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A Semantic Modeling of Personalized e-Learning System with Collaborative Refining and Content based on Clouds

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Abstract: This study proposes the concept of e-Learning cloud broker which is a framework of a learning management system on cloud, providing a common platform to all the e-Learning providers to share their data and increase their accessibility. After taking the stores of information from the registered providers, the orchestration layer of the system will semantically annotate the data and build a useful and manageable base of knowledge using defined global and local context ontologies. On the other side when a learner accesses the portal, depending upon his profile details, it gives him the precise and wide amount of data by semantically inferring his request. Learner will be also provided with a platform for blogging, recommending the content and sharing their ideas forming the foundation of collaborative learning. The framework will utilize the benefits of both ontology and cloud computing to provide the mechanism to connect man and machine. This way the information stored in any server of any part of the world can be organized into meaningful knowledge bases and hence can be accessed by those who can be benefited from them.

Key words: Cloud computing, cloud orchestration, cloud broker, e-Learning system, ontology, global

INTRODUCTION

e-Learning can be explained as utilizing networking and communication in the process of teaching and learning (Carabaneanu *et al*., 2006). It's not just about providing courses on desktop but also a blend of various resources, technology and support services in structured form, so as to provide high value integrated learning anytime, anywhere. Development in e-Learning has always been embryonic in nature. It started with CBT and now edging towards personalized, mobile learning as shown in Fig. 1. With this gradual and fast paced development, e-Learning always embraced the new technology to improve the quality and value of learning delivered to the learner. "An investment in knowledge pays the best return" Benjamin Franklin.

Before utilizing any technology such as clouds or orchestration for e-Learning enhancement, it is necessary to study the basic structure and fundamental issues related to an e-Learning model. A basic framework of e-Learning includes three components: content designed by experts, learning delivery models and tools and finally the portal which is accessed by the learner (Welsh *et al*., 2003). Each of the components has their importance behind the success of the e-Learning system. Content involves all the activities and tools required for designing, management and version control of the content in the repository (Rosenberg, 2001). It involves location and storage contents as well as metadata, libraries, etc. This content is distributed to the learner using learning delivery environment which includes structuring the detailed learning processes, collaborative tools and activity tracking, etc. Finally, it's the portal which involves registration, catalogues, course registration, profiling, financial processes and administrative processes. All these components are integrated by the infrastructural support including network backbone with protocols (e.g., TCP/IP), databases (relational DB, Microsoft exchange), Application tools and development languages and specialist protocols like video (H323), netmeeting, etc.

In today's competitive world when our daily requirements such as banking, medical help, bill's payments are fulfilled by tailored softwares on web, e-Learning is not left behind. There are many learning management systems available for the e-Learning providers which provide the basic functionalities like administration, documentation and delivery of e-Learning with proper monitoring and tracking in short all the components explained before (Dougiamas and Taylor, 2003). Some of the LMS vendors are: moodle, SWAD, canvas, etc. Now it's on the e-Learning provider to choose the best LMS which fulfills its requirements like customization, availability on multiple platforms should provide social learning tools should be in compliance with the LMS standards like SCORM, ADSL, etc.

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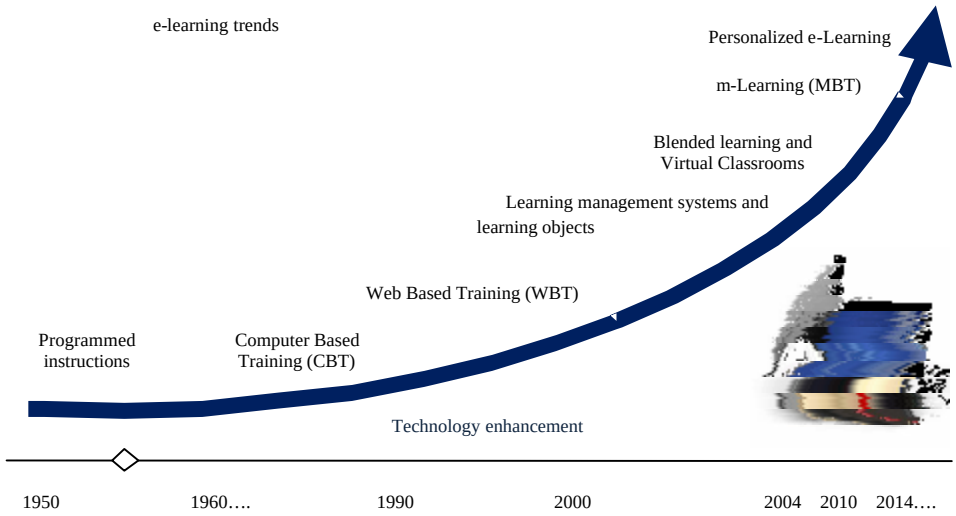

Fig. 1: e-Learning trends

MATERIALS AND METHODS

Motivation; Diversity of the content and learner oriented search: Elliot Masie, a leading e-Learning guru says, success of an e-Learning system lies much more than putting content on-line. It has been defined that amount of stored information in the web doubles every 2.8 years (Welsh *et al*., 2003). So, problem is no longer that needed information does not exist but it is that specific information is difficult or sometimes impossible to be located in the vast network of technology in which it is stored. The true power of e-Learning will be in its ability to bring the right information to the right people at the right time (Welsh *et al*., 2003). Here, it is a major challenge in front of successful e-Learning provider to convert widely distributed information into a well defined meaningful information structure that is understandable for different learners depending upon region, etc.

As the technology is advancing and worldwide content is condensing into web, the expectations of the learner are increasing. With on-time delivery of the content, they demand for good content too. The sole criterion in front of e-Learning is not just, to remotely deliver the e-Contents but also rich content. Many times due to the un-structured and scattered data, learner is not able to get the rich content on web. Though web is a sea of contents, to swim in it and get the best data is a tough task. There is a critical problem in front of the learner to select the best e-Learning site which can benefit him the most by its content, availability, etc. All e-Learning providers follow different standards for their Learning Management System (LMS) and content presentation, this hampers the interoperability of e-Learning system and also discourage learner to switch from one LMS to another (Dillenbourg, 1999).

With the presence of wide choice among the e-Learning providers available on web, the need is emerging for the interoperability of e-Learning sites, so that their contents can be shared and structured as per the learner. This will also help learners of different regions and intellectual level to share a common platform and do collaborative learning, so that, they can get a wide exposure of their field.

This study discusses the most important aspect of an e-Learning system 'content' and proposes the concept of e-Learning cloud broker which is a framework of a learning management system which provides a common platform to all the e-Learning providers (LMSs) to share their data and increase their accessibility on clouds. Cloud service is opted because it will be faster, simpler and on demand, e-Learning system resources will be more scalable related to overcrowded and lean periods. There will be optimized use of computing resources.

Cloud will easily handle peak load situation without any additional infrastructural support. Learners will be having unlimited storage and resources which will give them flexibility to explore their ideas and finally there will be high availability and reliability (Mell and Grance, 2011). As data is stored in various data centers of the cloud providers, there will be less chance of data loss (Salunkhe and Kelkar, 2016). Learners can use any electronic device anytime connected with internet to access the e-Learning system. There are various SAAS cloud learning management systems available like

DoceboLMS, EduWave, Expertus, SCORM cloud, etc. Therefore, the proposal of cloud based learning management system is feasible.

Unification and filtration of the content: There is a sincere requirement of a common learning management system which will be able to provide a standard platform to all e-Learning providers to create a repository of their data and further it can be accessed according to individual needs of the learner.

The proposed system provides e-Learning service, to the learner, that provides wide exposure of the data with maximum precision of learning content by filtration process. In particular, the proposed system mediates in between e-Learning providers and prospective learners. It provides two kinds of filtering methods:

- Content-based filtering
- Collaborative filtering

Content based filtering determines relevant information for the learner by calculating similarity between learning objects with learner's profile and requirements. On the other hand, collaborative filtering selects learning objects according to the recommendation, of other users with similar preferences.

This proposed system will also give a platform where, they can share their views to perform a collaborative learning. Collaborative learning (Dillenbourg, 1999) can be explained as learning in which two or more people having common interest attempt to learn together. We are targeting collaborative e-Learning for the web learners having common field of interest to get exposure of wide variety of data with interactive learning using blogs, surveys, feedbacks, etc. The working and structure of the proposed system is inspired from the SCORM but the difference is that its concentrates much more semantically than SCORM. The next study explains about SCORM technically.

Unification and standardization of the content explained using SCORM: SCORM (Shared Content Object Reference Model) is a collection of standards and specifications for web based learning. It is a set of technical standards for e-Learning software products. SCORM tells programmer how to write their code, so that, it can "play well" with other e-Learning software. It's the de facto industry standards for e-Learning interoperability. It governs how online learning content and Learning Management System (LMSs) communicate with each other. SCORM does not convey any instructional design or any other pedagogical aspect; it is purely a technical concern. SCORM basically creates units of online training material called SCO (Shared Content Object) that can be reused in different systems and contexts. It is composed of three sub specifications: content packing, run-time and sequencing. In 'content packing', SCORM package the contents in a ZIP self contained directory called Package Interchange File (PIF). This directory contains an XML file named imsmanifest.xml which contains all the information to be delivered. This manifest is the heart of content packing specifications which divides course into SCOs, assets and combine them into an activity tree structure representing the course and also describes how to launch each SCO with metadata describing the details. The 'Run-time' specification then controls how the learning management system launches the content and finally navigation is governed by 'Sequencing' which allows navigating between SCOs and progress data roll up to course level.

The proposed system utilizes this concept of SCOs (Shared Content Objects) and manifest file in order to standardize the data on web and also reuse it for sharing and collaborative learning. But now the manifest file is more structured and semantically inspired by ontology based on user centric contextual patterns (McClelland, 2003) and also existing LOM standards, example, IEEE LOM (Duval, 2002), Dublin Core (Weibel *et al*., 1998), SCORM, etc. Providing a common platform for integrating different services can also be defined as orchestration. So, basically the proposed system is providing orchestration as service explained in next study.

RESULTS AND DISCUSSION

Orchestration as service; Better content to the learner: Orchestration as a service means that to integrate many services (Yongsiriwit *et al*., 2016) at one place as shown in Fig. 2. Orchestration is like a Broker which can provide following services: service intermediate, service

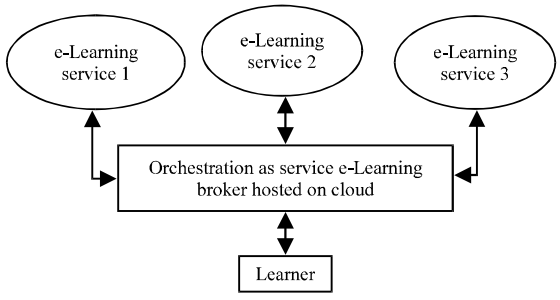

Fig. 2: Orchestration as service

aggregation and service arbitrage. In service intermediation, a broker enhances the service of the registered user by improving its capability and providing value added services. In service aggregation, broker combines and integrates multiple services into one or more new services. It provides integration and ensures the secure data movement. In service arbitrage, the broker has flexibility to choose services from multiple agencies registered to it.

This study proposes concept of e-Learning cloud broker which is a learning management system hosted on cloud and which will provide service intermediate as well as arbitrage service by providing a common platform to all the e-Learning providers to share their data and increase their accessibility. The detailed working of the system is explained in next study.

Proposed framework of e-Learning broker: An e-Learning cloud broker is a learning management system that manages the use, performance and delivery of e-Contents and negotiates relationship between various e-Learning provider's (can be various different LMSs) and learner. e-Learning cloud broker will be a broker which will be having all the three basic components content, learning delivery tools and portal where leaner will register himself. But the main difference lies in the concept that, e-Learning broker's content will not be its own content but that of all the various learning management systems who will register themselves to get their data published and delivered. The broker providing orchestration as service will standardize all the contents and save it with necessary metadata reflecting its contents, scope, etc. On the other hand, it will help the registered learner to submit his queries and depending upon his e-Portfolio which is created at the time of his registration and also is regularly updated on his feedbacks and preferences, he will be provided with the best suited learning management systems content and course (Parameswaran and Chaddha, 2009).

Thus, learner will be having exposure to wide variety of data with preciseness added according to his profile. The heart and success of the system lies in storing data and metadata in such a way that the searching process gives the best results. For this purpose, the framework is using the fundamental knowledge of ontology to make the content and repository stored in well targeted manner to the learner's requirement.

Patterns used in the framework: Ontology is a formal representation of a set of concepts within a domain and the relationships between those concepts. It is used to reason about the properties of that domain and may be used to define the domain (Fensel, 2003). The framework is using this fundamental use of ontology in storing and delivering the data considering three following patterns:

- Content context Ontology/patterns (Global/local) (Fig. 3)
- Learner context ontology/patterns (Global) (Fig. 4)
- Delivering and sequencing context ontology/patterns

Content context ontology/patterns composed of two types.

Common content context patterns/ontology; Global ontology: Common content context patterns are composed of those patterns which are meaningful and common in all the contents. It is composed of (common interest fields) example 'subject, author, date of communication, format, price'. It is basically inspired by common interest of the learners but will be regularly updated based on learner's feedback. All the contents units SCOs will be tagged with this ontology using rdf or xml, so that, system can understand what the stored content is all about. It plays a major role in content filtering.

Individual content context patterns/ontology; Local ontology: Individual context patterns are composed of those patterns which the individual SCO is possessing to make it different from other. It gives more specialization about the individual SCO and helps the system to assess its usability, quality, relevance and feedback for the learner. Example 'views, rating, feedbacks, scope, comments'. It plays a major role in collaborative filtering (Fig. 3).

Learner context ontology/patterns: It is composed of patterns relevant to learner which is based on his portfolio reflecting his skills, interests, abilities, etc., example "knowledge, skills, abilities, learning style, personal information". Learner related information helps the system to understand his profile, abilities and further will help the system to give him best search results and this information is generally taken at the time of registration and can be updated by the learner. This pattern is static in nature and doesn't update regularly. It plays major role in content filtering (Fig. 3).

Delivering and sequencing context ontology/patterns: Other than before mentioned two ontology patterns there will patterns/ontology related to publishing and delivering the contents based on already existing standards ex IEEE

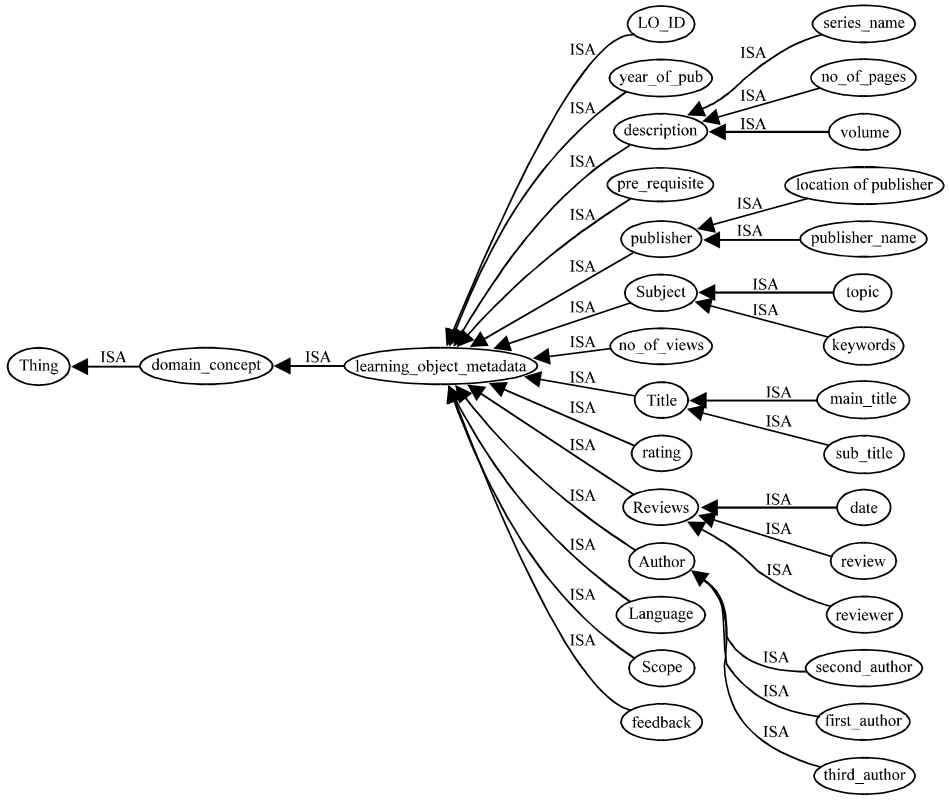

Fig. 3: Conceptualization of the learning object

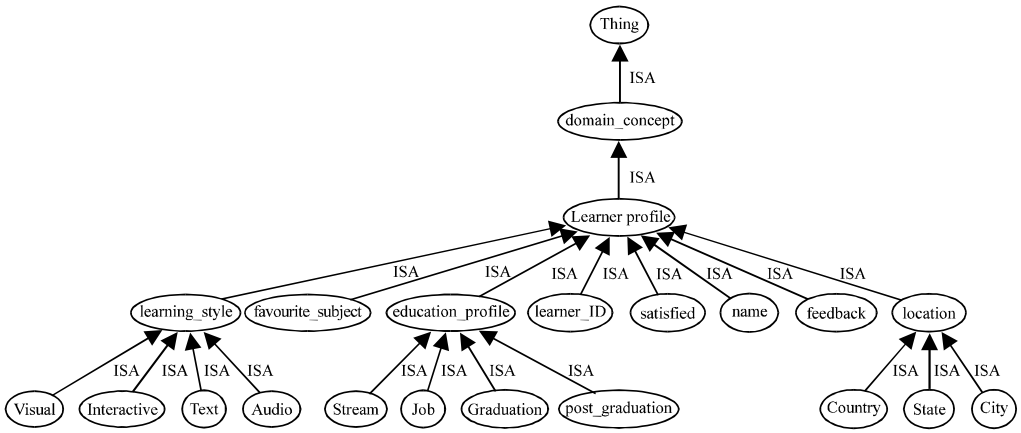

Fig. 4: Conceptualization of the learner's profile

LOM (Duval, 2002), Dublin Core (Weibel *et al*., 1998), etc. It plays a major role in launching, navigating and sequencing the content.

Structure and working of the proposed system: The working of the framework is divided into two modules:

- Interaction with the learner
- Interaction with the content providers

Interaction with the learner: The e-Learning broker will provide portal for the learner for registration, catalogues, course registration, profiling, financial processes and administrative processes. After registration, learner's e-Portfolio is created by taking information ex "knowledge, skills, abilities, learning style, personal information" and appropriately stored in as metadata based on learner context ontology. Learner related information helps the system to

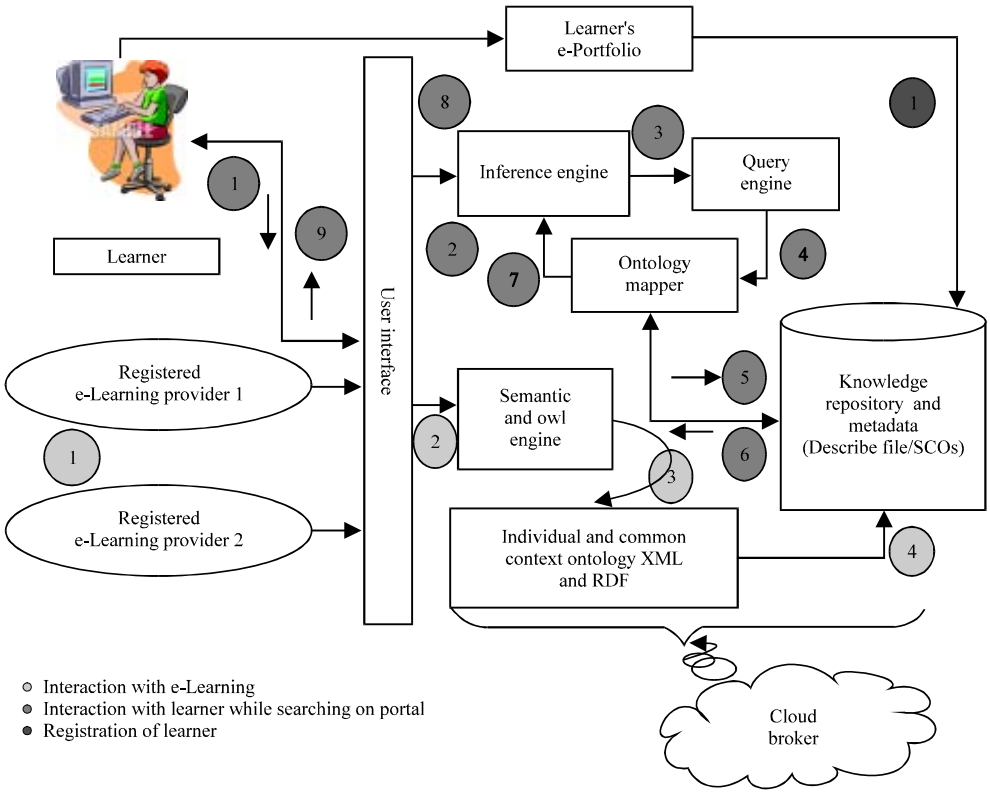

Fig. 5: Working of e-Learning broker

understand his profile, abilities and further will help he system to give him best search results.

After taking learner's request, it is further processed semantically, context ontologies earlier mentioned help to perform content and collaborative filtering based on field relevance and user profile, etc. The learner will also be provided with a common platform where they can blog or rate the content to provide recommendation and relevance to the quality of the content and this can be further used for collaborative filtering. After performing content and collaborative filtering, the appropriate content is shown to the learner. The working is explained in Fig. 5.

Interaction with e-Learning providers, it provides service aggregation and increase their accessibility to the large amount of learners by taking their contents from all the providers and converting the store of information into units of Shared Content Objects and Creating a describe file (inspired by SCORM) for each. It will be containing the resource details based on context ontologies explained earlier, structural details and finally the metadata (learning object metadata) in XML and RDF.

This manifest file will be the core of the repository and will give the system an ontological annotated understandable data to be stored in a repository. It will contain the resource material that makes a logical unit details submitted by the registered providers, hierarchical grouping of the contents and finally the metadata describing the contents and Depending upon the Describe file contents appropriate filtering is done on contents and they are further launched and delivered to the leaner depending up on his needs.

Comparison between existing e-Learning management system and UniEdu cloud: e-Learning plays a major role in increasing the availability of knowledge. This availability was increased when e-Learning service was launched on clouds, example, DoceboLMS, EduWave, Expertus, SCORM cloud, etc. as clouds enhance the efficiency of service by adding on infrastructural add-ons. The next step was to increase the e-Learning contents using the available technological advancements. The UniEdu cloud broker, not only take the advantage of cloud computing but also improves the content quality by integrating all the data from different providers and giving precise targeted knowledge to the learner using orchestration as service. There are two important benefits of the framework.

Collaboration: This manifestation of learning will engage the learner in "give and take type" learning. Learner will be learning from the knowledge base and also on the other hand recommending, giving feedbacks over data, so that, its quality can be improved for other in collaboration.

Personalization: Each registered learner will be categorized on the basis of his objectives, skill sets, etc. The leaner will be provided with information after analyzing his interest and proficiencies.

This framework not just steps in for advancement in e-Learning but also opens the door for integration of semantic web in e-Learning because yet it has to take time for converting syntactic web into semantic web. There are lots of standards available for e-Learning registered on web which can be adopted for designing context ontologies. These ontologies will be regularly refined by user feedback. In core letter 'e' in e-Learning not only means for making learning possible for a remote person electronically but also enhancing its contents. It follows all the factors of e-Learning: reuse, resource sharing, interoperability.

All the existing LMS are individual systems targeting local learners. Their contents and policies are country and location confined. Though they generally follow standards defined by SCORM, IEEE LOM, IMS, Dublin Core, etc. but still there is no way for their unification as learning content is like a sea and it is impossible to integrate without the participation of a third party. Their content and delivery of knowledge is not inspired with learner's profile and is a bit static. The proposed third party e-Learning cloud will not only unify the contents under one roof but also deliver the contents based on user demands and capacity. Therefore, it can be concluded that in the present scenario when semantic web acceptance is far vision and user centric learning is becoming necessary it is required to have a common platform where the various e-Learning provider's contents can be explicitly integrated and made available to the learner.

CONCLUSION

e-Learning technology can play an important role in achieving a true model of e-Learning which would need to demonstrate on what new learning principles the added value of the 'e' was operating. Propelling the need for technological innovation in education is technology itself. Ironically, many times availability of huge volume of information makes it even more difficult to find the information we need. The challenge of the new century is to take stores of information on web and build a useful and manageable base of knowledge that can be used by any student at any time to solve his problems. The proposed framework tries to work on the challenge, so as to unify the data and learners together. Though, it will be requiring SLA, security, royalty issues and finally also requires a proper business model but then also it can be surely adapted as a base for quality enhancement of web data used by online learners.

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