Multi-Adaptive Learning Objects Repository Structure Towards Unified E-learning

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Abstract: *This paper presents a new structure for Multi-Adaptive Learning Object Repository (MALOR) that is oriented towards unified Web-based educational systems. The urge for considering adaptability in the current e-learning systems has been outlined and emphasized in many different researches, due to the negative effect of "one-size-fits-all" approach that is currently implemented in the development of educational courseware. Many systems have been introduced as prototype solution towards providing adaptability in a smaller scope of two or three courses, while using one adaptive approach instead of merging multi adaptive approaches towards the learning experience. Searching the literature there are no definite solution or a framework provided for "Multi-Adaptive Unified E-learning Repositories". The objective of the "MALOR" approach is to provide multi-adaptability in unified e-learning repository environments. The MALOR structure will enable students of accessing a dedicated learning space in order to interact with the course materials that have been adapted to suit his preferred learning style by merging different adaptive approaches towards producing learning objects.*

Keyword*: e-learning system, Learning Object, Repositories, Multi Adaptive Educational Hypermedia.*

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1. Introduction

The continuous enhancements towards information and communication technologies have resulted in many services for educational technologies. Such services resulted in a wide diversity towards pedagogical approaches towards students, learners and instructors. The educational processes have been affected by continuous enhancements through providing new processes and methodologies towards sharing and delivering knowledge [15]. On the other side, universities have adopted such services and applications within their curricula by the availability of many different vendors for software productions towards educational environments. Most of the services and products have been used for managing the learning processes, students and distributing course materials by using dedicated learning management systems (LMS) and learning content management systems (LCMS) [2]. Different solutions and services shifted their focus towards using the full potential of the information and communication technologies (ICT), through providing the learning materials and courses by innovative technologies, using mobile networks and voice over IP technologies for just in time and mobile learning. However, on the learning object level, different software packages have also been used for creating and manipulating learning objects that varied from simple desktop applications (Such as Office applications) to more sophisticated packages that deals with multimedia and interactive learning objects [3]. Most of the created and used learning objects have enriched the educational pedagogy with different resources in terms of quantity and quality, and thus it was believed that such learning objects are providing the optimal educational and tutoring services and solution for online and e-learning for students, instructors and educational institutions, which proved to be false in many cases. The availability of different learning objects created by different instructors and managed by the capabilities and features of LMS and LCMS did not provide the expected flexibility of using e-learning and thus a new problem emerged that is called "one-size-fits-all". [13, 23, 5]. However, with the availability of big number of learning objects and learning resource, the need towards categorizing and classifying learning objects was a natural extension from the previous provided services and packages. The later demand focused on better utilization, sharing and reuse for learning objects, thus the learning object repositories were the answer for such demands. Learning object repositories (LOR), provided the services towards sharing resources among different educational institutions using different techniques and methodologies. Such approaches ranged from using simple structure as in the case of "LionShare" , while more advanced approaches were utilized by "LonCAPA". The presence of such applications and services solved many problems and answered many demands, especially for educational institutions that were lacking the expertise or fund for creating learning objects themselves. It also enabled many educational institutions to provide better means for enhancing the move towards creating and reusing quality learning objects, which helped many instructors lacking the knowledge and expertise for creating such learning objects to be in direct use of the available pool of such educational resources [2]. However, a contrary to what

have been expected a fall in the participants and subscribers towards these educational technologies was recorded in many different studies among students and instructors in comparison with the recorded participation level of such technologies at the early stages. Although that these technologies were provided to enhance the participation level and pedagogy the resent studies have also identified the reasons for such drop as lack of flexibility towards the learning contents and learning processes [13, 23, 5]. Thus a demand was raised for shifting the focus towards supporting learner needs and enabling flexibility rather than providing new technological services under the previous effect of "one-size-fits-all" [5,16]. Different adaptive e-learning applications where created towards satisfying students needs and learning style using different approaches. The focus of such applications was not oriented towards unified learning object repositories, rather it was more to be considered as a prototype towards providing an initial solution to such problem on a small scale covering one or more taught subjects [8]. The need for considering students adaptive needs towards learning resources according to their learning style is a current demand and a must have solution in current or new applications and services[3].

Thus the following sections will draw a clear image of the current repository approaches used and the associated problem of "one-size-fits-all" with such systems. Next this paper will discuss the distinct solution towards enabling a structure towards providing multi-adaptive learning object resources in unified e-learning repositories.

2. E-learning Repositories

E-Learning repositories are web based applications that are used for storing and delivering learning contents. The contents are called learning objects as they differentiate in granularity that ranges from complete courses to single file or image. Such systems are providing features that are oriented towards providing management of information regarding contents and users. Moreover, they provide instructors and course authors with ability to reuse learning objects and to assemble those learning contents into courses [11]. Different initiatives have been implemented to support the idea of unifying e-learning repositories among different organizations and educational institutions, and each initiation has different approach to provide in terms of the services [18]. The idea of UER is based on providing a system that is accessed by a web portal for the purpose of managing learning contents in that repository system. In such systems the process of interacting with learning objects is approved by system administrators that grant such privileges for users with respect for each user's role. Instructors, multimedia programmers, and course authors are granted privileges of using, reusing and updating the repository with learning contents. On the other hand students are generally granted privileges that enable them to view and interact with the course materials and activities that are provided for them through the system. Each UER has a different approach and policy regarding learning materials and resources. Some UER systems provide users with privileges to copy the course or learning materials into their own LMS or LCMS, while other UES restrict the use of their resources to their own learning network [10]. Instructors are mainly provided with different synchronous and asynchronous tools and activities through which they can contact their peers and share different ideas and discuss different solutions. Students are assigned to the system by their instructors or by the administrators of the system as different UER have different policies regarding the sign up and access process. Students are generally provided with different tools through the systems, through which they can interact with their instructors and peers.

3. Unified E-Learning Repository Approaches

The concept of "Unified E-Learning Repository Approaches" is mainly presented in two different structures that are:

- The Centralized LCMS Repository
- Network Learning Object Repository

The first approach of "Centralized LCMS Repository" is enabled by the use of specific LCMS such as (Moodle, Blackboard, Atutor…etc). In this approach the sharing is mainly performed on the course level packages that are generally structured according to the Sharable Content Object Reference Model (SCORM) and the courses are shared between universities or different departments. Using this approach for sharing is considered easy in terms of implementation, cost and sharing, as a centralized portal and access point will be used by all participating universities [16]. The problems associated with this approach are mainly associated with learning object granularity and syllabus requirements, as many instructors are not keen on constraining their courses and teachings according to the provided model by different universities. It has been found that instructors approach towards learning objects are in favor of smaller chunks of learning objects that are related to single learning requirement, idea or objective. From this demand the second approach of "Networked Learning Object Repository" came as an answer, as it constructed its structure on effective management and classification towards smaller learning objects. Providing effective use and sharing of smaller learning objects enabled many instructors on using these objects to construct their own courses according to the demand and context of each learning objective and course requirements defined by departments syllabus[19]. Different programs and applications were made to

provide the "Networked Learning Object Repository" and the following are a small list of some popular and widely used solutions.

- LON-CAPA: This system stands for Learning Object Network with CAPA (www.lon-capa.org). The LON-CAPA functionality is based on providing unified e-learning through a special dedicated network that gathers different universities to it's network. Any university that wants to participate in this network in order to use the repository should structure their servers to be part of the learning network with special demands for servers' types and software platforms.
- LIONSHARE: This system is another UES-oriented platform that uses the network approach for sharing learning objects between learners (http://lionshare.its.psu.edu/). This program offers the same functionalities as:
  - "KAZZA" (http://www.kazaa.com/),
  - "BearShare" (http://www.bearshare.com/),
  - "LimWire" (http://www.limewire.com/) and
  - "Gnutella" (http://www.gnutellaforums.com/),

  but it differs in a point that it requires user authentication before using the system or sharing resources. In addition the program is dedicated for educational environment. LIONSHARE file sharing operates through creating virtual directories into which users can upload files and push them to a remote peer-server. It also enables management of files on those remote servers as they are on the user's local system; moreover, it enables creating access control lists to restrict sharing to a defined group of users to protect users' copyrights. Another program that fit into the same categories of networked UES is "Edutella" (http://www.edutella.org/edutella.shtml). This program was used for exchanging resources between German universities; it was also used by Swedish universities and Stanford University.
- SPLASH: Is another "Network Approach" system that is used for distributing learning objects and managing metadata tagging. The system was developed as a part of the "Portal for Online Objects in Learning" (POOL) project, which is a consortium of several educational private and public sector organizations to develop an infrastructure for learning object repositories [20].

4. The Problem with Learning Object Repositories Approaches

The previous provided solutions towards sharing learning objects either by LCMS or networked approach are considered effective in handling and distributing learning objects among different universities or departments. Those features are mostly appreciated by instructors and educational institutions, while students as receivers of the provided courses and learning materials are been ignored through neglecting their learning demands and diversity of learning styles by the provided features towards displaying learning objects. This lack of support towards learning diversity and learning styles was noticed in most of the systems discussed previously and it was dubbed as the "one size fits all" problem [13]. Having inflexibility towards students preferred needs and styles of learning has resulted in serious drop rates of satisfaction towards the provided e-learning systems and solutions. The origin of this error was related to the early beginnings of LMS/ LCMS, as supporting students' needs and learning styles was not considered from the first time that the design was made of such programs and services. Some partial solutions came from different research studies to provide learning contents based on some criteria associated with students' profiles and performance [23]. Such solutions where found to be expensive and hard to implement in the current design of LCMS, LMS and UER. The problem still exists within the currently used systems and no definite solutions have been provided [1]. Many approaches, including this research, are trying to figure out a definite solution framework that incorporates a wider options for supporting diverse adaptability techniques towards students learning [13, 23, 5]. In order to have a better understanding towards the "one-size-fits-all" problem, the next figure shows a typical example of a course provided for students using LCMS. It is obvious that having this approach of providing course contents that the instructor has selected and added without considerations towards students learning styles. Moreover, the list of learning resources cannot be updated by students through adding additional resources that serves the same learning objective but in different format, or by adding additional resources of the same type to the list. This inflexibility is what is causing lack of interaction with e-learning and whatever instructor is serving into his course, student have to take without being able of choosing different resources from the repositories that satisfies the course learning objectives but in different learning or content style. Such existence for the courseware material is what is known by one-size-fits-all problem, which is affecting the adoption percent rate of e-learning among learners in a larger scale worldwide [16,13,5].

Figure 1. One-size-fits-All in the current courseware.

5. Providing Adaptability towards Students Learning

Different methodologies are being investigated towards providing adaptability for students learning styles. The recent studies are confirming that providing adaptive e-learning would bring better e-learning as facilitated by the pedagogical model provided by each adaptation methodology [9]. Different research studies have been implemented towards providing adaptive educational hypermedia systems such as ACCT [6]. AHA! [7], WINDS [14] and OntoAIMS [3]. The common aim of the previous studies was to find a solution against the one-size-fits-all problem, and to compensate knowledge deficits, and minimize learner fatigue and discomfort with the subject being taught, thus providing an easier introduction to the topic in hand [6, 7]. Each of the previous approaches has its own theories, methodologies and applications that support the idea of adaptability by defining a unique structure for the provision of such services. A major difference between the current e-learning solutions and the adaptive e-learning approach is the latter's capacity to allow the production or reuse of different learning objects from which the learner can select those that are relevant to his learning necessities with respect to different criteria's [4]. Adaptability in most of the cases is based on of the following three criteria's [1, 22] :

- Initial student knowledge.
- Knowledge objectives.
- Preferred learning method.

Our approach to the solution of providing adaptability will focus on bringing the three mentioned criteria's in one framework structure, which is able of providing diversity towards adaptability criteria's. Having this approach is considered new design and framework towards adaptability research studies, as no current solution or framework is implementing different adaptability criteria's through one dedicated framework. The new structure of implementation is named "MALOR". This structure aim is to provide multi adaptability and flexibility approach towards unified e-learning repositories.

6. MALOR a new Adaptive Repository Structure

The idea of the system consists of different models that provide a new design and structure for the implementation of Multiple Adaptive E-learning Repository (MAER). For simplicity, the design will be introduced in three simple structures which will later be assembled to form one final structure.

6.1. The Data Domain Model

The "Data Domain Model" that is represented by the repository structure, will provide the service of storing the learning objects into a specific designed structure. The structure that will be used by the repository will be called the "Book-Structure". The structure is capable of representing different categories in hierarchical order, starting by courses and with each course the chapters associated with it. Chapters will consist of topics and each topic with learning objectives and every learning objective will have a set of different resources associated with it [16]. Finally each resource will have different numbers of metadata and tags associated with it. Tags can include author name, date, type, size, format…etc.

The course repositories structure of courses can be defined and supervised by a consortium or committee which will consist of sub-committees that define and regulate course layout structure. The following figure shows an illustrated design for the repository data domain model.

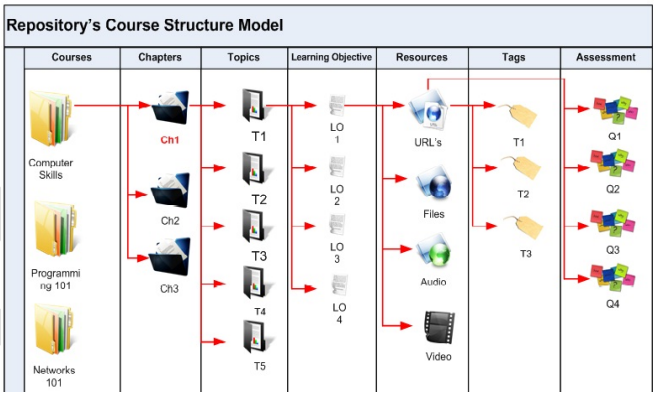

Figure 2. Repository data domain model.

The courses structure design can be approved by committees formed from different universities to supervise and to advice on the courses structure. Such committees will present an outline that merges the suggestions of the experts in the courses being taught, so that a particular course structure can fit and include all the needed chapters and topics required by each university's curriculum.

6.2. Users' Domain Model

The users' domain model is divided into three sub models that represent the users that are interacting with the system. The following are the defined user type's domain models [16]:

- System Administrators Domain Model
- Instructors Domain Model
- Students Domain Model

6.2.1. System Administrators Domain Model

- Administrators in the multi-adaptive repository system will be responsible for different tasks that include:
- Coordinating with instructors from different universities in order to create the appropriate course structure
- Creating the course structure and defining the course hierarchy and metadata used
- Creating instructors/students accounts

6.2.2. Instructors Domain Structure

Instructors in the multi-adaptive repository system will have four different responsibilities that are:

- They will be responsible for uploading different learning objects with respect to the course structure.
- They will be responsible for filling some of the metadata and tags that are associated with each resource with respect to the course structure.
- They will be responsible for adding assessments to be associated with each resource they upload to the course with respect to the course structure
- They will be responsible for creating sub-structures from the main course structure that are called (e-courses), so that they fit the subject's requirements for the course being taught according to university's curriculum.

The process of adding learning objects will be through a dedicated web page, through which the instructor will add special information about the each learning object uploaded or as it is called "Meta-Data". Using "Meta-Data" with learning objects will enable the repository to use advanced methodologies for searching and displaying learning objects, through incorporating resource data framework (RDF) technology. The scope of this research will not use RDF for learning objects retrieval, but having such flexibility in the repository design, can ensure its maintainability and flexibility for further and future enhancement on the multi-adaptive repository system. The process of creating e-courses from the main data domain model will be through performing different steps that are:

- Locating the course.
- Selecting the needed chapters from the main data repository model, which are required by the course syllabus.
- Selecting the needed topics from the course with respect to the chapters being selected.
- Selecting the needed learning objectives with respect for each selected topic in the previous step.
- Selecting different types of resources with respect for each selected topic.
- Selecting different types of assessment learning objects associated with each selected topic.

After selecting the needed course structure and learning objects, the final step is to click on a dedicated button that will create the e-course, next the course will be added to instructors' domain.

6.2.3. Students Domain Model

Students will log to their learning space through their privileges that are given for them by their instructors. Students will see the courses that have been registered to, with respect for each instructor teaching the course. The added courses will be an exact copy of the e-course structure and data added by the instructor. Students will have the privileges of adding and displaying additional resources with respect to their adaptability preferences of initial knowledge, learning objectives or learning style. Adding additional resources can be performed either as single preferences towards adaptability or through selected merging between the adaptability approaches in order to have the multi-adaptive approach. Students will also be able of ranking the learning objects in order to produce a repository that is having quality learning object, and the lowest ranking learning objects can be removed in the future by a decision made by instructors and site administrator [16].

6.3. Adaptability Domain Model

The adaptability domain model will be responsible for performing functionalities that are related towards selecting and displaying learning objects for students in adaptive and multi-adaptive manner based on their preferences towards initial student knowledge, knowledge objectives or preferred learning method. The adaptability model will be divided into two sub model that are:

- Adaptability Selection Model
- Adaptability Merge Model

The adaptability selection model consists of the previous adaptability approaches as separate entities, and each approach has its methodology of implementation as it is shown in the following section.

6.3.1. MALOR Students Initial Knowledge Assessment Engine

This approach is working towards student's initial knowledge towards the course being taught, as it is defined using an assessment questions derived from the assessment database related to each learning objective within the topics in the chapters, the questions can be selected randomly or based on predefine criteria defined by the course instructor. The results of the assessment are displayed as learning objects that are identifying students' initial knowledge from the selected learning objects of the course. The process of identifying students' initial knowledge is triggered by the user himself based on his request towards displaying the

course structure using this adaptable approach. This feature of identifying students' initial knowledge is mainly appreciated among learning adults as many of them come with good background towards the subject being taught, and thus using this approach would benefit them largely in mapping the new knowledge area. The following figure illustrates the processes used in identifying students' initial knowledge in MALOR structure.

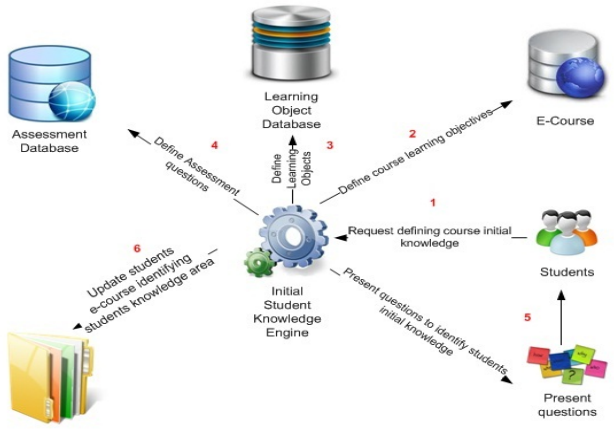

Figure3. Student initial knowledge adaptation processes model.

6.3.2. MALOR Students Learning Objective Assessment Engine

If the student selects to display learning objects based on his adaptability approach towards learning objective, he will be displayed with the e-course's learning objectives list from which he will select the desired learning objectives. This process will update the existing course structure and the displayed resources to show only resources that are identified within each learning objective selected by the students and previously identified by the instructor. This feature is e-learning environment is mainly appreciated by researchers and information seekers that are searching for specific learning objective to be fulfilled. Figure 4 illustrates the processes used to identify adaptability towards learning objectives in MALOR structure.

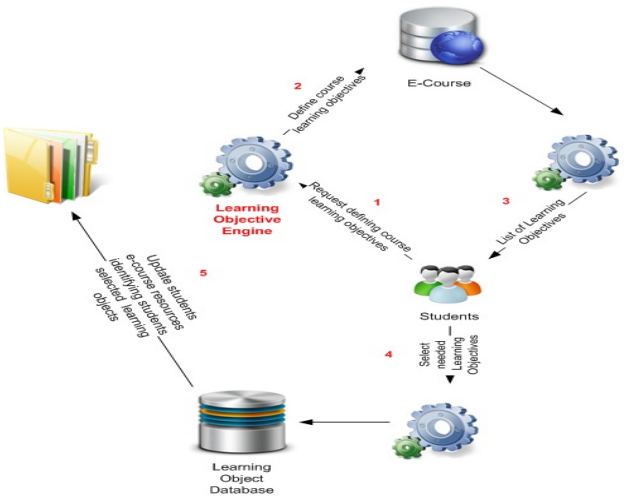

Figure 4. Student learning objective adaptation processes model.

6.4. MALOR Students Learning Style Assessment Engine

To provide adaptability using preferred learning style, an assessment process should be present in the structure. In this type of adaptability the assessment is different from the two previous approaches, as this process will use a predefined questionnaire for assessing learning style. The MALOR structure adaptability is based on using the visual, auditory and kinesthetic (VAK) method [1, 22]. The result of using this method is based on giving percents for the preferred visual, Auditory and kinesthetic learning objects. After the student finishes his assessment, he will be asked to define some additional features that are related to the nature of e-course and MALOR learning objects structure. The result of having this process will be an update version of e-course with additional resources added or identified as adaptability result towards learning objects. In order to bring to bring a better understanding towards this adaptability approach as it uses assessment that are not related to the assessment database, we will have the following example:

If "Student-X", had his learning style assessment according to VAK approach and we will presume that the following values had been displayed and recorded for him after the assessment.

Table 1: The VAK result.

Learning Style	Value
Visual	*70*
Auditory	*10*
Kinesthetic	*20*
N.O. of additional files for each learning objective	*10*
Rank of file quality	*>= 6 out of 10*
Max File Size	*10 MB*
...etc	*...*

The displayed values will define the number of additional resources to be added with respect to each learning objective. Liking back to our example, the student will have 10 additional resources added, seven of these resources will be of video type, one audio and two of kinesthetic type taking into consideration the rest of the constraints like the file rank and the maximum file size or other available constraints that can be added and configured by the system administrator. If the available learning objects are less than 10, then the system will work on displaying the resources based on narration to the nearest integer. The following figure will illustrate the processes towards displaying learning objects based on adaptability towards students' learning style.

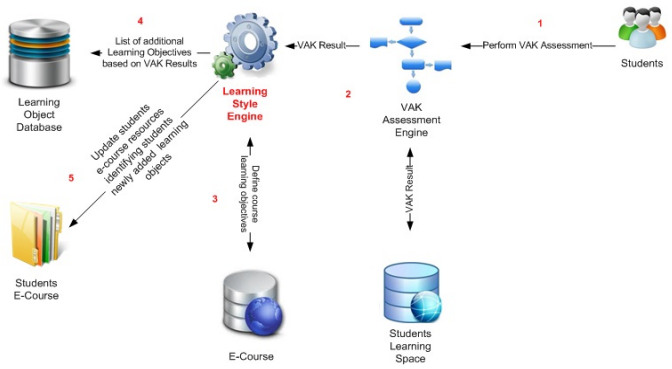

Figure 5. Students learning style adaptation processes model.

7. MALOR and Unified E-Learning Structure

The previous section showed MALOR's different sub models and discussed each functionality and processes. This section will present the complete structure of MALOR and will present the interaction between each sub module in order to present multi-adaptive learning object repository in unified e-learning environment. The process of performing multi-adaptability is performed by multi-adaptive engine that intersects the results of each adaptable approach in order to bring more specific adaptable learning objects towards student's learning. The following figure shows the concepts of intersecting between different adaptable approaches as each intersection defines a type of multi-adaptive approach.

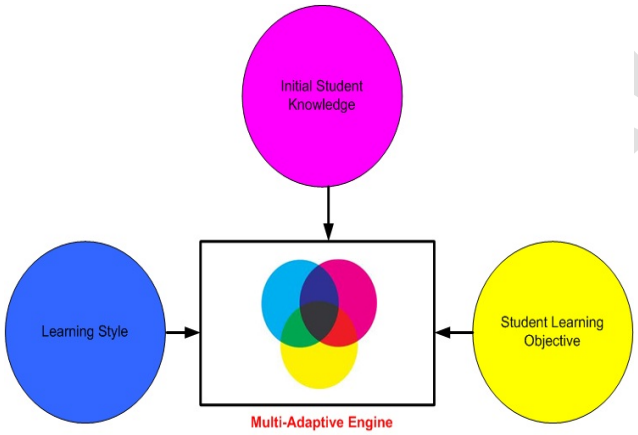

Figure 6. Multi-Adaptive Engine.

Based on the previous figure, the student will have four different multi-adaptive results that are:

M-adapt (IN + LS) = Student's e-course structure and data will be based on student's initial knowledge plus added resources of the VAK result percentage with each learning objective in the defined course.

M-adapt (IN + LO) =Student's e-course structure and data will be based on merging the structure of thee adaptable approaches with their defined learning objects.

M-adapt (LO + LS) = Student's e-course structure and data will be based on student's learning objective selected by student plus added resources of the VAK result percentage with each learning objective in the defined course.

M-adapt (IN + LS+LO) = Student's e-course structure and data will be based on merging the structure of adaptable approaches with their defined learning objects number plus added resources of the VAK result percentage with each learning objective in the defined course.

7.1. Malor System Structure Scenarioand of Use

In order to bring a better understanding for MALOR system we will assume the following scenario. Student-x logs in the system and selects his university and department to display all the available courses. For instance, he selects Java course, and thus he will be introduced by a list of instructors that are teaching this course in his university. He selects instructors-x as his professor, and based on that selection, the e-course defined by the instructor will be copied to his student e-learning space as a structure of pointers that point to the learning objects with respect to the course structure according to the repository. Student-x can use the course structure as it is displayed with the learning objects defined by his instructor or he has the option of enabling a single and multiple adaptive approaches. In order to use any adaptive approach he should perform assessment that will be used to guide the display of courses learning objects. In the case of initial knowledge and knowledge objective, the assessment will derived from the repositories assessment database. In case of learning style the assessment will be predefined by specific learning style questionnaire that are oriented towards defining the VAK learning style. If the student selects either approaches of (initial knowledge, knowledge objective), it will affect the course's display towards learning objects so that (color, shape, tag..etc) guide will show the student what learning objects he needs to learn and interact with. But in the case of learning style with or without any intersection with other adaptive approaches, it will change the display and the number of resources associated with each learning objective in the course. Figure 7 shows the complete MALOR system structure.

The following benefits are expected from the use of MALOR:

- Universities that are not having e-learning solution can use the system directly before having their own e-learning system.
- A better medium for sharing learning objects among universities will be provided.
- The system with its structure is more suited towards different types of learners, either as youngster in schools or freshmen or adult learners having some experiences in the courses being offered.
- Learners will be presented with equal chance of being introduced to the same quality and quantity of learning objects.

- Learning objects will be afforded for all the students in different adaptive manner.
- Students that are challenged with disabilities will have a better chance towards interaction with learning objects as they are displayed in adaptive manner.
- The student will be able to interact and control his learning space, as he will have his own edition of the provided e-course which fulfills the course requirement in adaptive manner.
- E system's structure flexibility can be used to provide different means of adaptive e-learning.

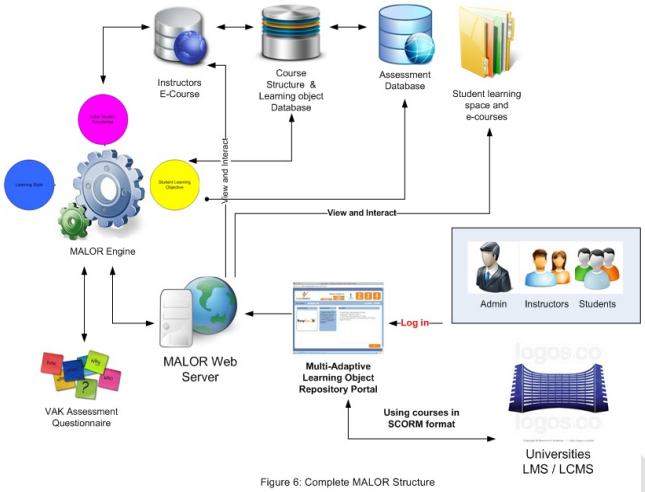

Figure 7. MALOR structure.

8. Conclusion

The need for adaptability within the current learning object repository systems should be considered, if the obstacles that prevent a comprehensive adoption of e-learning are to be overridden. By providing adaptive e-learning to suit a variety of student learning styles, the repository structure proposed here can go a long way in alleviating the burden each university has to bear in terms of effort and finance. With the presented features that were added to support other adaptability approaches in addition to the VAK method. These features towards adaptability are the precise one of the major strengths of MALOR system, as it provides enhanced functionalities and allows a better support for learners.

References

[1] Armstrong, T, 2009, "*Multiple intelligences in the Class Room*, 3rd ed." , ISBN:978-1-4166-0789-2 , ASCD Publishers1703 N Beaauregard St.

[2] Aroyo, L., & Dicheva, D. "The New Challenges for E-learning", *The Educational Semantic Web. Educational Technology & Society*, vol 7 (4), pp 59-69. 2004.

[3] Aroyo, L., Mizoguchi, R., & Tzolov, C. (2003). "OntoAIMS: Ontological Approach to Courseware Authoring". P*aper presented at the International Conference on Computers in Education (ICCE2003)*, December 2-5, 2003, Hong Kong.

[4] Brusilovsky, P. (2001). Adaptive hypermedia. Methods and techniques of adaptive hypermedia. *International Journal of User Modeling and User-Adapted Interaction*, 11 (1/2), 87-110.

[5] Cuthrell, K. and Lyon, A. (2007) "Instructional Strategies: What Do Online Students Prefer?", *Journal of Online Learning and Teaching* 3(4):pp. 153-163.

[6] Dagger, D., Wade, V., & Conlan O. (2005). 'Personalization for All: Making Adaptive Course Composition Easy". *Education Technology & Society*, 8 (3), 9-25.

[7] De Bra, P., Aerts, A., Smits, D., & Stash, N. (2002). AHA! Version 2.0, More Adaptation Flexibility for Authors. *Paper presented at the World Conference on e-Learning in Corporate, Government, Healthcare &Higher Education* (ELearn'2002), October 15-19, 2002, Montreal, Canada.

[8] Dolog, P., Henze, N., Nejdl, W., & Sintek, M. (2004). "The Personal Reader: Personalizing and Enriching Learning Resources Using Semantic Web Technologies". *Paper presented at the Third International Adaptive Hypermedia and Adaptive Web-based Systems Conference (AH2004)*, August 23-26, 2004, Eindhoven, The Netherlands.

[9] Duffy. T , and Kirkley.J , "Learning theory and pedagogy in distance learning". *Learner-Centered Theory and Practice in Distance Education*. Mahwah, NJ: Lawrence Erlbaum, 2004.

[10] El Saddik, A. and Hossain, M. (2007) "LORNAV: Virtual Reality Tool for Navigation of Distributed Learning Objects Repositories", In: Pierre, S. (ed.) *E-Learning Networked Environments and Architectures: A Knowledge Processing Perspective*. New York: Springer Book Series.

[11] Hatala, M., Richards, G., Eap, T. and Shah, A. (2007) "Secure Communication Layer for Scalable Networks of Learning Objects Repositories", *E-Learning Networked Environments and Architectures* pp:276-305.

[12] Hedberg.J. G, The online and digital experience: reassuring higher-order learning outcomes. In L. R.Vandervert, L. V. Shavinina & R. A. Cornell (Eds.), *Cyber education, the future of long distance learning*, New York: Mary Ann Liebert, 2001, pp 219-236.

[13] Jones, A. (2009) "Redisciplining Generic Attributes: The Disciplinary Context in Focus" *Studies in Higher Education* 34(1): pp. 85-100.

[14] Kravcik, M., & Specht, M. (2004). "Flexible Navigation Support in the WINDS Learning Environment for Architecture and Design". P*aper*

presented at the Third International Adaptive Hypermedia and Adaptive Web based Systems Conference (AH2004), August 23-26, 2004, Eindhoven, The Netherlands.

[15] Lockyer. L, Patterson. J,Harper. B, "ICT in higher education: evaluating outcomes for health education", J*ournal of Computer Assisted Learning* ,Vol. 17 Issue 3 Page 275 September 2001.

[16] Matar.N , Khwaldeh. S and Hunaiti. Z, " Adaptive Unified E-learning System for Supporting Better E-learning Approach", *Proceedings of the 8th Annual Postgraduate Symposium on the Convergence of Telecommunications, Networking and Broadcasting (PGNet 2007)*, Liverpool John Moores University, UK, 28-29 June 2007.

[17] Perkins, D. *Outsmarting I. Q The Emerging Science of Learnable Intelligence*. New York: The Free Press 1995.

[18] Peters, M. and Araya, D. (2008) "Networks, Information Politics And The New Paradigm Of Social Production", *Educational Research: Networks and Technologies* 2: pp. 33-42.

[19] Pouyioutas, P. and Poveda, M. (2005) "Designing a Learning Object Repository-The Views of Higher Education Faculty", *Lecture Notes in Computer Science 3583/2005*: pp. 111-121.

[20] Richards, G., McGreal, R. and Friesen, N. (2002) "Learning Object Repository Technologies For Telelearning: The Evolution of POOL and CanCore", *Proceedings of the IS2002, Informing Science + IT Education Conference*, June, 2002. Cork, Ireland.

[21] Rosmalen.P.V, Vogten. H,Van Es. R, Passier .H, Poelmans.P, & Koper.R, "Authoring a full life cycle model in standards-based", a*daptive e-learning. Educational Technology & Societ*y, 9 (1), 2006, 72-83.

[22] Santally, M. I., & Alain, S. (2006). Personalisation in Web-Based Learning Environments. *International Journal of Distance Education Technologies (IJDET)*, 4(4), 15-35. doi:10.4018/jdet.2006100103

[23] Willems, J. (2007) "Does Style Matter? Considering the Impact of Learning Styles in E-Learning", *In ICT: Providing choices for Learners and Learning*. [online],Available: http://www.ascilite.org.au/conferences/singapore07/procs/willems-poster.pdfascilite Singapore 2007. (Accessed on 7th December 2009).

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