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A Social Web-Based Personalized Learning Environment: Proposing a PLE

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Abstract*: The nature of e-learning has been advanced in the manner of how it structures with the advance of Web 2.0 and 3.0. Contemporary educational hypermedia is slowly but surely providing personalised user experience. Research in technology-enhanced learning is now more student oriented, in other words it is as a personalised learning environment. But, according to the progress of projects which has been published, it has been said that personal learning environment is left as a theory and the field has been faded. In this paper we have proposed our model by providing learners with three learning object representation options. In which users will have options to get either up to date content or mostly advanced content first or according to their learning preferences. Domain and knowledge modeling features are also detailed. Finally, empirical results for the affect values of the model were presented.

***Keywords*: Personalized learning environment, technology - enhanced learning, e-learning, learning object, Web 2/3.0.**

I. INTRODUCTION

Since Web 2.0 was coined by 2004 [1] it is emerged to change the meaning of e-learning. More those tools spread widely, more technology-enhanced learning becomes available. Among them, the ability of delivering learning content to student in optimal way become possible. The content can be massive but the end user receives a personalized, relevant, meaningful and more student oriented material.

Advanced social learning features of e-learning has been evolved during Web 2.0 period and reached to extreme with the involvement of Web 3.0 technologies. The open educational resource (OER) initiatives and assembled users by generating contents collaboratively, have influenced the e-learning [2]. On the web-oriented learning object spectrum this term "OER" comes with overlapping synonyms, such as: wikies, user generated contents, micro lessons. However, there is insufficient empirical studies which address the way of representation and providing options for students to personalize their profile how they like to see the sequence of learning materials.

In this research we propose a personalized learning environment (PLE). In which there are three types of personalized representation of learning object and propose our model for social network based PLE system. It will be a social network based system. The system will be powered with pedagogical methods, a range of web 2.0 tools and use of recommendation approaches (collaborative filtering/deep learning). Use of aforementioned technologies [3] enhances to provide user with personalized content and improve student engagement.

II. BACKGROUND AND SIGNIFICANCE

A. Current works in PLE

We have reviewed the current works in PLE. According to our academic and practical background, the appropriate research direction would be, more generally technology-enhanced learning, more specifically making learning better with the help of web technologies. Rapid trend on technology is opening new opportunities to facilitate learning process better. Since Web introduced e-learning an ability idea "anytime, anywhere", it is improving from static content to dynamic, from synchronous to asynchronous data exchanging. Those trends in the field allowing to apply artificial intelligence to deliver data more relevant, web 2.0 tools to improve user interface and make data-flow asynchronously.

In order to grasp all current requirements, the e-learning environment should take in the following features into account:

blog based and API support [4], integration of web 2.0 and semantic web [5], Artificial Intelligence-Bayesian networks [6].

III. RELATED WORKS

The term of PLE was first coined by [7]. Researchers [8], [9] and [10] start to appear with providing further definition to new phenomenon. The literature mainly argues the PLE as a collection of tools available on physical and digital world (Fig.1). And a student who is using them they are fully, but sometimes partially responsible to manage their own learning flows. These debates give the idea that a PLE is not a single system or software, it does not integrate all features of PLE [11]. This belief hold it interest for a few years and caused to the field to fade [12].

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A. *Definition of terms*

Though its exact definition was not clearly made in many debates, yet a range of prototypes have already introduced. For instance, LePress [4] with exploring and providing sustains teacher control in PLE by using blog based method, SoLearn [5] facilitates its environment by implementing semantic web and building a social semantic system.

And there are even successful studies which used student-driven constructing of learning environments [13]. More than a decade PLE had attempted find its place in the field.

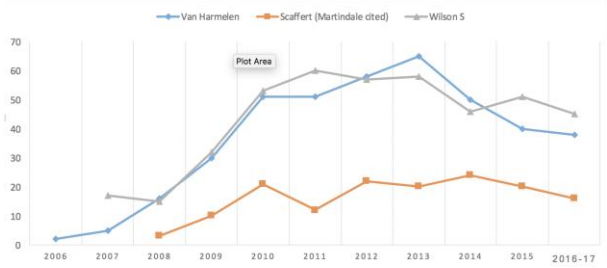

Fig. 1.Reputation of key authors' documents (the last data retrieved between 2006-2017)

IV. PROPOSING THE PERSONALIZED LEARNING ENVIRONMENT

We have covered three types of representation for personalizing our platforms. As soon as the users log in to the system, they may explore the reading materials on the our LMS, and may visit to their personal profiles and may adjust the way of representation of learning objects. By default, (Fig.2) it may be set to present the most newly created learning objects. Available options are: 1st newly created learning objects first, 2nd – the learning objects which have the highest scores, 3rd – the learning objects which reflect the users' learning style.

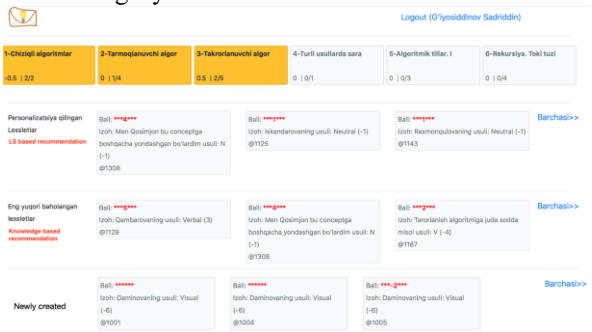

Fig. 2.A screenshot from a user profile page (All options are presented for demonstration)

A. *The domain model*

User modeling [14] is the main object and every intelligent tutoring system should develop one. For the first and second personalizing options the overlay model technique for learner's knowledge modelling was used. Our object model the objects are denoted as: O, [o1, o2, o3, …, on] refers to the application domain. n denotes the number of knowledge components and topics in the domain. They can be illustraites as a hierarchy of generalized object models. The elements on the set are c∈ n ∀ oc∈ O. The sets of objects were structured with two sets Foc and Roc. The first one denotes the set of individual features Foc [foc1, foc2, foc3, …, focn] of learning objects. The second kind of objects are the set of correlated features Roc [roc_1, roc_2, roc_3, …, rocm] of o_c object.

TABLE I. Representation Of Individual Features Of Concepts And Lesslets For Learning Object

Set of Fo_c *(Individual features of* o_c *object)*				
fo_{c1}	fo_{c2}	fo_{c3}	…	fo_{cn}
Set of Ro_c *(correlated features of object* o_c *)*				
ro_{c1}	ro_{c2}	ro_{c3}	…	ro_{cm}

Learning objects in the system are denoted as their quality levels as shown in equation in (1) and the second option of personalization can utilize this values to propagate the objects for the user.

$$UP = \begin{cases} Excellent & if\ ULT(Fo_{Tc}) > 85 \\ Good & if\ 85 \geq ULT(Fo_{Tc}) > 75 \\ Satisfied & if\ 75 \geq ULT(Fo_{Tc}) > 60 \\ Poor & otherwise \end{cases} \quad (1)$$

V. RESEARCH DESIGN AND METHODS

Technology enhanced learning has been strengthening with the power of several web based approaches, for example social semantic web, blog based, collaborative tagging, recommendation systems, etc. Since using artificial intelligence (collaborative filtering, recommender systems) is very powerful method and promising great success to achieve the goal, it is very complex and time consuming to build. On the other hand, in the case there is any misunderstanding artificial intelligent system toward the learner it can mislead the learning process. Applying semantic web and web 2.0 integrated manner into personalized e-learning environments is also the cutting edge method. And it is referred as social semantic web.

To build the social semantic web which points to deal with learning environment we propose to use a range of state-of-the-art methods which are nowadays cannot be find being used together in the same place:

- semantic web
- web ontology standards
- collaborative filtering
- API support
- online interaction paradigm (tagging, bookmarking, commenting, instant/short messaging, status updating and the like)
- Dynamic learner profiling
- use of web 2.0 & 3.0 tools

The aforementioned methods are technical investigation which we are going to use. In order to fulfil the pedagogical requirements, the below list of domain patterns are also going to be used:

- Semantic Description of learning objects
- Reasoning
- Self-regulated environment
- User evaluation
- Considering Student's cognitive style
- Using pedagogical practices
- Bottom-up approach
- Constructivism

As considering its difficulties of using above mentioned methods in a complex system, we want to approach by creating a subsystem and apply above methods gradually. In the second phase of the project we will implement a personalized learning system by using web 2.0 tools. In the same project, a case study will be conducted. Obtained results will be analysed and checked for positiveness.

Building a sub-system to start-up the research: A social web-based personalized learning environment.

In order to extend the possibility and strength the quality of education technology (Fig. 3) it is being demanded to use most advanced technologies. First, we want to develop **the sub-system** for start cultivate the research **objectives** in practice. Techniques and approaches to apply into system will be done along the way.

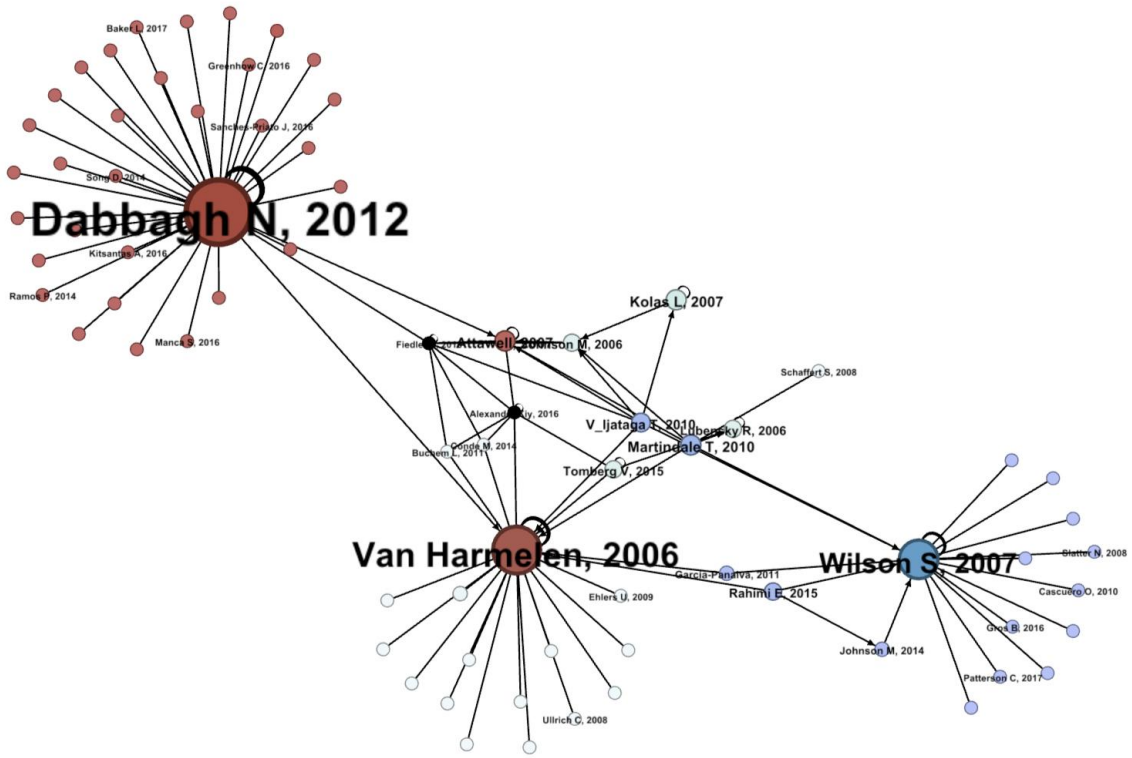

Fig. 3. Key projects contributed in this research direction

For **experiment** the target host university is selected as **ADU**. We are need to be sure the students in ADU all equipped with technically and able to participate online study. Because, users are required to have at least modern mobile/computer devices and Internet connection.

Decide the type of research **methodology**. Research questions:

- does the system fulfil and hold the engagement of students?

- is the results acquired from study satisfy and recover the the issue mentioned in the section *II.A*?

Two types of instruction groups were designed. Among the university freshmen from department of "Information education department" 64 students are assigned to participate in experiment. Initially, with an explanatory demonstration of the research students are invited to take part in the experiment. From total 93 students the assignment requests are recorded as 64 students. Since the majority of students are showed willingness of agreement which all students come from three classes, two classes are chosen. It is also the fact that every fourth student on the master list is placed in each class so the comprehension of students is equally distributed. Our project uses two types of instruction - recommendation or experimental group and control group which uses the system but without recommendation features - to determine the effect of quality level classification and personalised representation. The participants in the experiment are our freshmen students. For each group 32 students are randomly assigned to each type of instruction, it is reported that one of the students from experimental group has discontinued so he was excluded.

VI. RESULT ANALYSIS

In order to check the effect of the system between groups, we calculated Cohen's d for Independent t Test. According to (Cohen 1988) effect size analysis is applied when we need to calculate the standardized difference between mean values of two variables and denotes as d (2). Where M_1, M_2 are mean values of two experimental and control groups respectively. *SDs* are standard deviations and *n* is the number of participants.

$$d_s = \frac{M_1 - M_2}{\sqrt{\frac{(n_1 - 1)SD_1^2 + (n_1 - 1)SD_2^2}{n_1 + n_2 - 2}}} \quad (2)$$

For the convention of Cohen's values there may be three categories of results (Table II).

TABLE II. Cohen's conventions [15]

Cohen's conventions	
0.2	Small
0.5	Medium
>0.8	Large

The initial result of analysis for Cohen's convention effectiveness included all six topics was found 0.34 which is little higher than small. But when we made in-depth analysis it is reported that the last topic (Table IV) was found problematic in both groups. As a result, the overall scores were affected by the topic which involves the concept of "Recursion". As [16] states, the concept - recursion - is to be known as the most difficult which is associated with dynamic programming. For this reason, we thought it is hard to grasp for students and planned to find a solution for this problem.

When we excluded the concept -recursion - for both groups and recalculated the effectiveness then we have got higher effect values (Cohen's d: 0.657) which is higher than medium (Table II).

TABLE III. Group statistics

	N	Mean	Std. deviation	Cohen's d
Group 1	31	4	0.89443	0.657
Group 1 (Control group)	32	3.3125	1.17604	

With a Cohen's d of 0.657, 75.8% of the "experiment" group will be above the mean of the "control" group (Cohen's U3), 72.6% of the two groups will overlap. There is a 69% chance that a student assigned at random from the experiment group would have a better score (probability of superiority) than a student picked at random from the control group. Also, for instance, in order to have one more mastered student result in the treatment group compared to the control group we need to include to experiment 4 students. This means that if 100 students take the system activities (create lesslet, vote and share on social) and at the same time got personalisation feature, 24.4 more people would have a mastered level compared to if they had received the control group.

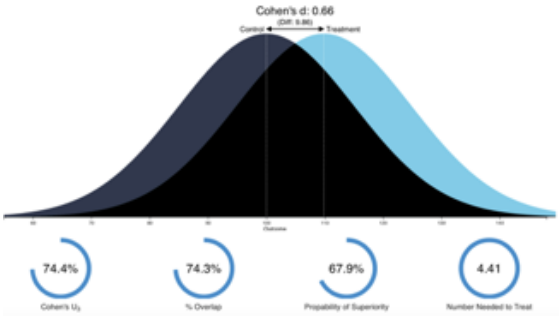

Fig. 4. Illustration of two groups higher than medium effect size after exclusion of last concept.

According to further in depth analysis scores for the last topic was significantly lower than other topic scores. The coding for statistical analysis was based on 4 scale from 2 to 5. They have translated the qualitative values of classes from NBC such as "expert" - 5, "advanced" - 4, "Intermediate" - 3, and "Foundational".

TABLE IV. Mean and standard deviation of the comprehension of the experimental groups

Topic	Min	Max	Mean	Std. Deviation
Chiziqli algoritmalar	3.00	5.00	4.0968	0.74632
Tarmoqlanuvchi algoritmlar	2.00	5.00	3.9032	0.87005
Takrorlanuvchi algoritmlar	2.00	5.00	3.9355	0.85383
Turli usullarda saralash algoritmlari	2.00	5.00	3.8710	0.99136
Algoritmik tillar. Ijrochilar va ularning ko'rsatm...	2.00	5.00	3.7419	1.03175
Rekursiya. Toki tuzilmasi	2.00	5.00	3.1290	0.80589

VII. CONCLUSION

The aim of this paper was to enhance our e-learning system with personalizing user generated contents by applying recommending techniques while supporting user preferences and knowledge comprehension. Commonly used LMSs in educational practice focus on providing teachers an environment for creating, maintaining and administrating online courses. For this kind of platforms there small, or in most cases, no features are utilised for adapting user traits. Besides, adaptive learning systems take the user capacity into account by providing a tailored learning content but the reported works are rare in real life use maybe because of luck teacher's technology acceptance factors or luck of technical support. The main objective of this thesis was to use the benefit of Open Educational Resources in the form of crowdsourcing approach and to inject the machine learning NBC classification approach for adaptivity. By doing so we have able to use the wisdom of crowd.

Furthermore, the current research on recommendation studies are still suffer from properly addressing the "cold start" problem.

These issues were especially emerging when the traditional questionnaires are being criticised on psychological behaviour detection to initialise the user model. We have proposed an interactive, item response-based web-based instrument in order to create seamlessly detecting user preferences.

The limitation of this work can be found in the luck audio and video materials with could enhance the user's motivation. Also the luck students' comprehension on last concept "recursion" also impacted to decrease the effectiveness. Furthermore, the participants were only invited form a single university which limited us to have broader view of the system usage.

The future studies can use our findings and prototypes for developing adaptive user generated-based e-learning environment and automatic detection of user preferences.

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