



A Learner-Centric Personalized and Adaptive E-Learning Framework for Higher Education

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Abstract: In recent times, E-Learning systems or Learning Management Systems (LMS) have emerged as vital and constituent resources in teaching & learning process. The main aim of this study is to analyze the preferences of contemporary learners towards essential aspects of e-learning that contribute to its success. It is evident from previous studies that learners are not satisfied with the existing e-learning systems or LMS as majority of present systems are not catering to the individual requirements of learners. Personalization of teaching & learning process is one of the significant advantages of e-learning over traditional methodologies. A survey was conducted to determine learner inclination towards various aspects of e-learning motivation, pedagogical preferences and personalization. 71.86% of the respondents were motivated to e-learning as it would assist them study at their own pace. 68.33% of respondents felt that e-learning would provide them a choice to learn at preferred time and place. 51.77% of learners prefer learning through LMS with need based collaboration with teachers and peers. Majority of learners felt that personalization of content, pedagogical style and need based collaboration as the most important aspects they would prefer in personalized e-learning systems. Developing personalized content demands additional time and effort from the content writers and designers. Satisfying the individual needs of learners would be highly complex for Higher Education Institutions (HEI) as they need to consider several aspects of personalization. Hence, a collaborative effort would be inevitable for HEIs to fully meet the learning needs of their students. This paper suggests a cloud based collaborative and scalable framework to personalize the learner experience on e-learning systems with reduced effort compared to personalizing individual LMSs being used by HEIs.

Keywords: E-Learning Motivation; Learner-Centric E-Learning; Personalized and Adaptive E-Learning; Collaborative E-Learning Framework; Cloud-based E-Learning; Higher Education

1. INTRODUCTION

E-learning systems have traversed from Synchronous mode to Asynchronous and then to Blended mode at present based on the requirement of the learners. Earlier there were audio/video conferencing systems to disseminate live lectures to wider audiences. Later, technologies to record these lectures and stream them through web have gained popularity. At present both these modes with few more advanced features are being used in LMSs.

The use of internet and technology in higher education created avenues for more information being made readily available to learners [1]. This may lead to overloading students with plenty of information which is not preferred by the student or may not be suitable for a given situation. Although advanced technologies were available, moderate efforts have not been made by majority of HEIs to meet the individual needs of their students [2].

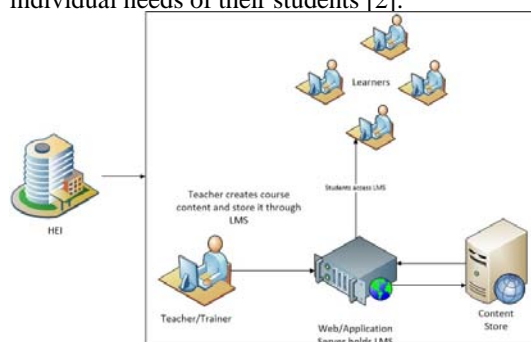


Figure-1: Traditional model of E-Learning System/LMS

LMSs are mostly being used as electronic media to distribute teacher written materials and other institution specific content among students. Figure-1 represents the traditional model of e-learning systems being offered by majority HEIs. The main objective of this study is to propose a personalized and adaptive framework in collaborative environment based on learner requirements.

2. BACKGROUND AND MOTIVATION

There are several diversified challenges for higher education teachers to meet the learning requirements of the students. The focus of this research is the concept of personalization of e-learning, where events are particularly selected to meet the learning requirements of individual learners.

2.1 The Paradigm Shift

A paradigm shift has taken place in higher learning from fixed place, pace and time of learning to anywhere-anytime at one's own pace on any device of choice. It is widely accepted that learning diversities exist among learners of the same course and they are inevitable [3]. Students learning a course will have their own personal learning characteristics and hence requirements are varied. Teachers in HE face challenges to adopt their teaching style or pedagogy to suit a variety of students in the classroom. It is rather easier to develop e-learning courses than adjusting to the individual needs of the students in a classroom.

2.2 Gap between Concept & Realization

There are software frameworks and also applications designed over those frameworks. But, majority involvement of stakeholders is lacking [4]. The reasons may be difficulties in content authoring or lack of platform for easy collaboration. The gap between the concept and its realization into personalized e-learning is the focus of this study. Various systems which were developed with an intention to achieve adaptive content were reviewed. Few examples of such systems are given below:

- Adaptive Course Construction Toolkit (ACCT) authoring tool was proposed with the intention to help the authors represent pedagogical approaches. Authors were able to represent their pedagogy as a series of description concepts [5].
- CopperCore Service Integration (CCSI) framework was proposed by Vogten and team in 2007 which can act a learning design tool [6].
- Adaptive Hypermedia Application Model (AHAM) was proposed and updated after a decade to Adaptive Hypermedia Architecture (AHA) [7].
- Generic Responsive Adaptive Personalized Learning Environment (GRAPPLE) is an EU FP7 funded research project specifically targeted at delivering a Technology-Enhanced learning (TEL) environment to the learners [8].

Current e-learning systems are offering customization to personal needs often limited to preferred selection of Graphic User Interfaces (GUIs) [9]. Users have the choice to customize physical appearance of the course website or the LMS interface. Rather than concentrating on GUI customization, focus should be on customizing learning systems to meet the individual needs of learners considering their prior knowledge of the topic, learning objectives, pedagogical requirements, personal learning abilities etc. Adaptive learning indicates that the learning content is provided based on prior knowledge, learning style, objectives etc. and adjusting content in runtime by screening learner behavior during the progression of the course [10]. If these requirements are not taken into consideration during the design of an e-learning course, it may cause significant discomfort to the learner which may further constrain learning leading to drop out.

Another major challenge faced by the e-learning systems is finding appropriate and scalable architectural solutions that allow customization of teaching-learning facilities in a more personalized and adaptive collaborative environment

3. RESEARCH QUESTIONS

This study is based on critical examination of the state-of-the-art systems in the field of e-learning for Higher Education. Referring to some drawbacks of the existing systems and in the light of modern teaching requirements, the paradigms of the new generation learning systems are as follows:

- *Student-centered learning*: Student is the critical point of success in effective education process.

- *Student-collaboration in education*: Encourage the students for active collaboration in the education process.
- *Minimize discomfort*: Reduce the impact caused by factors such as time, distance, learning abilities, pedagogy etc.

The main objective of this study is to analyze perceived preferences of contemporary learners on essential aspects of e-learning personalization which leads to its success. Hypotheses guiding the present study are classified into four categories with each category focusing on various preferred factors for learners on e-learning. Hypotheses proposed in present study are as follows:

- What are the pedagogical preferences of contemporary learners? This question is to observe the pedagogical inclination of learners.
- What are factors that are motivating learners towards e-learning? This question is to observe the motivational factors driving learners towards personalized e-learning.
- What are the factors that influence the success of e-learning courses? This question is to observe the learner inclination towards influential factors for a successful e-learning course.
- What are the significant requirements of contemporary learners in personalized e-learning? This question is to identify the learner inclination towards important aspects of e-learning personalization.

Analyzing the results of the above hypotheses, this study considers the need for an appropriate Framework / Architecture as an important aspect for producing intelligent e-learning systems which are personalized and adaptable. A collaborative framework integrating hybrid multi-level architectures is proposed to answer an important hypothesis given below.

- Will it be possible to design and implement collaborative framework/architecture for adaptive & personalized learning experience meeting the diversified requirements of the learners?

4. METHODOLOGY

In order to explore the preferences of the learners on e-learning systems, and to identify their viewpoints on the significant success factors of personalized e-learning, a survey was conducted among present learners across disciplines and levels of study in higher education institutions.

4.1 Survey Sample

A survey was organized with a sample of 622 contemporary learners from various higher education institutions during the academic years 2015 and 2016. There are diversities in age, gender, location, area of study, and level of study among the survey participants. Participants in the survey were chosen based on their familiarity in using LMS or E-learning systems within their institutions.

4.2 Survey Instrument and Description

The survey was conducted using a pre-designed questionnaire. The questionnaire was circulated in multiple modes using online form, face-to-face and interviews. The

survey has questions related to general and demographic information of the participants that include age, gender, location, and field & level of study. The questionnaire consists of four questions each relating to the first four hypotheses described under research questions. Each question consists of multiple options for the participants to choose. The multiple options provided under each question are related to a category described in hypotheses. The first question has options for pedagogical preferences of learners. The second question has options on motivational factors towards e-learning. The third question has aspects significant for success of e-learning and the fourth question has significant requirements of learners on personalized e-learning courses.

The perspective of the survey was clearly explained to the participants in order to ensure unbiased responses. Clarifications were provided to the participants at times of uncertainty to make them understand the context of the question.

5. SURVEY RESULTS AND DISCUSSION

Results of the survey are represented in the form of charts. The result charts demonstrate the inclination of contemporary learners towards various aspects of e-learning in each category mentioned in the research questions. Inclination levels for each aspect are represented either in numbers or percentage.

5.1 Pedagogical Preferences

The inclination of contemporary learners towards different teaching styles is represented in Figure-2.

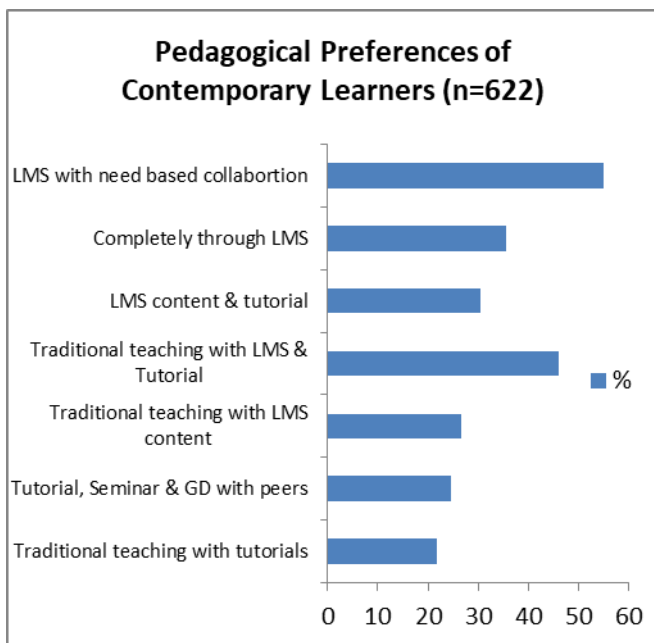


Figure-2: Inclination of contemporary learners towards teaching styles (n=622)

The results show that more learners are aligned towards teaching style which includes LMS or e-learning system. 54.98% of the participants preferred learning through LMS with need based collaboration with peers and teachers. This factor attracted majority of the participants. The subsequent leading preferences are traditional teaching in combination

with LMS, online tutorial and completely through LMS with 46.14% and 35.53% respectively.

5.2 Motivation Factors

The motivational factors driving present learners towards personalized e-learning are shown in Figure-3. The results show that an average of 70.10% of learners felt that they were motivated towards personalized e-learning as it would facilitate learning either at their preferred time or pace. 59.65% of the learners also felt that the option to choose better online courses wherever they are offered to be the other significant motivational factor.

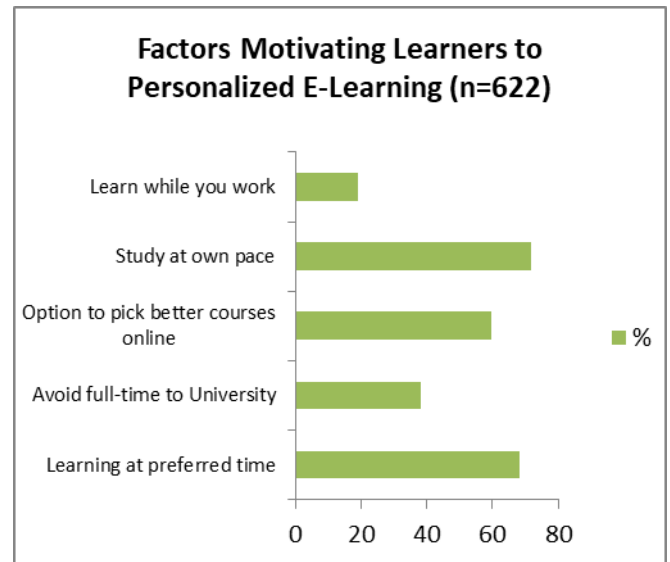


Figure-3: Factors motivating learners towards personalized e-learning (n=622)

5.3 Factors for E-Learning Success

Figure-4 given below displays the inclination of the learners on the factors important for the success of personalized e-learning.

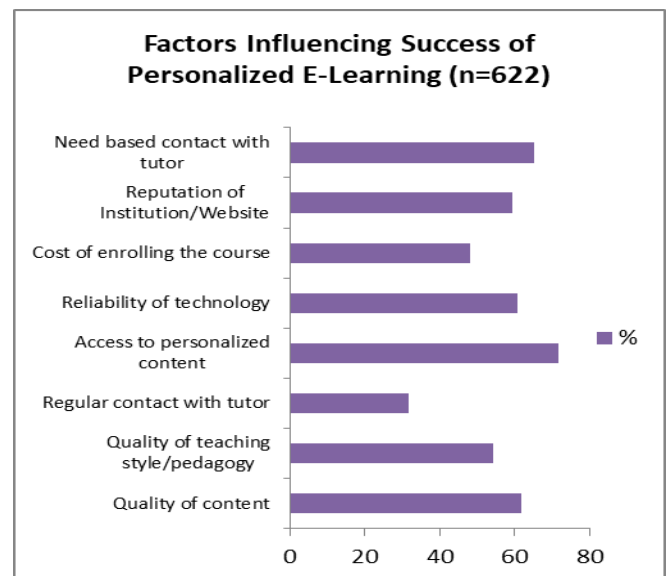


Figure-4: Factors influencing the success of personalized e-learning (n=622)

71.86% of the participants indicated that access to personalized content would be their preferred success factor which is the leading among the factors surveyed. 65.11% felt that need based contact with tutor or moderator is also a leading success factor. Quality of content with 61.74%, reliability of technology with 60.77%, reputation of the website/institution offering the course with 59.32%, and quality of teaching style/pedagogy with 54.18% are among the other leading success factors as per the learners.

5.4 E-Learning Personalization Requirements

The results shown in Figure-5 depict the inclination of learners on requirements for personalization of e-learning. The prominent requirement in the chart is content appropriateness with 75.40% of participants choosing it as a requirement. The facility of need based collaboration with teachers and peers attracted 72.03% of the participants. Pedagogical suitability, content navigation as required by the learner, and mapping assessments with learning objectives are among other important requirements with 63.50%, 61.74%, and 58.52% respectively. Customization of media according to learner preference also is a considerable requirement with 54.34%.

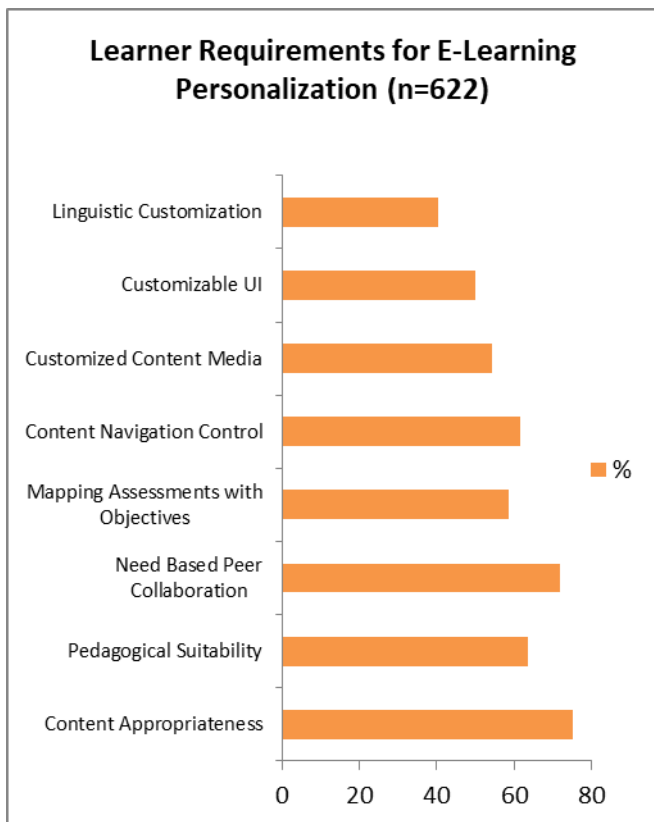


Figure-5: Learner requirements for e-learning personalization (n=622)

6. SUGGESTED COLLABORATIVE FRAMEWORK

As the focus is on learner-centric model of teaching, this study attempts to present the challenges faced by the e-learning course/content designers. Designing course content

considering the individual learning objectives and pedagogical preferences of the learners is quite difficult to achieve with the significant inclination of majority learners towards e-learning. Addressing the content needs of a large number of learners with a variety of preferences is going to be a challenge for content developers. Hence, measures to accomplish these challenges are highly important for the future generation of e-learning systems [11]. This study introduces few such measures/practices to overcome these issues.

Previous studies found that there is minimal or no learner needs assessment conducted before the start of the course. It is also observed that majority of contemporary learners do not possess ability to choose learning preferences on their own. There is significant growth in the number of learners seeking assistance from a moderator/course advisor to freeze their learning preferences [12].

6.1 Conceptual Model of Collaborative Framework

Meeting the expectations of individual learner's requirements through the concept of e-learning personalization often would be a challenging exercise for individual higher education institutions. Hence, collaboration with associating institutions will be an ideal solution to accomplish this challenge. A conceptual model of e-learning involving a moderator assisted cloud framework is shown in Figure-6.

The collaborative framework will enable partnering higher education institutions to share their learning resources through a collaborative cloud. Each HEI would integrate its LMS/E-Learning system to a collaborative cloud so that the end users including learners and teachers can access shared resources. Results of this study pointed out the growing need for moderator supported e-learning systems. Although it would be an additional burden for teachers to act as moderators online, collaborative model shall enable teachers to identify the uncertainties of learners during the learning process. Learners shall have access to moderators within and outside their institution thus reducing the load on an individual teacher/tutor.

6.2 Computational Model of Collaborative Framework

The conceptual model shown in Figure-6 above portrays a broad concept of collaborative solution involving multiple HEIs for e-learning personalization using cloud platform. The computational model shown in Figure-7 below illustrates the process flow between entities involved. The computational model describes suggested solutions to significant inhibiting factors for the success of e-learning.

The model illustrates the suggested framework as three important processes:

- Learner profile generation based on learning needs assessment
- Course profile creation based on course content
- Course delivery and evaluation

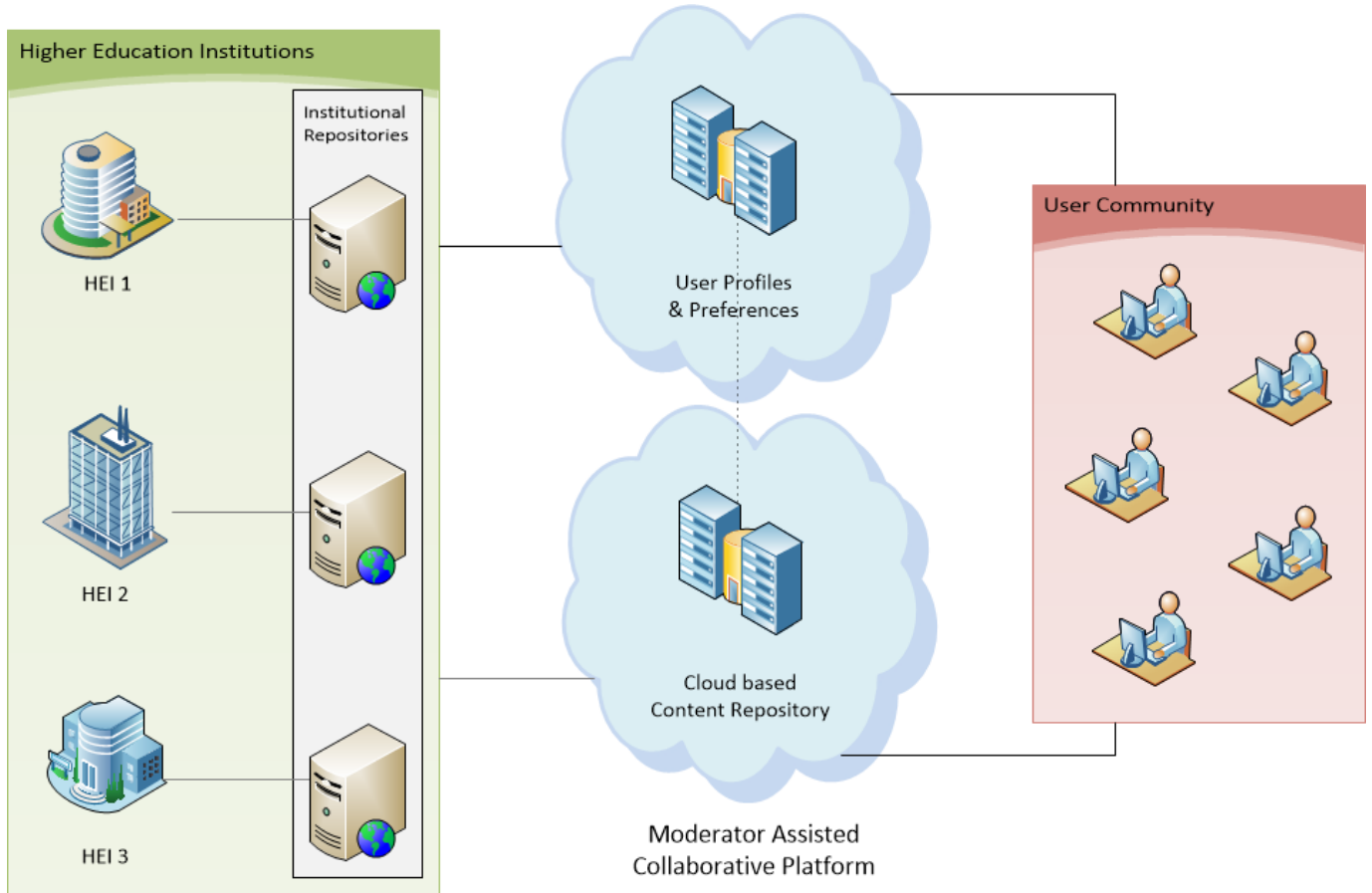


Figure-6: Conceptual model of collaborative cloud framework for e-learning

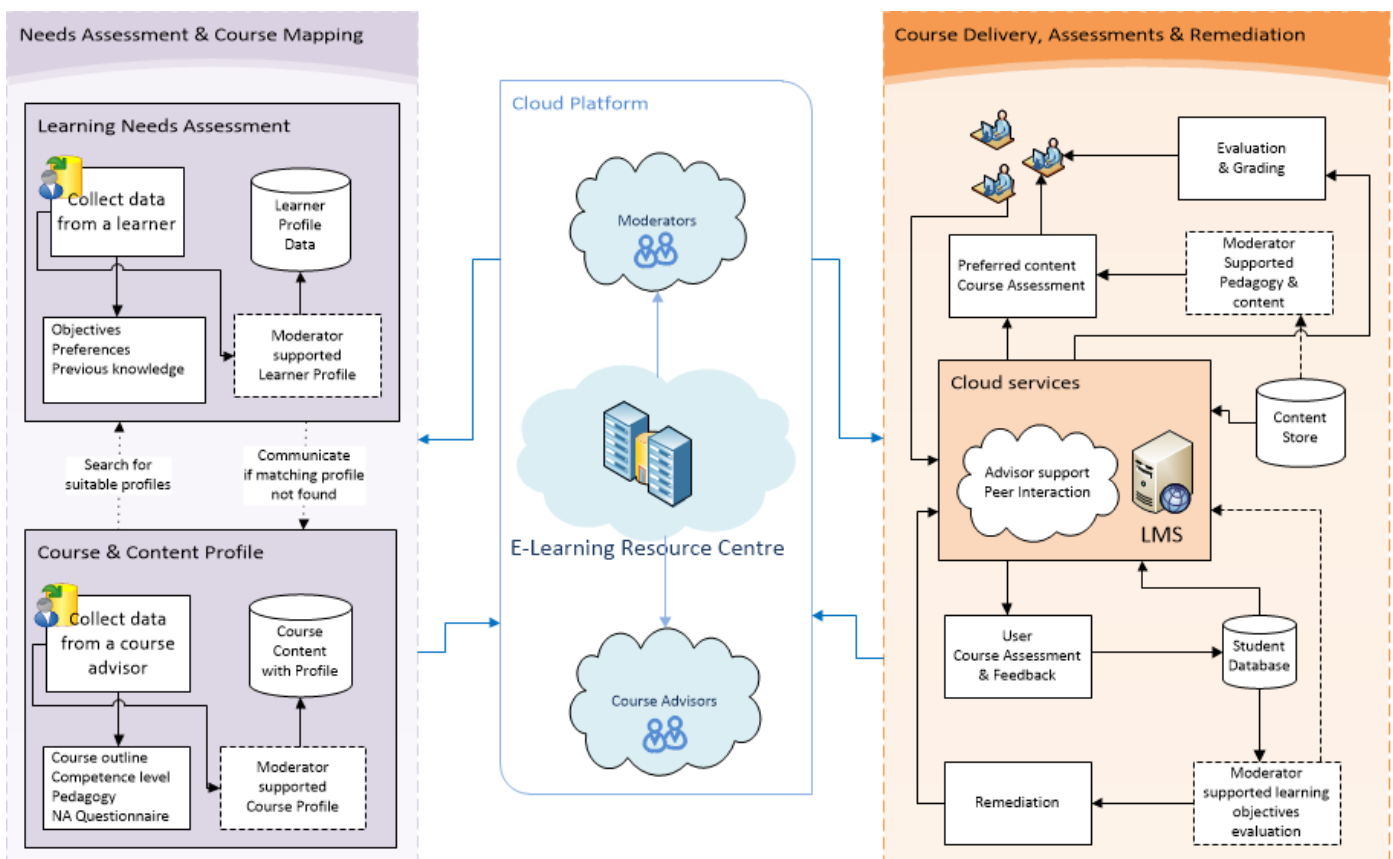


Figure-7: Computational model of collaborative cloud framework for e-learning personalization

6.2.1 Learner profile generation

The framework provides opportunity to assess learner requirements either within the institution or on a collaborative cloud platform. If a learner expresses basic interests on the course which can be met within the institution, a suitable course based on the needs can be mapped from within the institution content repository. If the learner requirements are more precise and complex, an appropriate course profile can be explored in the collaborative cloud repository. In a situation where a suitable course meeting the learner needs cannot be identified, a new course requirement can be created which can be considered by content authors and course designers as future requirement. This framework also provides provision for need based moderator support in order to help learners with uncertainties in choosing their learning preferences.

6.2.2 Course profile creation

This study identifies the need for course profile creation before the course can be distributed to prospective learners. Course profile includes all important attributes of the course like course objectives, pedagogical approach, content media and prior knowledge requirements of the course etc. This framework necessitates creation of course profile before the content is actually uploaded on the content repository as it would be a crucial resource to presume matching courses based on learner profile. Considering authoring/design difficulties of teachers with limited Information and Communication Technology (ICT) expertise, this framework considers provision for moderator assistance on content authoring or design. Course profile shall be appended with automated feedback and success rate of the previous learners of the course which can be presented to the prospective learners so as to indicate better accessible courses.

6.2.3 Course delivery

This framework considers the requirements of contemporary learners for personalization of e-learning. Hence, course delivery is tailored to the needs of the learner. Growing demands like peer/moderator assistance, content navigation as controlled by the learner, and mapping assessments with the learning objectives of the learner etc. are deliberated. Learners can request peer/moderator assistance as and when required during the process of course study. As the assessments would be in line with learner's objectives, provision to track one's own progress would be easy. Learner shall have the option to reconsider his/her learning preferences based on evaluation and may either opt for remediation him/herself or recommended for remediation based on automated criteria. Success rate and feedback of the learners is automatically appended to the course profile so that future learners can be benefitted.

7. CONCLUSION

Considering the findings from this study, a Framework for personalized and adaptive learning is proposed. The key findings relating to the inclination of modern learners towards e-learning, their abilities in providing the learning objectives and preferences, influencing factors for personalized e-learning etc., formed a basis for this framework. As the majority of the learners are inclined towards asynchronous mode of learning where there is no scope for continuous access to the teacher, assistance of the

teacher/moderator as when required will be beneficial to learners in order to meet their learning objectives.

To address the issues related to development of content for learners with diversified needs, a collaborative cloud model of e-learning is suggested through which Higher Education Institutions can collaborate with each other in finding the right course content for the learner. The suggested e-learning framework illustrates the cloud based collaborative practices to overcome the prevailing drawbacks and meet the growing demands as discussed in this study.

With provisions for compensating principal aspects leading to the success of personalized e-learning, this framework is expected to have the ability to get adapted over time to satisfy learning needs of majority of learners with diversified requirements.

8. REFERENCES

- [1]. O'Donnell, E. (2012). "The student perspective: Can the use of technologies transform learning?" In I. R. M. Association (Ed.), *Virtual Learning Environments: Concepts, Methodologies, Tools and Applications*. Hershey, New York: IGI Global.
- [2]. Gurmak Singh, John O'Donoghue, Harvey Worton, (2005). "A Study into the effects of eLearning on Higher Education", *Journal of University Teaching and Learning Practice*, UK.
- [3]. Lou Siragusa, Kathryn C. Dixon, Robert Dixon, (2007). "Designing quality e-learning environments in higher education", *Ascilite Singapore 2007, (Article in Conference)*.
- [4]. P. De Bra, L. Aroyo, & A. Cristea, (2004). "Adaptive web-based educational hypermedia". In M. Levene & A. Poulovassilis (Eds.), *Web Dynamics, Adaptive to Change in Content, Size, Topology and Use*. Springer.
- [5]. Dagger D., Wade V., & Conlan O. (2005). "Personalisation for all: Making adaptive course composition easy". *Journal of Educational Technology and Society*, 8(3), 9-25.
- [6]. Vogten H., Martens H., Nadokski R., Tattersall C., Van Rosmalen P., & Koper R. (2007). "CopperCore service integration". *Interactive Learning Environments*, 15(2), 171-180.
- [7]. Knutov E., De Bra P., & Pechenizkiy M. (2009). "AH 12 years later: A comprehensive survey of adaptive hypermedia methods and techniques". *New Review of Hypermedia and Multimedia*, 15(1), 5-38.
- [8]. GRAPPLE, (2008). GRAPPLE Project Website. Retrieved April 10, 2017, from <http://grapple.win.tue.nl/home.html/>.
- [9]. K.Anandakumar, K.Rathipriya, A Bharathi, (2014). "A Survey on Methodologies for Personalized E-learning Recommender Systems". *International Journal of Innovative Research in Computer and Communication Engineering*.
- [10]. Giridharan Anandi, (2005). "Adaptive e-Learning Environment for Students with Divergent Knowledge Levels", *ELELTECH India 2005, IISc, Bangalore. (Article in Conference)*.
- [11]. Chakurkar Manasi, Deepa Adiga, (2014). "A Web mining approach for personalized E-Learning System", *IJACSA*, Vol.5, No.3.

- [12]. Venu Madhav. S and Rajasekhara Rao. K, (2017). "An Analysis of Learner Satisfaction and Needs on E-Learning Systems", *International Journal of Computation Intelligence Research*, Vol.13, No.3.

APPENDIX - 1

Questionnaire to obtain learner preferences on factors influencing e-learning success.

General and Demographic Characteristics

1. Name of the Learner:
2. Learner's Age:
 - a. 18-21
 - b. 22-25
 - c. 26-30
 - d. Above 30
3. Learner's Gender:
 - a. Male
 - b. Female
4. Location of Study:
 - a. Urban
 - b. Rural
5. Level of Study:
 - a. UG
 - b. PG
 - c. Professional/Certificate
 - d. Doctoral
6. Domain of Study:
 - a. Engineering
 - b. Management
 - c. Sciences
 - d. Others

Question-1: Pedagogical preferences of learners

What are your preferred teaching styles among those mentioned below? Select those you feel are more beneficial to you.

- Face-to-face teaching with tutorials
- Tutorials, Seminars & Group Discussions with peers
- Face-to-face teaching with LMS content support
- Face-to-face teaching with LMS & Online Tutorial
- Teaching through LMS content & tutorial
- Completely through LMS (Teaching, Learning & Evaluation)

- Teaching through LMS with online forums & chat rooms with peers and teachers when needed.

Question-2: Motivation factors towards e-learning

If you were provided access to an e-learning system that suits your requirements, what are the factors that motivate you to prefer e-learning? Select all those apply to you.

- Learning at preferred time and place
- Avoid going full-time to the University
- Option to pick better courses online wherever they are offered
- Study at own pace and comfort
- Learn while working without disturbing profession

Question-3: Factors for e-learning success

According to you, what are the factors that influence e-learning success? Select all those you feel are important.

- Quality of content
- Quality of teaching style/pedagogy
- Regular contact with tutor
- Access to personalized content
- Reliability of technology
- Cost of enrolling the course
- Reputation of Institution/Website
- Need based contact with tutor/moderator

Question-4: Personalization requirements

According to you, what are your requirements for a personalized e-learning system? Select all those you feel are important.

- Appropriate content delivery based on individual requirements
- Suitable teaching style based on individual learner's comfort
- Ability to collaborate with teachers and peers based on need
- Mapping assessments with learning objectives
- Facility to navigate through learning resources as required by individual
- Ability to choose preferred media of content
- Customizable user interface design to choose preferred look and feel
- Facility to choose the level of language to be used for teaching