

# Knowledge Lattice Approach For Web Courseware Authoring

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## ABSTRACT

In this paper, we present the application of knowledge lattice approach in a Web-based courseware authoring support system. Knowledge lattice is widely known as ontology in Semantic Web environment. Ontology is a formal and declarative representation for knowledge. Knowledge is represented in the form of chunks in several layers. This approach is being used to develop Instructional Management Support System (IMSS). IMSS aims to support students, teachers, courseware developers, administrators, and parents. For example, it supports teachers by managing tasks such as monitoring progress and presenting subject content in a Web-based learning environment. Knowledge lattice is applied as the main interface to navigate the system modules. The lattice is used to represent the subject domain by linking the basic knowledge chunks to more advanced knowledge chunks. To further explain this approach, we define a set of functions related to each knowledge chunks.

## Keywords

*Knowledge Lattice, Ontology, Courseware Authoring*

## 1.0 INTRODUCTION

Courseware is a computer-supported presentation and use of teaching material aimed at improving student performance by giving individualized instruction together with the assessment. Nowadays, with the revolution that the Web has brought to information access worldwide, the meaning of courseware is changing. The goal of courseware authoring is to support authors in creating and linking subject details. Courseware authoring traditionally consists of teaching material and courseware delivery engine. This adaptive hypermedia courseware was to remove the constraints of predefined paths in the learning material. Web-based courseware can be viewed as a gateway to a variety of Web educational materials related to specific topics or educational goals, developed by the courseware author and stored locally, or represented by Web addresses and descriptions. We used the navigation tool called knowledge lattice to navigate the teaching material based on the subject domain. Through this lattice, will allow the users to perform tasks in a Web-based learning and teaching environment. This paper focuses on the development of lattice-based approach for web courseware authoring. The paper is divided into several

sections; the second section will discuss the common navigations tools in courseware. The third section discusses how the knowledge lattice is used in courseware authoring. In the fourth section explains the use of knowledge lattice as a navigation tool. The fifth section presents our system as an example of courseware authoring. Finally, the conclusions and future directions for the research are presented.

## 2.0 NAVIGATION TOOLS IN COURSEWARE

Computer-based learning is used in many domains. Computer-based learning involves products such as courseware, intelligent tutoring system and others. To navigate through the material in the courseware, developers use a variety of navigation tools. Traditional navigation uses graphical menu, which is located on screen for easy viewing. There are three main navigation tools for navigation which are hyperlink, button and tree view. These tools are explained below: -

### 2.1 Hyperlink

Hyperlink is used mainly to navigate items in a website. Figure 1 shows an example of hyperlink usage.

#### The MGS home page

... of Cellular Microphysiology, CellML: An Extensible Markup Language (XML) for representing and exchanging **computer-based biological model** (Auckland University ...  
mgs.lami.univ-evry.fr/~27k - 10 Aug 2003 - [Cached](#) - [Similar pages](#)

*Figure 1 A hyperlink example*

Users need to click on the underlined blue-colored text to access MGS home page. A hyperlink is usually in colour to distinguish it from normal text. A 'hand' symbol will also appear when the mouse cursor passes over the hyperlink as a visual identification aid for users.

### 2.2 Button

Buttons are also commonly used as a navigation tool (Figure 2). By clicking on the button Google Search, the browser will return the list of web sites corresponding to the text "computer based biological model". This approach is commonly used for web site navigation.

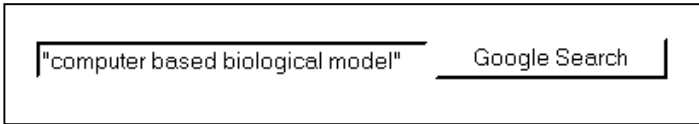


Figure 2 A button example

### 2.3 Tree view

An example of tree view is shown in Figure 3.

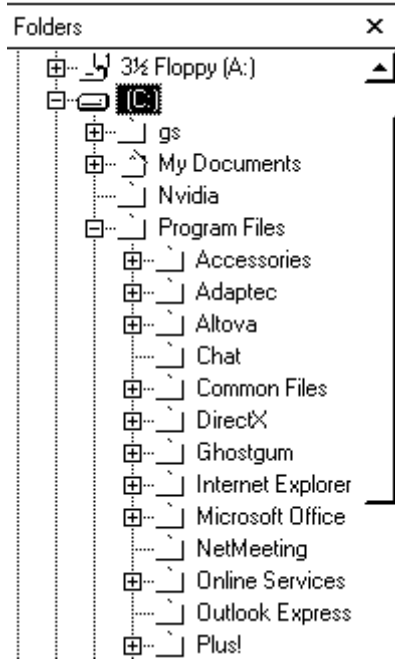


Figure 3 Tree view example

In this example, users use tree view to navigate through the folders in his computers. User can click on any folder to view its contents.

### 3.0 KNOWLEDGE LATTICE BASED APPROACH TO COURSEWARE AUTHORIZING

To efficiently organize on-line learning environment, we proposed a powerful approach called knowledge lattice (widely known as ontology in Semantic Web environment) in building a subject domain. Ontology has been used for about a decade in knowledge systems field. Tillinghast and Beretta (1997) define ontology as a formal and declarative representation, which consists of vocabulary (or names) relevant to the terms in certain subject area and logical statements that explains the terms, relationships among the terms, and how they can or cannot be linked to each other.

In this project, we explore the use of ontology /lattice as a tool to design structures for information about a specific topic, so that related topics are placed in adjacent locations and can easily be navigated using

personalized user models. This lattice can be navigated; the user interactively broadens or narrows the search and chooses a certain learning functions by specifying the current focus within the corresponding multi-term query and multi-topic respectively. Tillinghast and Beretta (1997) have experimented with an ontology editor and verified that it is effectively possible to systematically specify structures. According to Garzotto et. al (1993), a generic model for hypermedia navigation includes three components: a source context, a destination context and a transformation function. Navigation can be seen as a shift in focus from the current context to another context. Conventionally, the contexts are media items and the transformation is done by the selection of an explicit link.

IMSS (Instructional Management Support System) applies adapting learning processes to enhance and personalize the learning process for each student who uses the system. In order to implement this adaptive learning capability, the modules utilize the knowledge lattice that provides the knowledge structure for the system. The lattice is organized in layers of knowledge chunks that represent the topics and sub topics of the teaching and learning material. Figure 4 shows the structure of knowledge lattice divided in three learning levels: advanced, intermediate and beginner. At each level (or sub level within the level), the student must demonstrate the mastery of the sub skill by achieving a specific marks threshold before moving to a higher level.

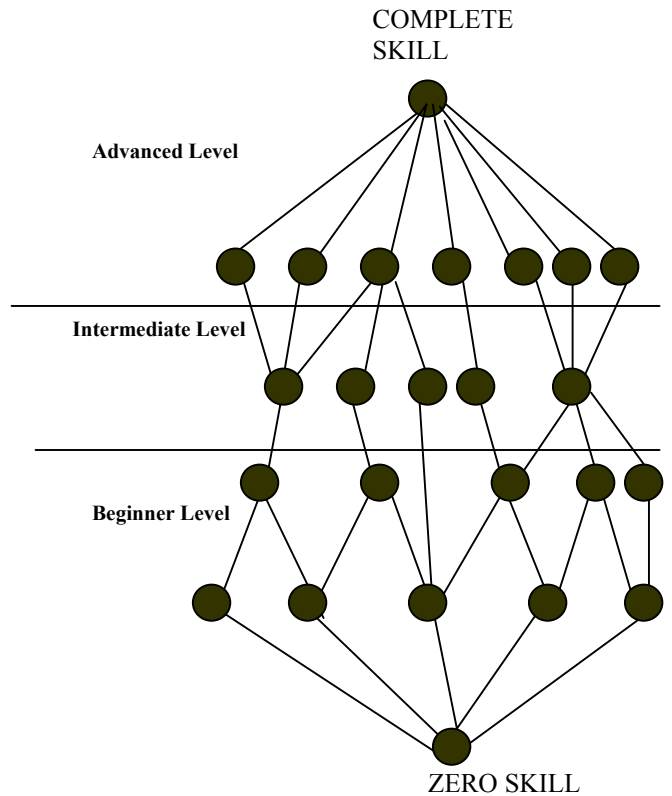


Figure 4: Knowledge lattice

This courseware improves the common level of knowledge problem by applying an adaptive tutoring system that ascertains the level of knowledge for each student who uses it. By utilizing a skill (Navigation Rules) lattice design for the questions given to students, the courseware will be able to use an adaptive learning metric to assess the student's knowledge level and personalize the learning process by accelerating or slowing the learning pace based on student's performance.

Using BLOOM taxonomy on teaching and learning, the subject domains were organized from simple to difficult. We used the Knowledge Lattice to organise the lesson plan. The node structures were used to build up the lattice, where lines were used to connect between the nodes. The first node in the lattice is the student prior knowledge and the last node in the lattice is the student with the knowledge that we want to teach the student where the lesson objectives being reached. The nodes between the first and the last nodes is the path that the student need to go through. The student will not allowed to go to the next nodes until they reached the lesson objectives by taking and passing with certain threshold all the assessment. The system will bookmark the learner's progress and records test scores. Through Knowledge Lattice editor, the courseware authors are able to construct their lesson planner. The nodes represent the knowledge chunk or the lesson objectives.

#### 4.0 KNOWLEDGE LATTICE AS A NAVIGATION TOOL IN IMSS

In IMSS, a knowledge lattice editor will be developed for the author to build their own subject lattice. As a prototype, our system will use a lesson plan in the Information Systems Development Methodology subject which is taught at the Faculty of Information Science and Technology, UKM as an example. A section of the lesson plan is as follows.

<p>1.0 Pengenalan kepada asas pembangunan sistem maklumat berkomputer</p> <p>1.1. Persekitaran kepada pembangunan sistem</p> <p>1.2. Perkakasan kepada pembangunan sistem</p> <p>1.3. Spesifikasi kerja mereka yang terlibat dalam pembangunan sistem</p> <p>2.0 Perbincangan kajian kes projek</p> <p>3.0 Perancangan strategi sistem maklumat</p> <p>1.0 Peranan perancangan strategi sistem maklumat</p> <p>1.1 Pendekatan yang digunakan dalam perancangan strategi</p> <p>1.2 Kaedah perancangan strategi</p>
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Figure 5 : An example of the lesson plan

The topic and the subtopic of the lesson plan will build on the lattice and the overall content of the lesson plan is depicted in the following figure 6. Title for the topic and sub-topic are displayed at the bottom of the screen.

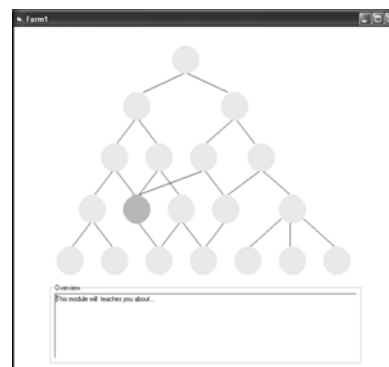


Figure 6 : Subject Lattice as a main interface for the courseware

#### 5.0 IMSS AS AN EXAMPLE OF COURSEWARE AUTHORIZING

IMSS will provide five different interfaces for five categories of users. The five categories of user that the system supports are

1. **Students**  
The user who will use the system for learning purposes and take online exams and quizzes after the learning take place.
2. **Teachers**  
The user who will assess a student progress and guide them throughout the learning process.
3. **Courseware Developers**  
The user who develops and provides courseware for the system.
4. **Administrator**  
The user who will supervise and provide maintenance for the system.
5. **Parents**  
The user who will received reports on students progress and achievements.

IMSS have five main modules such as Teaching and Learning module, Monitoring and Task Assignment Module, Courseware development and update module, System Administration module and Information accessing module. All these modules will be integrated to support IMSS authoring architecture.

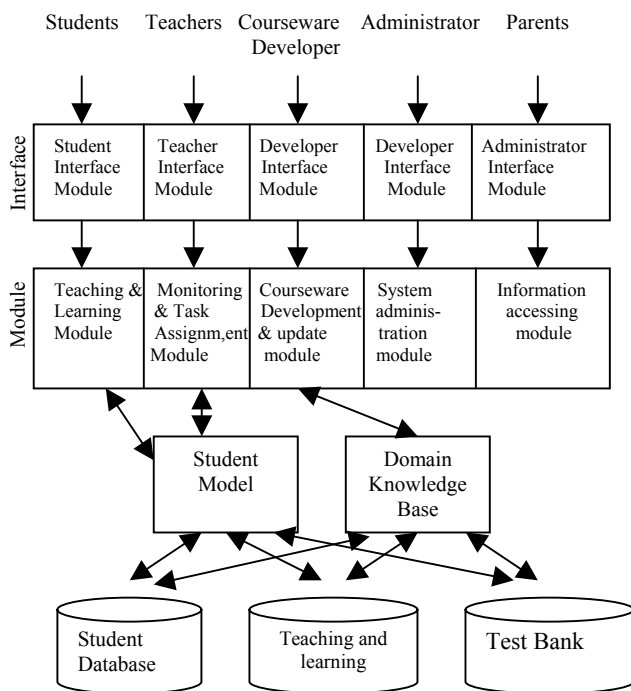


Figure 7 IMSS Authoring Architecture

Basically, teaching and learning module will support the students and teachers through the following functionalities:

1. Display students' current knowledge and skill level
2. Access their current marks
3. Display subject contents
4. Access external resources related with the subject
5. Administer test
6. Retrieve the teaching and learning material
7. Record student test result
8. Classify student's current knowledge and skill level

While, monitoring and task assignment module will help teachers monitor their students by the following functionalities:

1. Display/Search student profile
2. Display student's current knowledge & skill level
3. Assess student current progress/performance
4. Construct task
5. Assign task
6. Record task marks

Courseware developers will use the courseware development and update module to:

1. Launch Lattice editor/tool
2. Display lesson plan
3. Update courseware
4. Administer courseware
5. Launch courseware

System administration module basically for management purposes such as:

1. Editing user records
2. Security controls
3. Maintenance

Information accessing module will support parents to view their children's academic progress.

The system will have three different databases to support the architecture. The databases are:

1. Student database – to record all the students profile
2. Teaching and learning materials database – to store all the related materials given by the courseware developers.
3. Test bank – to keep all the quizzes and exams materials.

The system is also supported by a Student Model and Domain Knowledge Base. The Student Model will provide personalized learning for each student.

Domain Knowledge Base will manage all the resources that relate to the subject domain such as:

1. Link to test bank
2. Link to teaching and learning material
3. Displaying contents
4. Passing the students results
5. Add topics
6. Links to external resources

## 6.0 CONCLUSIONS

In this paper we have introduced knowledge lattice approach to support Web-Based courseware authoring. The main idea is to use subject domain lattice to capture the semantics of the subject domain terminology, in order to provide enhanced authoring support. IMSS is a courseware-authoring tool developed based on the concept of knowledge lattice. Through IMSS architecture we provide adaptive educational hypermedia where a web-based courseware can be viewed as a gateway to a variety of Web educational materials related to specific topics or educationan goals. This gateway will provide access to multiple coursewares in a particular domain. We believe that the knowledge lattice approach will revolutionize courseware navigation and provide a novel approach to users who are used to traditional courseware delivery method. The advantage of the approach compared to the approaches discussed in Section 2.0 is its flexibility and adaptability in conforming to the individual students' capability. Hence the students can navigate through the course structure in

accordance with their level of understanding of the subject material. Once completed, the system can then be used to support the Smart School project.

## **7.0 REFERENCES**

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