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Development of Web-Based Learning Object Management System

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Abstract— **This paper presents the development of a web-based learning object management system. The basic principle of learning object is that ' smaller is better". Essentially, it is better to breakdown the learning content into small modular chunk of learning contents which are reusable in many learning context and also can flexibly be assembled into electronic courses. Accordingly, in this paper , emphasis was laid on the development of content chunking method-based atomization mechanism and the adoption of metadata mark-up for the atomized contents. Based on the atomization mechanism and the metadata scheme, a web based learning object management software system was developed. The database for the system was designed based on the Extensible Markup language (XML) and the IEEE 1484.12.1-2002 Learning Object Metadata Standard (LOM) attributes. The database system is implemented using MySql database management system. As a web application, the Hyper Text Markup language (HTML), Cascading Style sheet support(CSS), JavaScript, Extensible Markup Language (XML) and Hypertext Preprocessor(PHP) were used for the user-side and the server side scripting. The developed software has over ten (10) key functionalities and some relevant screenshots of the software were captured and discussed in this paper. The ideas presented in this paper will be useful to assist the leaning content industry to transition from the one-size-fits-all approach to learning content customization.**

Keywords— Learning Object, Metadata, Learning Object Metadata Standard, Atomization, Reusability, Extensible Markup language (XML).

I. INTRODUCTION

Over the years, the concept of learning objects has been widely proposed to enhance the reusability of electronic learning materials [1,2,3]. The idea of learning objects is based on the assumption that small pieces of learning contents have greater potential to be reused in different educational contexts than large units, such as whole courses [4,5,6]. While whole courses are designed to suit a specific target group of learners, learning objects may be used as building blocks to produce diverse learning units for different learner groups and learning objectives [7,8,9].

Due to advance in technology, there is need for standardization, wide distribution and expansion of learning object which requires effective, convenient, flexible, and assured way of learning; therefore, an efficient atomized learning object management system is able to provide this [10,11,12]. Persistent advancement in information and communication technologies leads to continuous refinement of learning object technologies and ensures future growth of this domain [13,14,15,16].

Consequently one of the most crucial factors that influence quality of the content of learning object depends on how reusable the subject matter is, but the way of organizing and sequencing the content, its delivery and presentation can be pre-defined in a standard way [17,18,19]. In order to develop and manage learning objects and to enhance the already existing system, design and development mechanism for generic web-based learning object management system is presented in this paper. The system enables users to create, store, reuse, and manage learning contents. Also, the paper provides procedure that will help creators of learning content to atomize the learning content and also use appropriate metadata specification to efficiently mark up the contents of the learning object. The ideas presented in this paper will be useful assist the leaning content industry to transition from the one-size-fits-all approach to learning content customization .

II DEVELOPMENT OF THE ATOMIZATION MECHANISM AND METADATA MARK-UP OF THE ATOMIZED CONTENTS

A. The Atomization Mechanism

Atomization can be defined as the process of breaking down content into smaller, bite-sized bits of easily digestible information that are easy to comprehend, learn, and commit to memory[20,121]. Many e-learning content developers make a mistake

of providing learners with too much information at once [22,23,24,25]. It is better to limit content, to avoid an overload in the working memory and enable connections with information already in the long term memory [26,27,28,29]. Atomization works by presenting a large amount of content in small modules to make the information easier to read, process, and remember. It is a useful technique for all types of effective e-Learning design but particularly in courses that cover complex concepts [30,31].

The atomization process adopted in this study is the chunking method. An entire course content is broken down into little chunks; these chunks are arranged into some organized training sequence so as to help encode the learning schemas in the long term memory. This will easier for learners to understand the course materials or the learning content. A detail breakdown of how the atomization mechanism can be conducted is shown in Figures 1. The learning content or materials can include more than one activity or course.

In the chunking atomization method used in this work, the entire course content is first broken down into modules, secondly, each of the modules broken down into units or topic level and thirdly, each of the units or topic level is broken down into slide or screen level (as shown in Figure 2).

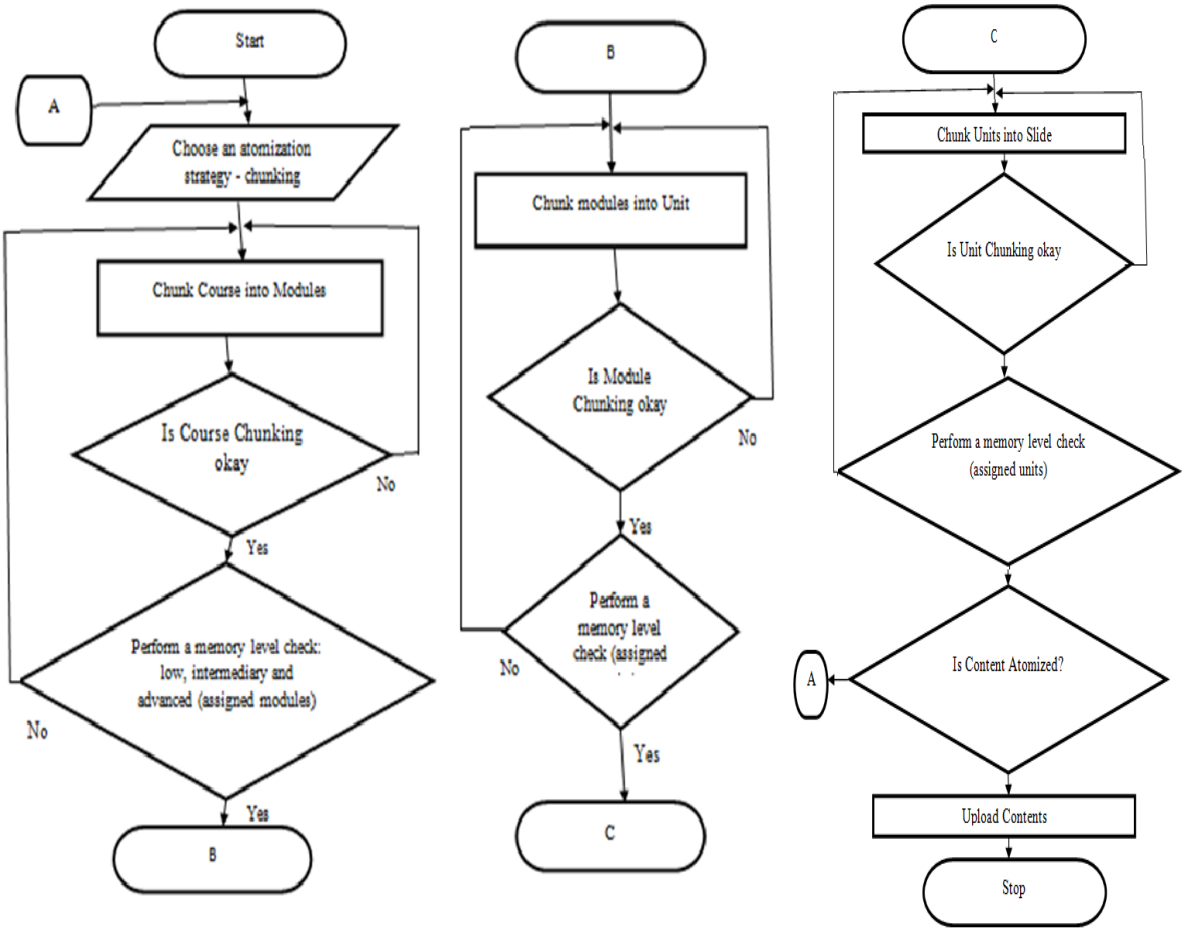

Figure 1: Atomization mechanism.

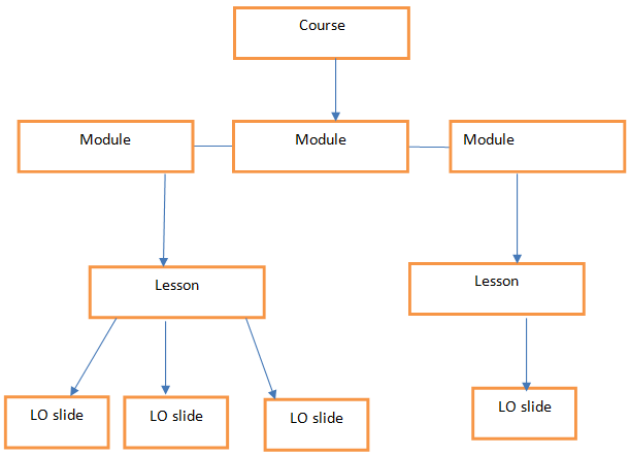

Figure 2: The instructional design course structure.

After breaking down the course content into modules, it is checked to verify if the chunking result is okay and also a memory level check is performed based on the three identified user categories, namely, low, intermediary and advanced user/learners. This helps to optimize the number of ideas to place in a slide for ease of understanding by the learner. If the number of ideas placed in a slide is more than the number required by the system the contents will not be uploaded. Lastly, the atomization process is check to verify whether the contents has been duly and efficiently atomized; if it is not the atomization process is carried out again. Essentially, content development

is always about evaluation, revision, and continual improvement to get rid of unnecessary contents.

B. Metadata Mark-up of the Atomized Contents

The representation of the learning object in this work is based on the Learning Object Extensible Markup Language (XML) technologies. The XML`s metadata are not only used to markup the contents for adaptation and reuse, but also to markup all the data needed to manage different activities involved in the learning process. The procedure for the markup of the learning object using the (XML) metadata is shown in Figure 3.

The IEEE 1484.12.1-2002 Learning Object Metadata Standard (LOM) is adopted for the metadata which groups the data elements to describe a learning resource into the following nine categories: general, lifecycle, meta-metadata, technical, educational, rights, relation, annotation and classification [32,33,34,35]. The metadata attribute of the atomized course data schema includes: Course Material , Course Title , Licenses , Reference Material , Scope , Structure , Aggregation , Course Materials , Versioning , Duration , Learning Standards , Size , Interactive Type , Interactive Level , Semantic Density , Copyright and Context.

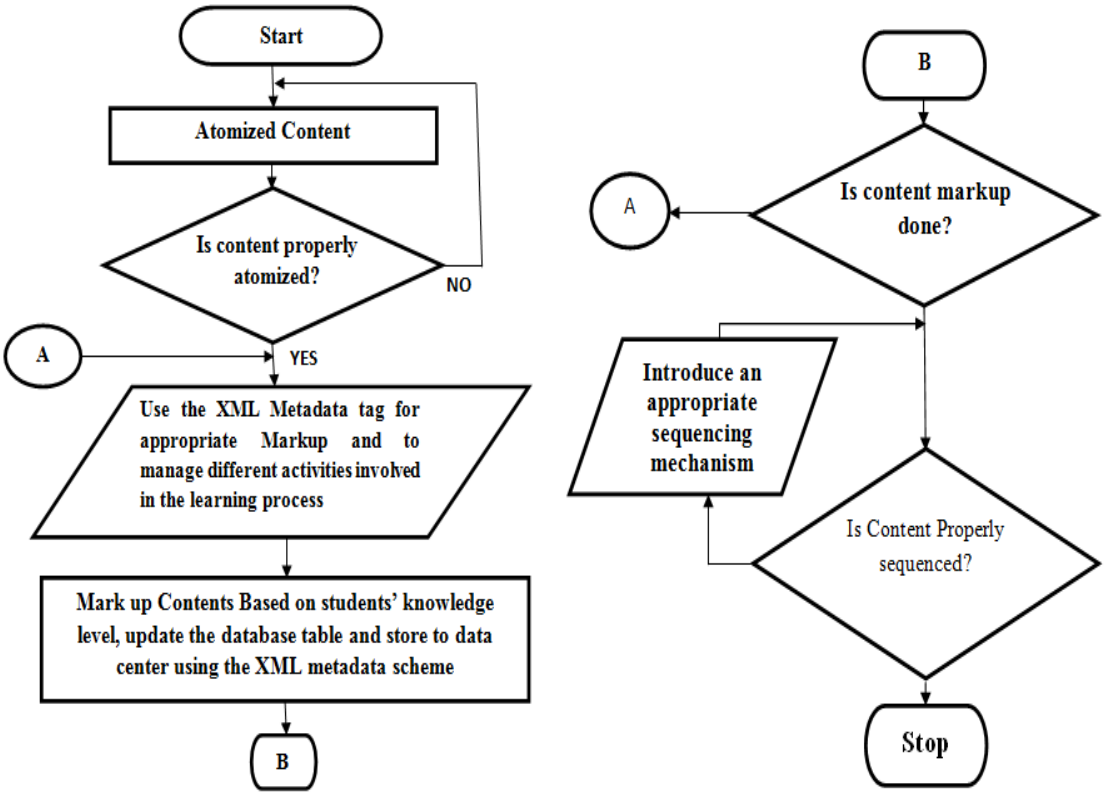

Figure 3. Extensible markup language(XML) metadata content markup

III . DEVELOPMENT OF THE SOFTWARE FOR LEARNING OBJECT MANAGEMENT SYSTEM

Based on the atomization mechanism and the markup scheme presented, a web-based learning object management software system is developed. The software is designed with a database for the storage and retrieval of data. The database is also responsible for holding users details like registration details, the learning contents, user generated contents, audit trail of users activities in the system, etc. The database is designed based on the XML and the IEEE 1484.12.1-2002 Learning Object Metadata Standard (LOM) attributes [36,37,38]. The database system is implemented using MySql database management system.

The learning object management software system is a web application that has two major modules; the user and the administrative module, as given in Figure 4. As a web application, the Hyper Text Markup language (HTML), Cascading Stylesheet support(CSS), JavaScript, Extensible Markup Language (XML) and Hypertext Preprocessor(PHP) were used for the user-side and the server side scripting.

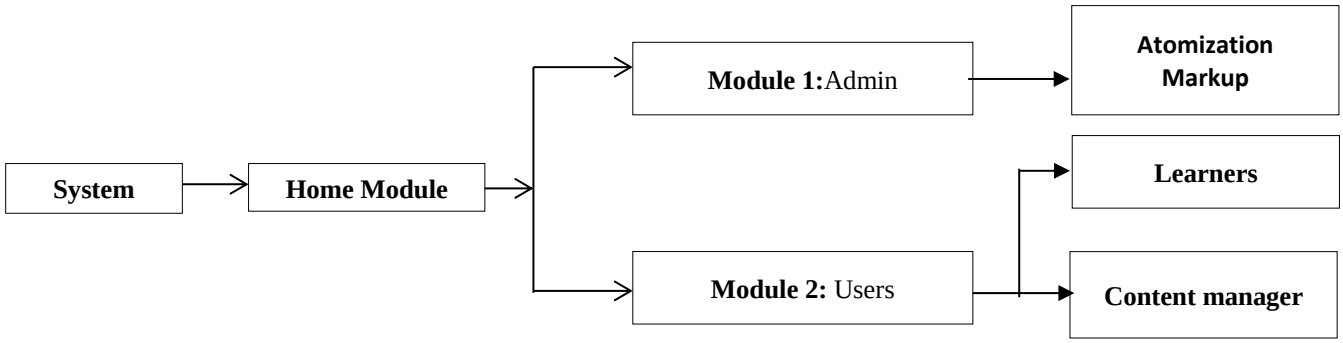

Figure 4: Functional decomposition of the application.

The functionalities provided by the system are as follows:

i. **Registration**: The system has a module that handles the registration of new users into the platform depending on the area of the user's interest. One could register as a content manager or could register as a learner.
ii. **Log in:** Registered users can log in to the system.
iii. **Password encryption:** The passwords of the different users registered are encrypted in the database for security purpose.
iv. **Data storage:** With the use of a database, the system can store and retrieve data.
v. **Platform registration:** The system has a module that aids registered users who are learners the ability to navigate through the system resources and learn on the web-based application using learning objects.
vi. **Check mechanism:** The system enables the admin to verify the various content managers to ascertain their deliverables and make sure it is properly atomized.
vii. **Communication of users:** The system enables registered users to communicate with the console or the instructors through their feedback after enrolling in a course.
viii. **Search mechanism:** The system has a module that helps investors to search for different topics of their choice. This is powered with the aid of a metadata.
ix. **Evaluation mechanism:** this system has an evaluation mechanism to check if the learners really understood the lessons.
x. **Rating system:** the system learning process could be rated by the learners on a scale of five.

VI. RESULTS AND DISCUSSION

The web-based learning object management software system presented in this paper is titled JPrimeLearn and it is locally hosted for demonstration purposes. Some relevant screenshots are captured and discussed.

A. Accessing the Application

When a user using a web browser accesses the URL address the landing page shown on Figure 5 will be displayed on his web browser. The reference link shown at the top of the home screen from left to right are top lectures, latest lectures, categories, sign-up and login reference link respectively. The user can decide to click on the reference link displayed so as to have access to the features listed there.

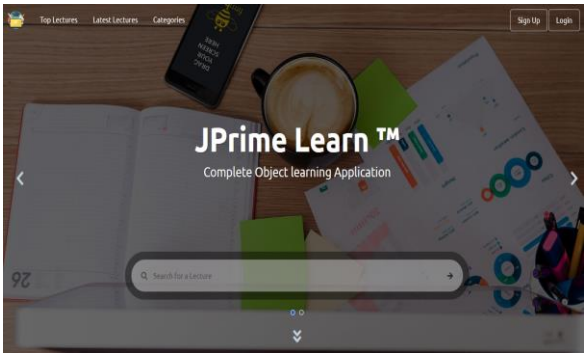

Figure 5: Screenshot of Jprimelearn Home Screen.

B. User Sign-up Screenshot

When a user visits the web page, on clicking the sign up button on the homepage, the user's registration details will be required and when the user supplies them they are stored on the system. The user can sign up as a learner or could sign up as a content developer. The content developer will be verified based on then developer's teaching discipline. The verification process is carried out by the administrator. This session could be seen on Figure 6.

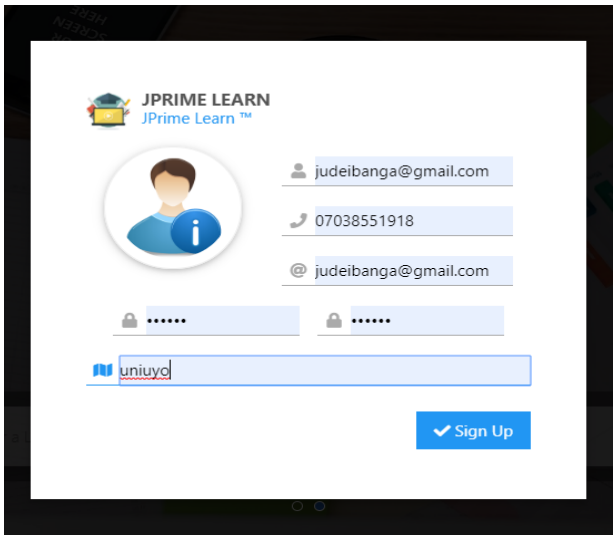

Figure 6:Screenshot of User Sign-up Screen.

C. Log-in Screen

The user must be logged on to have access to the functionalities provided by the system. The user can log on as a learner or as a content developer. The login authentication uses a two way process. When a user inputs his email address, if this email address is not already registered it will not allow the user input his password so as to limit the amount of processing time on the server. The password is encrypted with a Secure Hash Algorithm (SHA-3). Once one hovers around the log-in icon on the top-right corner of the home screen the login page is displayed as shown in Figure 7 .

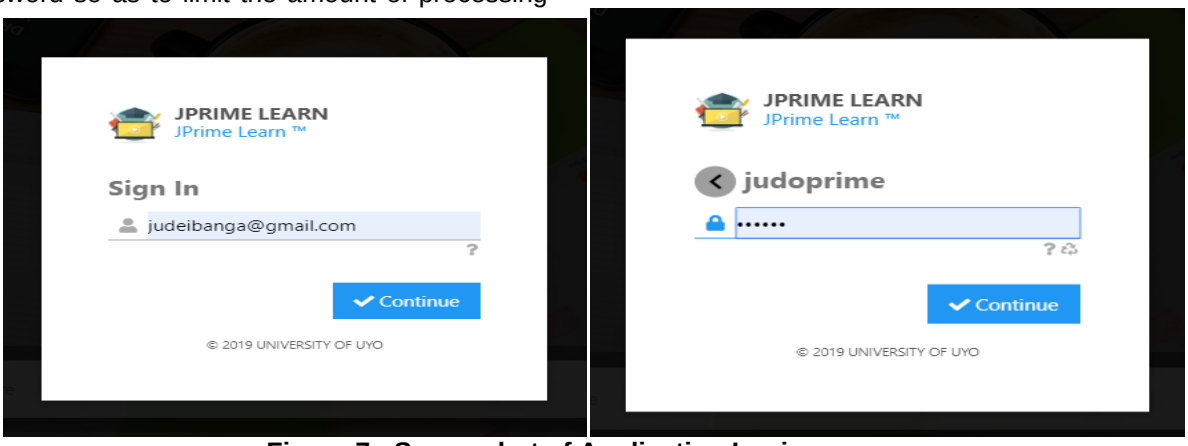

Figure 7: Screenshot of Application Login screen.

D. User Dashboard Items

After a user logs into the system, the user can have access to the lecture with the best rated authors; the user can also view the top lectures and the latest lectures. In the best author section, names of authors whose contents have been rated best are displayed (as seen in Figure 8).

A learner can also search on contents based on how good the author's works are rated. This is accomplished by the use of the metadata attributes that are applied to the atomized contents that are appropriately marked up with relevant tags. Therefore, the system can carry out query operations with the use of the metadata tag. Figure 8 gives a screenshot of the user search page. The screenshot for the top lectures and the latest lectures can be viewed on Figure 8.

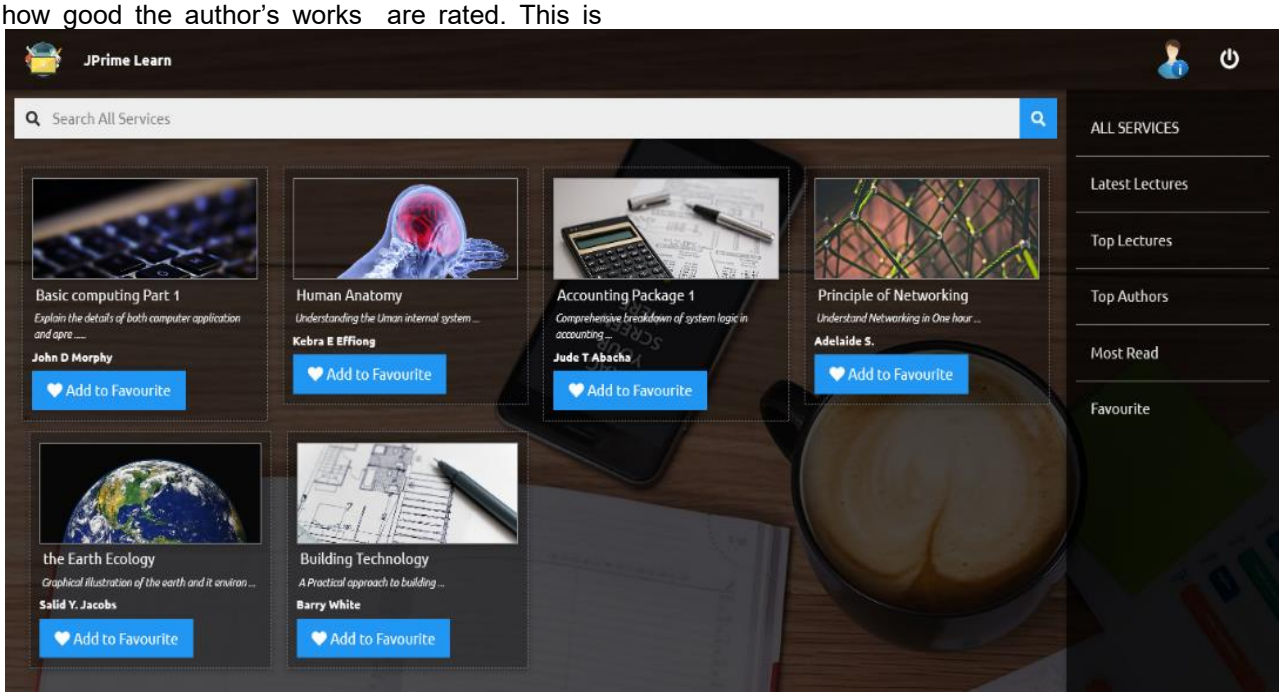

Figure 8: User Search Page.

E. The lecture Content Manager Page

This is the main interface that houses the major operations of the web application. Remarkably, the software provides numerous learning content sequencing templates that are suitable for different sequencing methods. As such, in this lecture content manager page the atomization of learning content is carried out and the atomized contents can be sequenced with the help of the sequencing templates provided within the software. Hence, content developers can use the system to format their contents in a way that suits their particular learning method. Figure 9 shows the template-based sequencing paradigm and also the different learning discipline a content uploader could adopt.

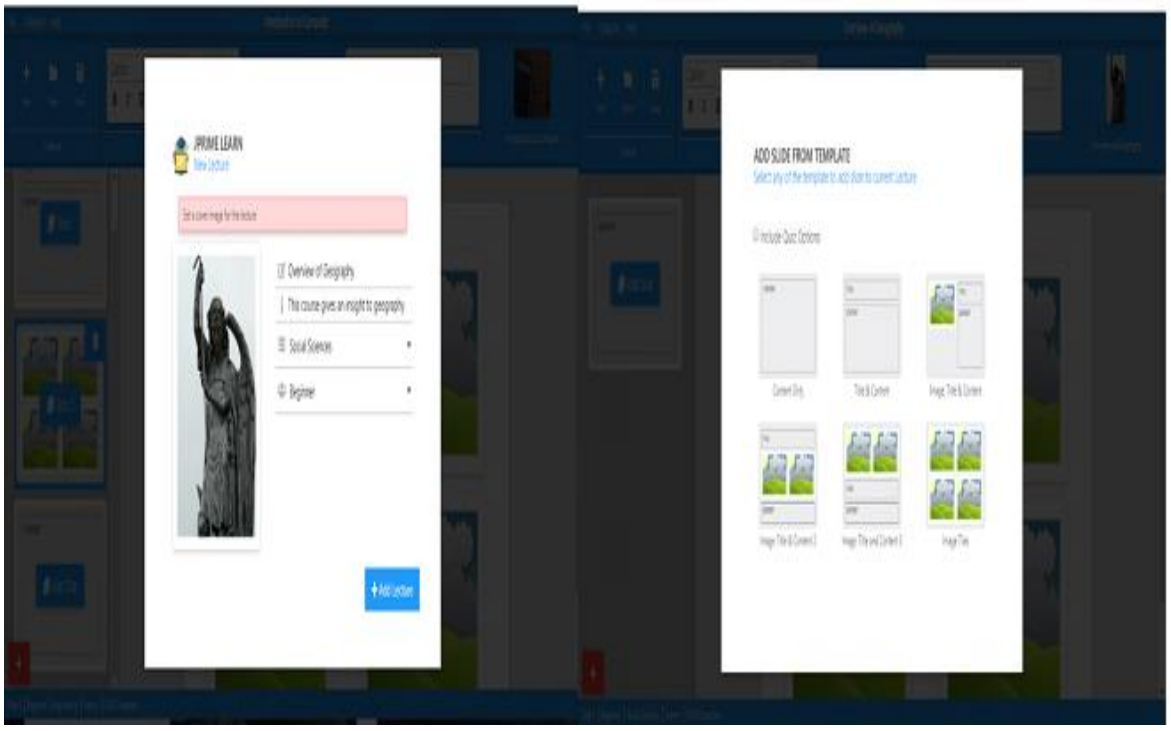

Figure 9: Screenshot of the lecture slide page.

A content could be tagged atomized when the contents of the course has been broken down into acceptable screen or slide level. The screenshot of a sample atomized content of a course titled "Overview of Geography" is shown in Figure 10. When a user logs in to the system, the learner can search for content based on the listed categories of courses. The learner can select any course of his choice, after which the learning content is displayed for the user.

Figure 10: Screenshot of Atomized Contents

V. CONCLUSION

Reading online contents has changed the way people process information, and nowhere is this change more obvious than in fields where the design and development of this content must adapt to the emerging and evolving e-Learning technologies. E-Learning course creators need to refine their content to suit learner's behavior and accessibility to learning content. Therefore, in this paper the development of a web-based learning object management system is presented. The emphases in the design is on on the creation of an atomization mechanism that will enhance the reusability of learning contents and also enhance proper content presentation with the adaptation of XML markup language and the IEEE 1484.12.1-2002 Learning Object Metadata Standard (LOM) attributes. The system is developed as a web application and hosted locally. Sample learning

contents were used to demonstrate the applicability of the ideas presented in the paper.

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