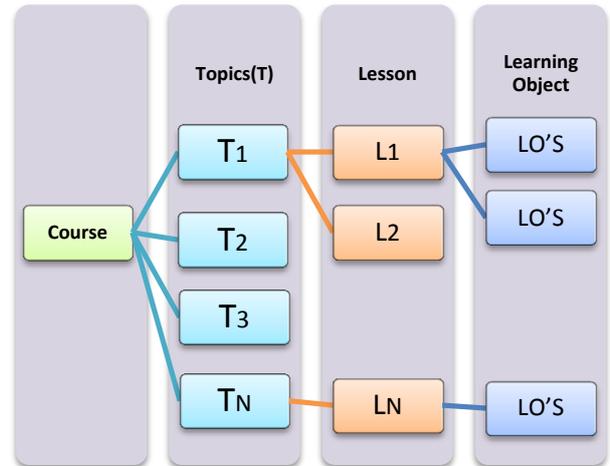

Figure 4 course organization

C. Learning object rating

Learning object recommendation sequence is based on learners rating. LO's sequence take into consideration the evaluation on the content i.e., the number of stars voted for this content, learner reputation and the number of likes and dislikes in order to evaluate the content.

$$\text{Rating LO} = \sum(L) + \sum(C)$$

Where $\sum(L)$ represents, the total number of evaluations of a learner and $\sum(C)$ represents the total number of evaluations of the contents of this learner. After weighting learning object as shown in table 2 , we obtained a preference model for each learner defined as a Learner-Learning Object Rating(RatingLO) matrix with L denotes the number of learners L ={L1, L2,….. Ln},and VC

columns denotes the number of learning objects $C = \{ C_1, C_2, ..., C_m \}$. After calculating learning the object rating adaptive engine start to take a weighted average of all the ratings on those learning objects . RatingLO : refers to learner vote for learning object satisfaction level .This evaluation is in the form of scale from zero stars to five stars as follows: Null = 0 , Poor = 1 ,Medium = 2 ,Good =3, Very good = 4 ,Excellent = 5

Table 2. Sample from learner rating

Learners	LO₁	LO₂	LO₃
Fatma	2	4	Unrated
Tom	1	3	5
Clara	3	5	2

Cleaning and Preprocessing

The data preprocessing is a recommender task for reducing the scale of the dataset a good way to enhance the quality of the recommend learning object. Imagine that we have 3 objects 1, 2 and 3. Suppose that we have simple one-dimensional ratings by users Fatma, Tom, and Clara as follows. We see that user Fatma did not rate "Object 3". One approach is to observe that on average "Object 3" rated based on learner Tom, and Clara, hence we can predict that Fatma will rate "Object 3"

We adopted this equation in e-learning content, in such way we can rate all learning objects by characterizing the score function S

$S(0) = 1/2 (E(0) + I(0))$

Where E (0) is the explicit score given by the learner for each learning object 0 and I is the implicit score that defined through time spent on each learning object.

$$I(\theta) = \frac{time\ spent}{total\ time}$$

D. Adaptive Engine

Adaptive Engine is the core inside the learning adaptation process the core of our proposed system. This is the decision body allowing associating the most suitable teaching techniques matching with learning objects based totally on learner's adaptive profile. The matching teaching strategy with learning object module helps to decide whether a given teaching approach is suitable for a particular learning style or no longer. This module uses the collaborative filtering to categories a teaching strategy as "suitable" or "not suitable" for the learner. Learning objects displaying the Based on the recommended teaching strategies that match learner profile. Once the teaching strategies are obtained the Dynamic Learning Objects will be recommended and the most appropriate electronic media.

5. ULEARN implementation

ULEARN recommender system has been implemented with java and SQL server. The main purpose of system is to recommend useful and personalized teaching strategies and learning object prepared based on learner preferences in e-learning context.

ULEARN has three main roles exist in the system:

1. Learners: they are attending the course and use the system in order to gain certain knowledge.
2. Instructor: add course lessons and learning object in different format as well as add assignments.

3. Administrator: assign learners and instructors to specific courses in addition to manage system database.

Therefore, proposed system includes separated user interfaces are provided based on their rule such as learners and Instructor. Instructor's interface helps in process of managing data about a learner and course material.

Organization of pages within ULEARN system Learner's portal is presented in Figure 5. Sequence of pages changes depending on whether the learner first entered the system or continuing his/her course.
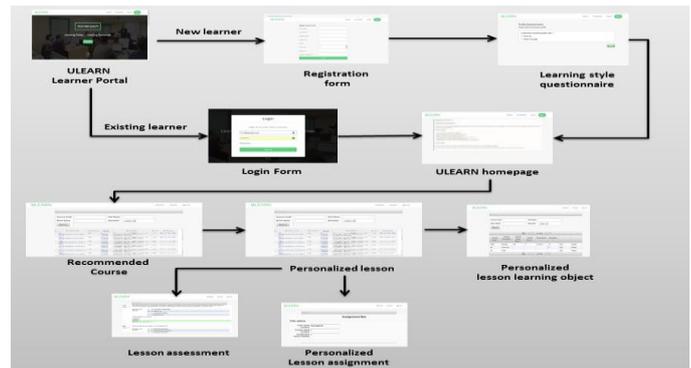

Figure 5 ULEARN map

6. Use-cases application scenario

The following user case study presented how teaching strategies and learning object will be recommended based on learner adaptive profile. For example Tom adaptive profile learning style is (visual, active, sensing and sequential) so the recommended teaching strategies are problem solving then personation and finally project design. according to problem solving teaching strategy learning objects will be recommend based on learning rating first system will start to recommend forum discussion ,after that video conference and then simulation as shown in the following figure 6.
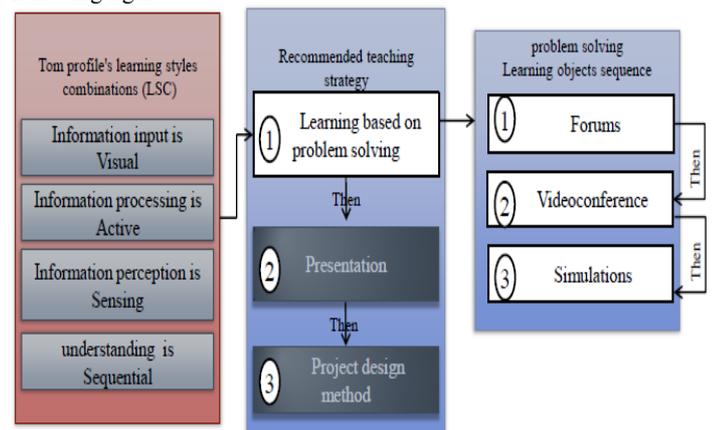

Figure 6 teaching strategies and learning objects recommendation scenario

7. Conclusion

In this paper, we presented ULEARN intelligent personalized course content Recommender system as for varying learning styles and teaching strategies. It recommends a method for mapping distinctive student styles with appropriate learning

objects and Teaching strategies. ULEARN support recommendation of LOs that best fit every particular understudy, considering the wide variety of understudies' profiles. The prototype (ULEARN) is currently under testing with several sets of learning materials. In future, we intend to experiment ULEARN on a large number of learners widespread use during a long period to test the viability of our proposed approach.

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