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資訊管理研究所

碩士論文

Multi Level Usage in Various Environments of Higher
Level Education



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Multi-Level Usage in Various Environments of Higher Education

ABSTRACT

The concept of Multi-Level Usage is widely used in the area of education today. It can be beneficial to all; elementary schools, high schools, but especially to universities and higher education institutions which focus more and more on offering high tech and graduate courses in English rather than in the country's native or official language. Nowadays universities around the world want to stay competitive by having international programs offering many courses in English either online or 'in classroom'. But there are some problems with both online and 'in classroom learning. Studies show that E-learning alone is not the most efficient teaching/learning method because a student learns best by seeing, hearing, writing, reading, speaking (asking questions) and interacting with the teacher and classmates. However, 'in classroom' learning is not always efficient especially when students learn a subject in other than their native language, where the language can be a barrier to efficient learning. A student can benefit more when the two types of learning (online and 'in classroom' learning) can be combined. Therefore, we developed a system for teaching/learning courses in classrooms, online, and also combine learning systems. We show the uses of Multi-level and how it can improve both online and 'in classroom' learning by creating a Multi-Level course system and applying it into an educational environment. Any educational institution can provide an environment for Multi-Level Usage because it is not too costly, it's reusable and not difficult to use once its platform and methods are developed and implemented into its system. We use the applications and purposes of SCORM (a popular standard for E-learning) since it is widely used in Multi-Level, to implement a Multi-Level Usage web site based on the Learning Management System (LMS) which is provided by Advanced Distributed Learning (ADL). The web site made can make up and maintain different levels for SCORM-based digital contents, it keeps only one copy in the hard disk, it shows the proper level of any course chosen or taken by a user, and it can reduce the time and money spent on learning while making it easier and more interesting.

**Keywords: Multi-Level, SCORM, E-Learning, Distance Learning, Macro
University**

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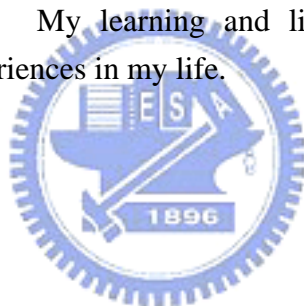


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Chapter 1

Introduction

With the arrival of globalization and international job opportunities, international study programs around the world became more and more popular especially in the higher education areas. The improvement of Internet & World Wide Web is making online learning more efficient and many educational institutions offer online learning besides the traditional ‘in classroom’ learning (where students need to go to school for studying every single subject using teacher to students direct interaction via seeing, hearing, and speaking). One reason is that ‘in classroom’ learning in many situations (international programs, difficult material, teacher speaks too fast, classroom too big) seems to create barriers and difficulties between the teachers and students [34]. For example: a teacher (local or foreigner) may be great at lecturing a course in English, but some of the local or foreign students may not have good command of the English language. These students may be better off if taught in their native language, but as the case is, courses are offered only in English. The other way may be when a professor can’t teach a subject well in English. He/she may be an excellent professor when teaching in his/her native language. The department may not have much choice because there may not be another professor available to teach this course. So, what could the outcomes be if the teacher is required to teach in English and the students to learn in English despite their ability to speak and comprehend it well?

Higher education comes with many difficult terms and technical language, which can create difficulties even for students studying in their native language. Therefore, schools need to focus on finding the means for providing better and easier ways for students to learn if they are required to learn more or study in a foreign language.

Most if not all college and graduate local students can read and write English better than they can listen to it or speak it [32]. Their comprehension level may be different, and some may have to start with a more basic course, or a course that uses simpler language. Thus, this raises the possibility of Multi-level courses and various teaching environments ('in classroom, online, live online, and combined environments) which can help a student learn easier. He/she can start with an easier level of a course and then move up to a more advanced level of the same course, and/or he/she can choose the learning environment which is most comfortable or appropriate. This may be more beneficial to the student and less troublesome for the teacher and the institution to deal with.

An excellent contribution of Multi-Level Usage is that of being able to provide different levels of the same course to both online and combined ('in classroom' and online) learning. Students should not have to go to different schools to take a lower level of a course, and the course can still have the content, material, and teaching ways of the most qualified professor even if he/she cannot teach well because of the language barrier. The teacher can set up the course online, and he/she may just schedule occasional 'in classroom' meetings to gradually expose him/herself and students to difficult content in another language [33].

In the past, certain educational institutions focused on E-learning alone, for time, convenience, and money saving, but a student doesn't always benefit from a learning system done solely on reading and writing. Also, reading and typing on a computer all day is not the most exciting and healthy way of learning and things can be forgotten quicker when only learning them online. But there are ample benefits of E-learning; students can study courses at home, in the library, at a coffee shop, while traveling, or basically at any convenient place. The students need not worry about understanding the teacher well; take notes, or carrying a recorder with them to class. It also

benefits a government of any country by not having to build and maintain so many classrooms within a school, while it allows the students to reduce the time and money spent trying to beat the traffic and going to school as often.

Implementing Multi-Level Usage to both E-learning and ‘in classroom’ learning can make higher education an easier, cheaper, and more interesting learning avenue. The school or knowledge provider would be able to serve more people than before in less time and in an easier way. Therefore, some higher education organizations are devoted to provide a standard of the digital content for implementing such a Multi-Level Learning System so that the content of learning material can be reused and easily accessible. The Advanced Distributed Learning (ADL) [33] is one of these kinds of organizations and primarily focuses on E-learning, so we will look into its contents and attributes. The ADL defined standard called Sharable Content Object Reference Model (SCORM) [11-16, 18, 24-25], it’s a standard of E-learning, [1, 2, 17, 21, 27] and it defines the content aggregation, runtime equipment, sequencing, and navigation. It has the advantages of accessibility, adaptability, affordability, durability, interoperability and reusability. In this paper, we describe and show why we are focusing so much on the SCORM’s Multi-Level Usage [6, 19-20, 26, 28, 31].

1.1 Motivation

Observing the obstacles and problems that students must deal with when studying in an international environment, we have thought of a way or system to try to overcome such barriers in the near future. Multi-level is an important learning concept nowadays and can be used for many areas especially higher education. Various learning environments (‘in classroom, online, and combined) are also very important in providing students the adequate way of learning subjects. In education, we have

different phases of schooling such as primary school, high school, university and post graduate. In industry we have different levels of certification to classify the ability of people such as Cisco certified programs, Java certified programs, and Microsoft certified programs. When we refer to any kind schooling in various areas, the quality of education is the important issue to be addressed, and improving its quality is our main goal. As it was mentioned in the introduction, schools are more aware of the new problems globalization and international studies are bringing to the traditional 'in classroom' learning. We hope to introduce this concept of combined 'in classroom' & online Multi-level learning and also to provide a proper digital content for courses being offered to students which can improve traditional 'in classroom learning' to better cope with the needs of today's students. Due to the fact that the registration and part of the learning process will be online or via computerized means, it is important that an adequate digital content is created to handle all the operational means of this program not just the registration process.

To successfully operate such an educational system, we refer to SCORM as a standard for the E-learning part of Multi-Level Usage. It defines the Course Package & Runtime Environment and uses XML [33] technology to implement its Manifest File and Meta-data File. The SCORM-based courses can be widely shared and reused by people via Internet. Some schools build the Learning Management System (LMS) [8, 23, 29-30] to assist the students' learning process of a particular course and provide a Distance Learning system. They focus on transferring existing courses using traditional teaching methods on the web and make the non-individual and non-adapted teaching more easily and widely available. However, the course can only be used within their intranet system. Besides, if a course with different levels is to be built, a lot of time must be spent to edit the levels and to make several copies of the contents.

Therefore, we would like to research the Multi-Level Usage and SCORM to see if there can be any better ways of using or improvising it for educational purposes in different kinds of environments. We will look at the following situations: Can Multi-Level Usage help teachers to teach better? How can a teacher with poor command of the English language use SCORM to teach a course well in other than his/her native language or in a bilingual environment? Is there any way to provide different levels of content with only one copy in the hard disk available? What would happen if we combine Multi-Level Usage and SCORM-based Digital Contents?

1.2 Overview of Research

According to the problems and scenarios mentioned above, we refer to the concept of Multi-level Usage, the Growing Book, and SCORM in order to provide the teachers a solution for Multi-Level courses and combined courses. We will build a SCORM course editor, which will help the teachers to easier organize the course structure, typing, and maintaining digital content of the SCORM standard. Then we will implement a Multi-Level Learning Management System (MLMS) that provides a friendly interface for the teachers to create Multi-Level courses and a Multi-Level learning platform.

1.3 Thesis Organization

Chapter 2 briefly describes the background materials, literature review, and related works. In Chapter 3, we conduct a feasibility study then show and discuss its results. In chapter 4 the system's architecture is revealed and discussed. The system implementations and system's various scenarios & prototypes are covered in Chapter 5. In the last chapter (Chapter 6) all the concluding remarks of this research, possible

future work, and continued research in this field are included.

Chapter 2

Literature Review and Related Work

There are many research areas related to the work done in this study. Such areas include E-Learning [1-4], the Growing Book [5-6,], SCORM [7, 10] and the comparisons of some LMSs [8, 25, 28]. This chapter introduces some literature review work of these topics and how they are related and involved in this research.

2.1 E-Learning

In these current days, new technologies come about quickly and on a daily base. People need to learn much more and retain a lot more knowledge than before to operate the new inventions and technologies available. Therefore, one of the issues we face now is how to provide an easier way for studying and also make it more interesting! Although the traditional ‘in classroom’ learning is still the most beneficial and perhaps most interesting way of learning because it is able to provide the full learning process of hearing, seeing, reading, writing, and speaking, language barriers for subjects thought in other languages than the native language of the students have created problems for both students and teachers. So E-learning evolved as a learning method for students with various needs and it seems to be more practical when students study a course in a language other than their native one [4].

E-learning can be done over a computer via CD-ROM, Internet or satellite broadcasting and can provide either a group or an individual learning experience. Some students like verbal interaction and want to ask questions in class but are too

shy and feel embarrassed to do so in a 'in classroom' environment especially if the course is not in their native language. But may they have no problem asking questions if the other students don't know who they are or cannot see them. So a live online course can be set up by itself, or combined with an 'in classroom' course. Unlike 'in classroom' learning, it can easier adapt teaching to the various needs of a student. E-learning (live or recorded) can also be used completely in a course or it can be just a part of a course in a combined learning system of 'in classroom' and E-learning. A student may use E-learning as an introductory course to a more difficult 'in classroom' course he/she must take to complete the degree requirements.

In the traditional system, a teacher needs to teach one course for few or many students at a time. A teacher plays the main role during the class. He/she decides the way of teaching and also controls the process of studying. Though some teachers will consider the degree of the students' learning to modify their teaching methods and speed, they still cannot fit the needs of all the students. After all, the level of the students in one class is not the same, and the time of the teacher is limited. With Multi-level E-learning, some situations can be changed and adjusted. The students are able study the courses anytime they want and can control the learning progress because this type of learning can be either individual & group, and the teaching is adaptable. In many cases, however, people supporting traditional education have focused on transferring existing courses using traditional teaching methods on the web. They just made the non-individual and non-adapted teaching more easily and widely available.

Current 'in classroom' and online learning systems provide the same content for all the students. This means that the students may not learn efficiently so new implementations and changes must be made. Students should be able to choose what they feel is appropriate for them to learn rather than learn more content than they can

understand or content that is unrelated to their particular study objective. Although, it is much easier to make changes and implement different levels to online learning contents, Multi-Level Usage can be used in both environments, online and ‘in classroom’ [33].

2.2 The Growing Book

A Growing Book is an electronic book co-developed by a group of teachers who are geographically dispersed throughout the world and collaborate in teaching and research. The Growing Book must be constantly updated and expanded, as it is necessary. The Growing Book is used by every one of the teachers involved both in the local classroom as well as in the worldwide Distance Learning environment. The contents of the Growing Book are owned by different authors who may utilize and/or provide different tools for Distance Learning, ‘in classroom’ learning, self-learning, and assessments. The Growing Book should support the Multi-Level, Multi-lingual and Multi-modal shared content co-developed by the many teachers and also it must have comprehensive material. Multi-Level Usage means that the ‘same course’ materials can be organized in different ways to be used in a regular semester course, a short course, a introductory exposition, an advanced seminar, etc. Multi-lingual Usage means that the same course materials can be translated and used by different languages. Multi-model Usage means that the same course materials can be used by people with different perceptual preferences and various handicaps. The Macro University is a framework made in such a way, that many virtual universities could pool their resource together.

2.3 SCORM

SCORM was launched by the ADL, an initiative sponsored by the Office of the Secretary of Defense (OSD) in the USA. The SCORM is built upon a common Web-based “Content Aggregation Model” and “Run-Time Equipment” for its learning content. SCORM is a collection of specifications and standards that have been bundled into a collection of “technical books.” These technical books are presently grouped under three main topics: 1) the “Content Aggregation Model (CAM),” 2) the “Run-time Environment (RTE),” and 3) “Sequencing and Navigation (SN)”. The features of the SCORM are accessibility, adaptability, affordability durability, interoperability and reusability. As shown in Figure 2.1, the Content Package is composed of Manifest File and Physical Files. The Content Package uses Manifest File to arrange and pack Physical Files as the framework of the course.

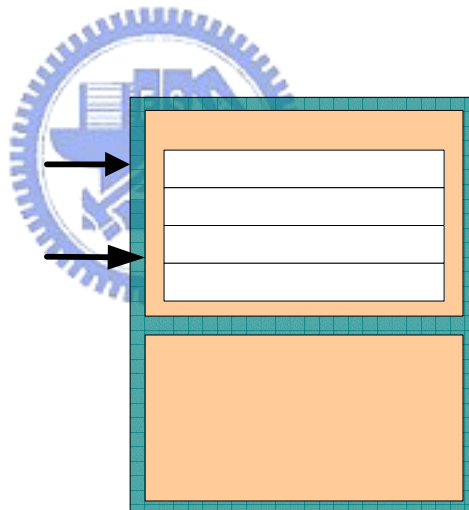


Figure 2.1 The Conceptual Content Package

2.4 Comparison of some Learning Management Systems

Table 1 shows our comparison of Learning Management Systems between Fu Zi College, MIT Open Courseware and Cyber Link CTMS. Fu Zi College [34] is a web site used for E-learning and sharing teaching materials between teachers in Taiwan. It has an Account Management System but it is only used to keep users’ information. It

does not provide any assessment to help someone know what kind of material he/she should learn. One can choose what he/she prefers to study. It does not implement any standard of E-learning or the concept of Multi-level.

Massachusetts Institute of Technology (MIT) Open Courseware (OCW) [35] is a free and open educational resource for faculty, students, and self-learners around the world. OCW supports MIT's mission to advance knowledge and education, and will continue to serve the world in the 21st century. OCW is a publication of the MIT course materials, not a degree granting or a certificate-granting program. It doesn't require a registration process or provide any assessments for a user, and also, it doesn't follow E-learning standards but it provides Multi-level courses for students.

Lotus LMS is a product of IBM which provides a solution of E-learning for the enterprise to train their employees. It is a web-based system that also provides account management. It follows SCORM E-Learning standard but it doesn't provide Multi-level application.

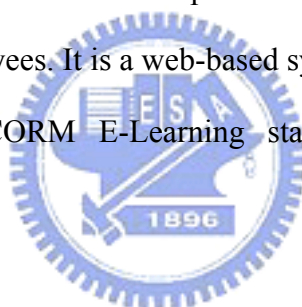


Table 1. Comparison of Some Learning Management Systems

	Fu Zi College	MIT OpenCourseWare	Lotus LMS
Web-based	Yes	Yes	Yes
Account Management	Yes	No	Yes
Assessment	Yes	No	No
Standard	No	No	Yes
Multi-level	No	Yes	No

Chapter 3

Feasibility Study

We performed a feasibility study to find out about the benefits teachers can get from using Multi-Level Usage in their teaching. For analyzing ingredients and related concepts in developing our Multi-level learning system, we requested the developers to fill out the questionnaires we prepared so we can later evaluate them and make some system implementation decisions.

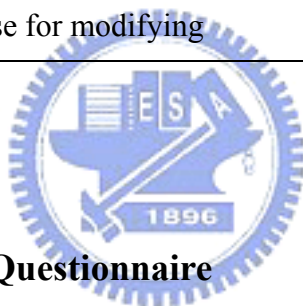
The developers are participants of the survey who have the goal of editing the teaching materials while combining teaching experience with knowledge, expertise, and devotion. There were 12 participants in our sample size used as developers of our system and its implementation. Half of them are teaching in colleges and technology schools in Taiwan. The other 6 are teaching undergraduate and graduate programs in universities around Taiwan.

Table 2 shows the features of our research and what the teachers can use and benefit from. We provide a Learning Management System (LMS) based on some of the concepts of the LMS's previously discussed and compared, which can help teachers to easier implement a Multi-level course with as many levels as they prefer. We use a section as our basic unit when setting up the levels of a course. We don't provide the re-indexing function (used to arrange the index of the chapters and sections) because we think if we change the index, the students cannot easily refer to the original course, which is more complete. We use SCORM as the basis of our Multi-Level E-learning system and we get the SCORM-based course package as an

input for our system. This will help teachers to save time when build a digital course. We also implement a tool for teachers to easier transfer their digital content to a SCORM-based course.

Table 2. Features of a Multi-Level System

Easy to implement Multi-level Usage?	Yes
Number of levels	Decided by teachers
The basic unit of a Multi-level courses	Section
Re-indexing	No
Supporting E-learning standard	SCORM
Provide an easy to use tool for building a course package	Yes
Get a shareable digital course for modifying	SCORM-based course



3.1 The Contents of the Questionnaire

We provided 15 questions (Appendix A) for the 12 participating teachers to find out their needs while teaching a course. First, we needed to know if the participating teachers could see any uses or benefits of a Multi-level system in their courses. Then we asked them several different questions to see the needs they encountered from various difficulties or obstacles that a course may present.

3.2 Analysis of the Questionnaire

Each figure contains the 12 participants and their preferred choices. Figure 3.1 shows the needs for Multi-level courses in three different situations. We can see that most participants have a high requirement (8 chose high) for Multi-level courses for different levels of a course situation. If different classes of the same course are offered

at the same school ('in classroom' and online), most teachers (6 responses) didn't see much use for more Multi-level courses to be implemented. They felt the students would benefit enough from the same course being offered in two environments (online and 'in classroom'). For different students' abilities in the same class, the teachers that chose Multi-level for a course (5 participants) are almost the same in number as the teachers chose not to use Multi-level (4 participants). The requirement for different level students in the same class situation is higher than for different classes being offered at the same school situation.

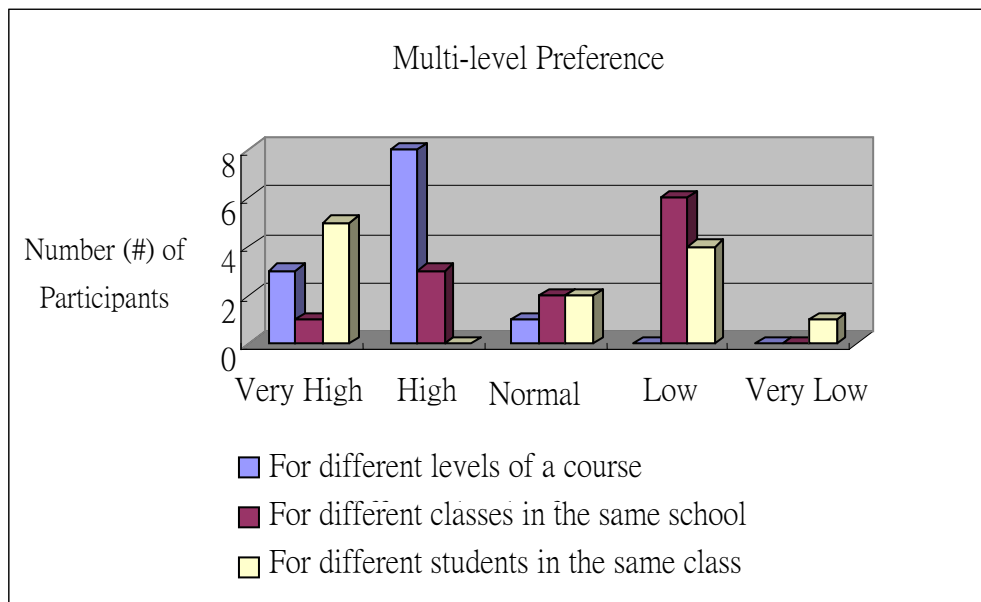


Figure 3.1 The need for Multi-level courses. If there is only one type of course offered (online or 'in classroom'), the teachers think there is a need for Multi-level use.

Figure 3.2 shows the scale of for Multi-level necessity that the participants might see for their courses in three different conditions or situations. Most of the teachers preferred three levels for a course, but some of these teachers felt they may require more or less levels depending on the kind of courses. For scenarios having different

class levels in the same school and having different level students in the same class, two or three levels are enough. For different type of schools and teaching in another language some teachers need more or less levels for a class and type of course.

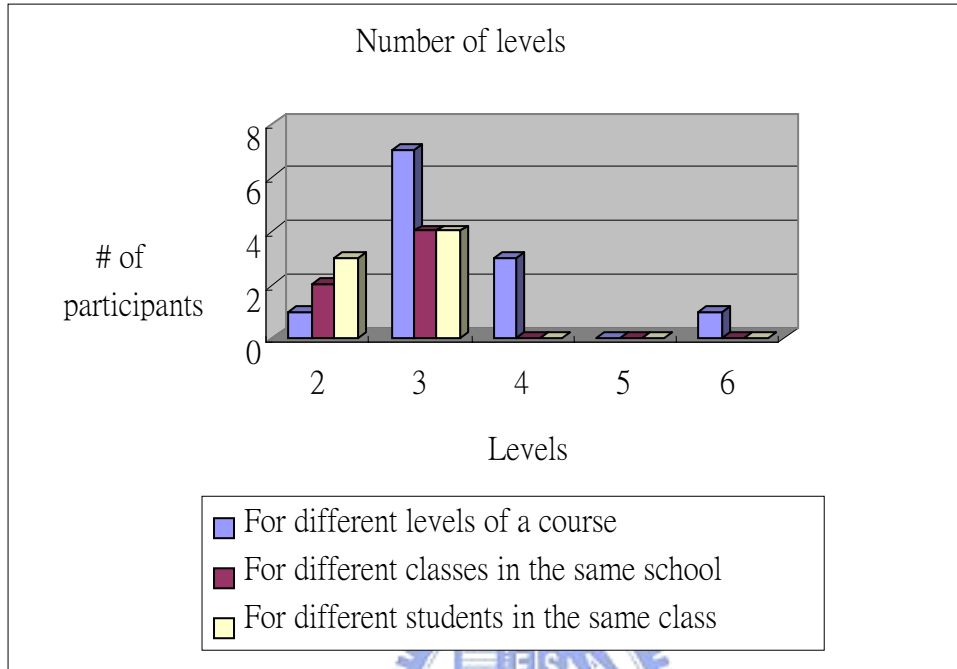


Figure 3.2 Three levels is what most teachers want for a Multi-level course

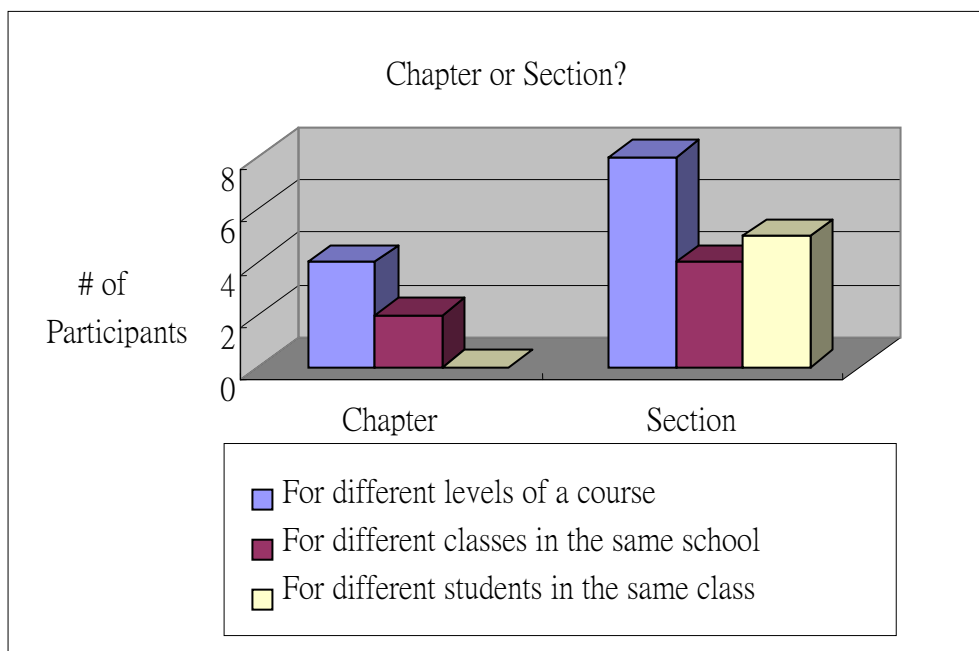


Figure 3.3 A section is the preferred unit for Multi-level courses

We are also interested in the issue of what we should use as the basic unit for a Multi-level course. Should it be a chapter or a section? As shown in Figure 3.3, most of the teachers would like to choose a section as the basic unit for the course.

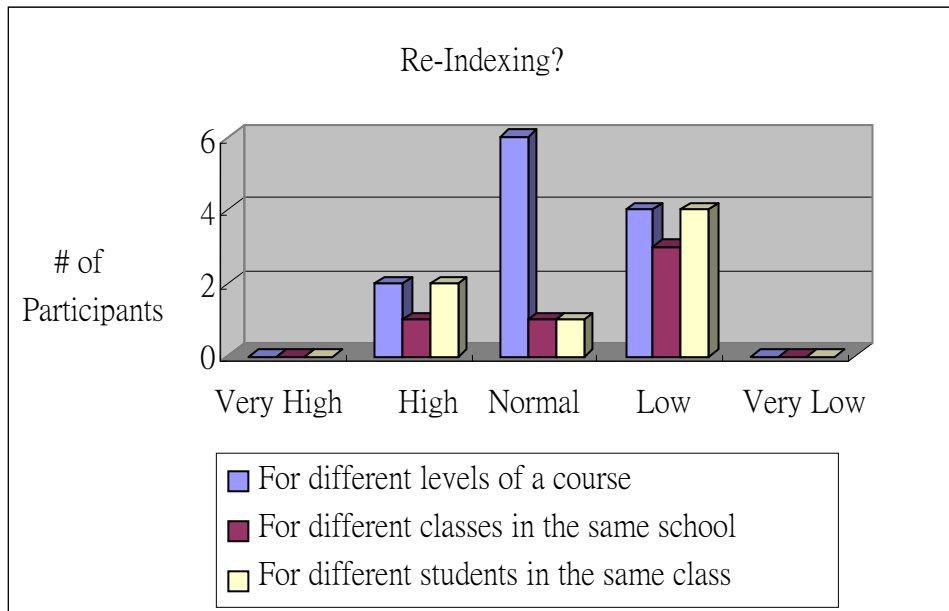


Figure 3.4 The Necessity for Re-indexing. If the course has different levels, most teachers think it should be treated as a normal course, and therefore it should have the same content or topics as the original. Only the degree of difficulty should vary.

A Multi-level course may be a sub-set of the original course. After we re-organize the course, should we treat it as a new course or just as a sub-set of the original one? If we treat it as a new course, should we change the index of outlines? Figure 3.4 shows the opinions of teachers regarding the need to change the index of outlines after building a new level for the course.

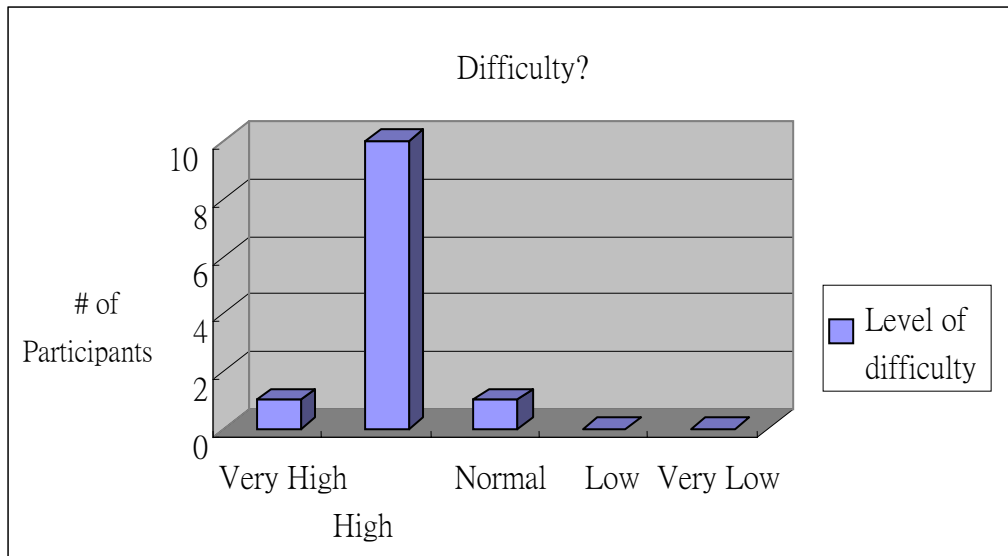


Figure 3.5 The Difficulty of Making a Digital Course

Figure 3.5 shows how the participants feel about the difficulty for making a digital course. Most of the teachers felt that making a digital course is quite difficult. Since making a digital course is difficult, can we get the shareable digital content for reuse purposes? Must teachers build the contents by themselves? As shown in Figure 3.6, most teachers consider that it is helpful if they can get shareable digital contents.

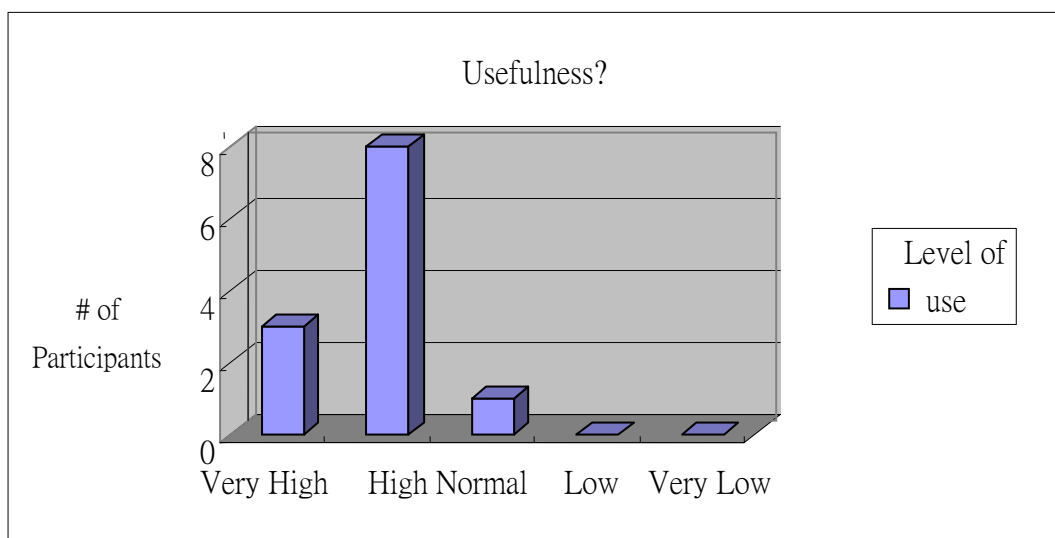


Figure 3.6 Usefulness of Getting Shareable Digital Contents

3.3 Summary and discussion

Because of increased globalization in recent years, various international programs at different universities and higher-level institutions around the world have strived to attract students from various countries and different backgrounds hoping it would make the institution more competitive. Moreover, an international program is thought to improve and benefit the studying environment through more diversity in knowledge and thinking and a greater variety of research projects conducted at that particular school. But learning dilemmas in a traditional ‘in classroom’ environment caused by language barriers between students (local or foreign) and professors (local or foreign) and also extra money being spent on such programs are raising the issue of efficiency and benefits of such programs to both the students and educational institutions. Multi-Level Usage as shown by this survey can be one way of dealing with situations as above. It can be used in educational systems to reduce various problems created by certain teaching barriers and also improve a student’s learning.

Based on the results of this survey we will built the architecture and system implementations in the following chapters.

Chapter 4

System Architecture

Our Multi-level Learning System is composed of the Account Management System, the Course Management System, and the Assessment System as shown in Figure 4.1. The Account Management System is used to manage the account's authority to control what a user can or cannot do. It includes Login(), Logout(), AddUser() and DeleteUser(). The Course Management System is used to manage the courses for these various purposes: to register for a course, view a registered course, import a course, and set up the Multi-level system of a course. The Assessment System provides an exam for a user to help him/her to choose the appropriate level of a course and also assess if he/she can go to the next level.

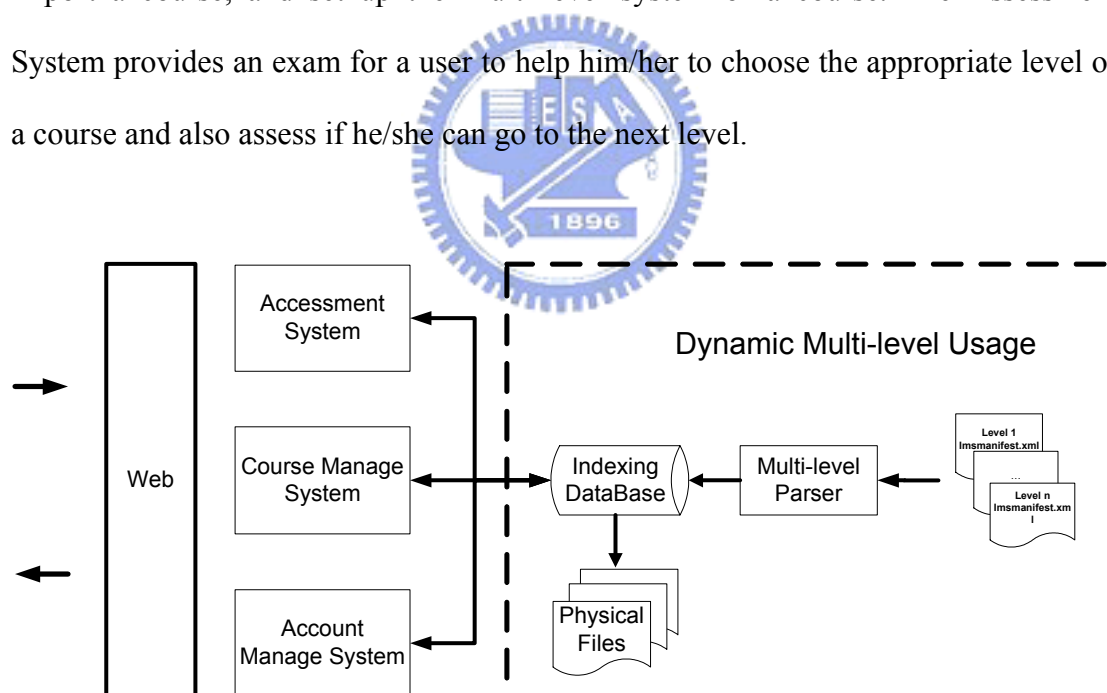


Figure 4.1 The Architecture of Multi-level Learning System

4.1 Account Management System

The Account Manage System is used to manage the authority of a user. It keeps the user information and defines what he/she can or cannot do. As shown in the Figure

4.2, the users may be separated into two groups. One group is the learner (student), while the other is an administrator. When a user logs into the system, the Account Management System will provide the functions according to the role or title of user. An administrator can login the system, logout the system, add a user, and delete a user for various purposes. If a student logs into the system, then the system will provide the course to be learned according to the student's registration. Usually, an administrator would be a teacher or a teaching assistant. He/she can add the students to a class and assign the courses to them. Then it could be treated as a virtual classroom for a course. As the number of courses increase, it becomes a **macro university**.

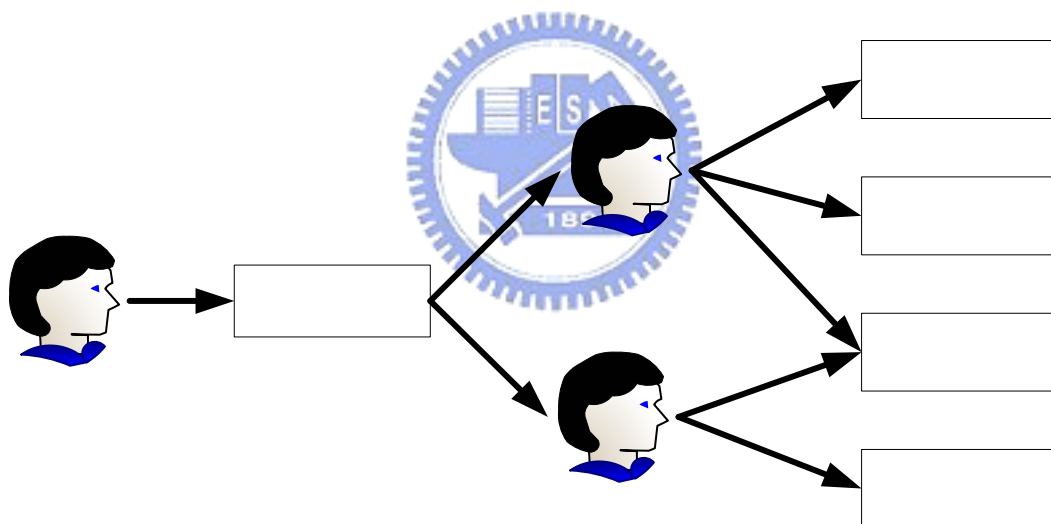


Figure 4.2 The Diagram of Account Management System.

4.2 Multi-level Course Management System

The Course Management System has the functions as shown in Figure 4.3. An administrator can import a course, delete a course, and define the Multi-level of a course. An administrator can also register as a student if he/she wants to study or complete a course but he/she must be admitted as a student first. A student can register

a course that has already been imported by an administrator and then view the registered course. He/she can register for many courses, ‘in classroom’ or online courses in the same way students register for a traditional ‘in classroom’ learning environment. The course management system will record the status of a student and his/her progress or accomplishment in this course.

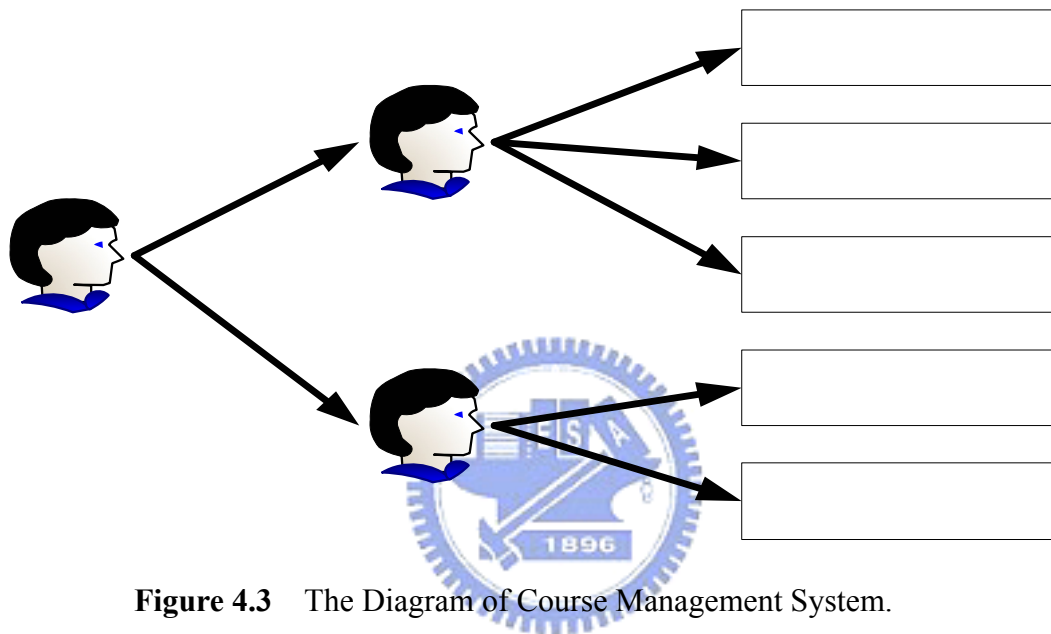


Figure 4.3 The Diagram of Course Management System.

An administrator may be an expert teacher or a program director and he/she can organize a course into different levels according to the needs. He/she can determine if this course would be an ‘in classroom’ or online course based on the information available from the system (course has adequate resources for either ‘in classroom’ or online environment). The system can provide an easy way for the administrator to do this so that he/she can only concentrate on classifying the level and/or type of course and not spend too much time on other aspects. As shown in the Figure 4.4, the course management system loads a course into a Multi-level course definition web page. The teachers just need to classify the level and type of course (‘in classroom’, online, or combined) for each chapter by clicking the radio button on the web page. After

he/she finishes the process, the `ClassifyCourse()` will generate a Multi-level course package of SCORM. The Learning System can load this Multi-level course package for a Multi-level course purpose.

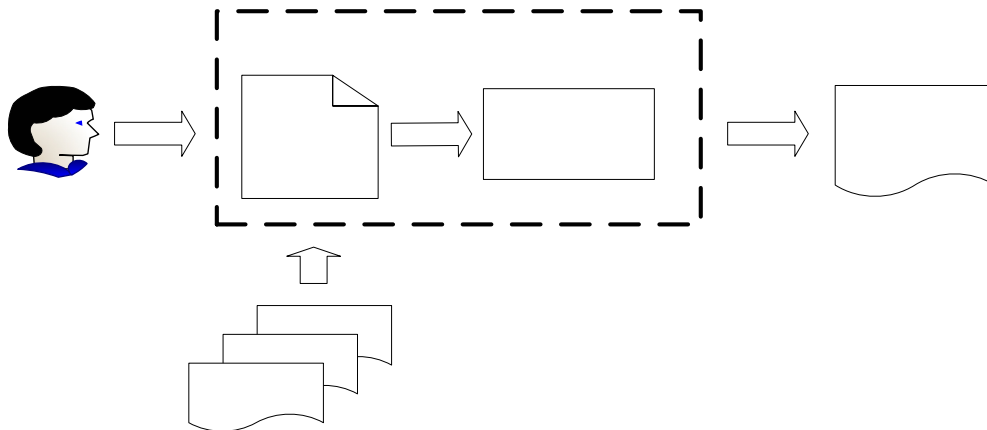


Figure 4.4 The Model of Generating a Multi-level Course

4.3 Multi-level Assessment System

The assessment system helps a student find which level he/she should start by providing an assessment exam. It can be both oral and written. The Assessment System will calculate the score he/she gets and then dynamically load the proper level or type of the course ('in classroom' or online). The system will record the level of the user and load the level/type of course every time a student continues studying the course until he/she finishes it. After the learner finishes a level and/or type of course, another assessment exam is provided to see if he/she can go to another level/type or whether more study at the present level is necessary.

4.4 Multi-level Course Structure Definition

SCORM uses the Manifest File as framework of its course package. We define our course structure using the basis of the Manifest File XML structure. As shown in

Figure 4.5, the <title> tags are the outlines of the course; the <item> tags will be chapter node, section node, or content resource, depending on its depth in the tree chart. The <title> tag, which is referred to as ‘a child’ of <organization> tag, is the title of the course. The <item> tags, whose parent node is <organization> tag, are the chapter nodes. The <imsss:sequencing> tags are used to control the flow of the course and seen as a sequencing node. The <title> tag, which is a ‘child’ of chapter node, is the tile of that chapter. The <item> tags, whose ‘parent node’ is a chapter node, are the section node. The section node may have only a <title> node or have a <tile> node and several <item> nodes. If the section node has only a <title> node, it will also be a resource node, which maps to the physical file. The <item> tags belonging to the section node then will be considered as resource nodes. The ‘child’ of these resource nodes will also be resource nodes and can continue on in this pattern.

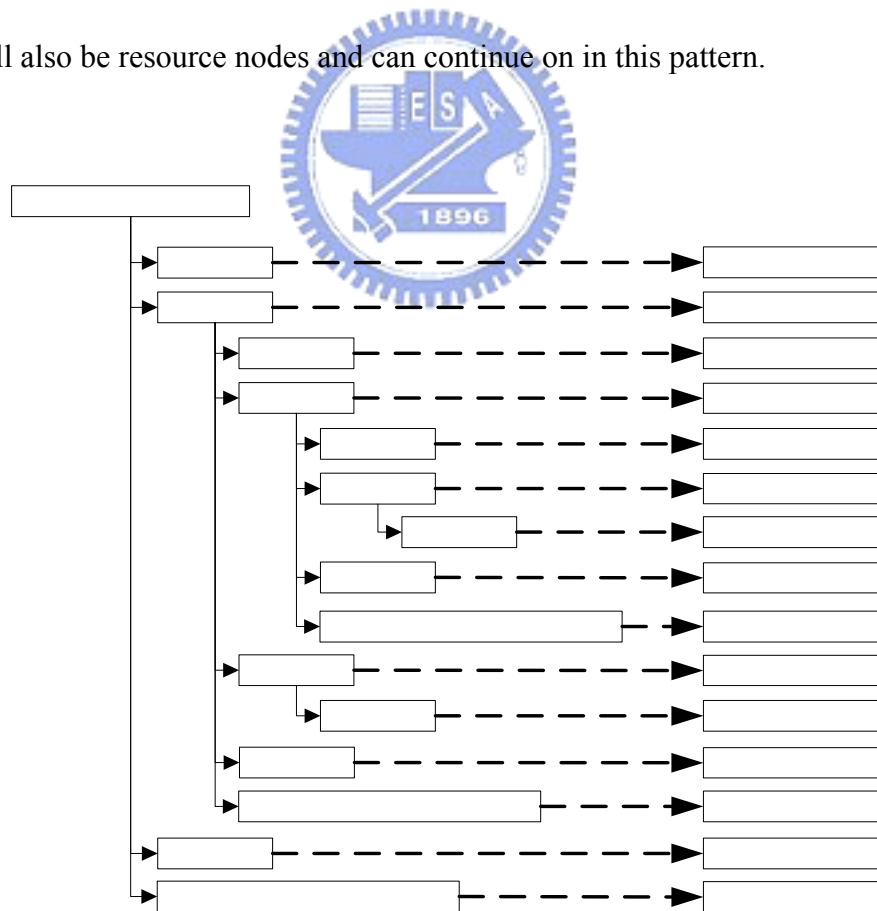


Figure 4.5 The Definition of Multi-level Course Structure.

Chapter 5

System Implementation

This chapter describes the implementation of our Multi-level Learning System. First, we introduce the system platform, then our SCORM Course Editor and our Multi-level Course Generator system. Finally, we will describe the Adaptive Learning activity and the model that dynamically loads a Multi-level course.

5.1 System Platform

The Learning System provides a commonly used web interface for the user to access the system. We use JavaScript and Java Server Page (JSP) language for programs and we use Microsoft Access as the database to store the Multi-level indexing data and the account information. We use Microsoft windows XP as our system platform and Apache Tomcat v4.1.24 as web server. In addition, we use the Sample Run-time Environment, which is distributed by ADL, as the base of our prototype. As shown in Figure 5.1, we also need to setup a windows XP system with Java Run-time Engine and Apache Tomcat Web Server.



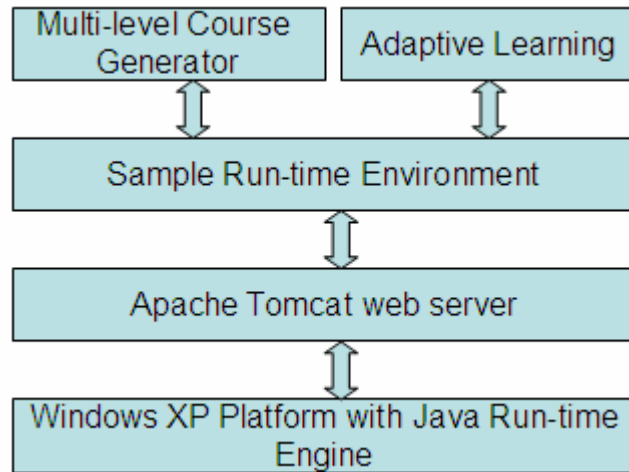


Figure 5.1 The Hierarchical Structure of Multi-level Learning System.

We use the grammar as shown in Figure 5.2 to parse the XML-based Manifest File. The `<organization>` is the root of the grammar and is defined as `<item>`. The `<item>` is defined as `<title>`, `<title>+<item>` or `<title>+<item>+<imsss:sequencing>`. The `<title>` can be defined as `outline` and `<imsss:sequencing>` can be defined as `sequencing`.



Figure 5.2 Grammar used for Parsing XML-based Manifest File.

5.2 SCORM Course Editor

We provide a SCORM Course Editor to help teachers easily reorganize the existing learning content so they can implement a course that matches SCORM standards. The Course Editor provides some templates so that teachers can easily build various types of sequencing and navigation. Those templates include None,

Linear, Linear Controls, and Linear Choice. This tool provides a friendly user interface and it can show the learning material or method one chooses to allow easier view of what is handled by a user. A user (administrator) can drag and draw the learning content to organize a new SCORM course. He/she can also load an existing SCORM course structure for reorganizing. After the user finishes editing the course structure, our tool will help him/her to packet the learning course into a SCORM course with zip file. Though there are many SCORM course editors, they are too difficult and complex to use and their learning curve may be too long. By using our SCORM based editing tool, an administrator can easily transfer traditional learning content to the SCORM type. Figure 5.3 shows the Top-down Function Block of our SCORM Course Editor.

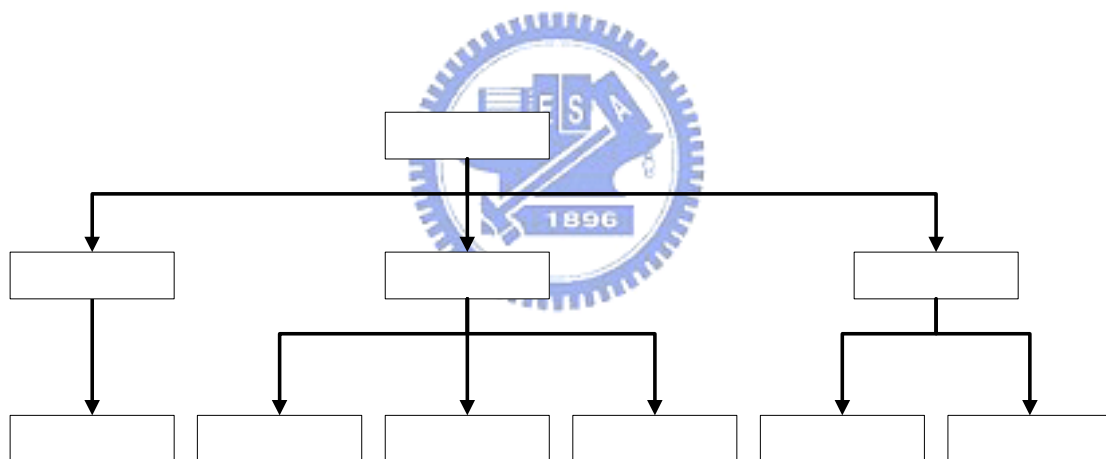


Figure 5.3 Top-down Function Block Diagram of a SCORM Course Editor.

5.2.1 LoadCourseXML()

This function is used to load an existing SCORM course structure for editing. A SCORM course is organized by specifying a XML file named “Imsmanifest.xml.” Our function parses the XML file to extract the text meaning from the node into a tree node. The main role of the function is ParseXML(). In the ParseXML(), we use

recursive function to achieve the editing of a course as shown in Figure 5.4.

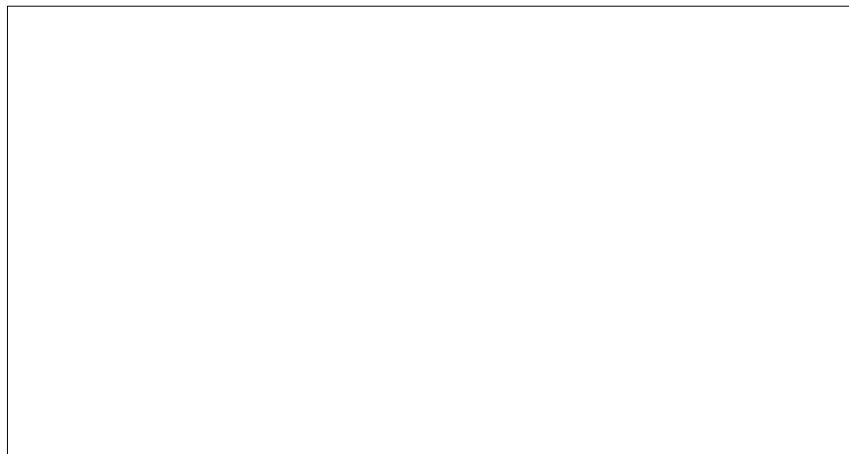


Figure 5.4 Algorithm for Loading a SCORM Manifest File.

The ParseXML() is a recursive function. Line 1 is the declaration of ParseXML(). It needs XMLNode and TreeNode as inputs. The XMLNode is a node in XML document and the TreeNode is a node in the component of TreeView, which is used to display a tree structure in windows platform. Line 3 checks if the XMLNode is an Element-Node. Line 4 checks if the XMLNode is a Text-Node. If both lines 3 and 4 are correct, then line 5 will be run. Line 5 creates a new node in the component of TreeView as newTreeNode. Line 7, line 8, and line 9 show whether or not the XMLNode has any 'child' and run ParseXML() for every 'child'. The inputs of line 9 are the 'child' of XMLNode and newTreeNode.

5.2.2 EditFunctions ()

The Edit Functions include three sub-functions: 1) AddItem(), 2) DeleteItem(), and 3) ShowItem(). AddItem() and DeleteItem() help a user to add and delete items in the organization tree show in Figure 5.5, and ShowItem() displays the handling content immediately.

```

1 ParseXML
2 {
3   if(XML
4   if(XM
5   new
6   }
7   if(XM
8   for(
9   Pa
10  }
11 }
12 return
13 }

```

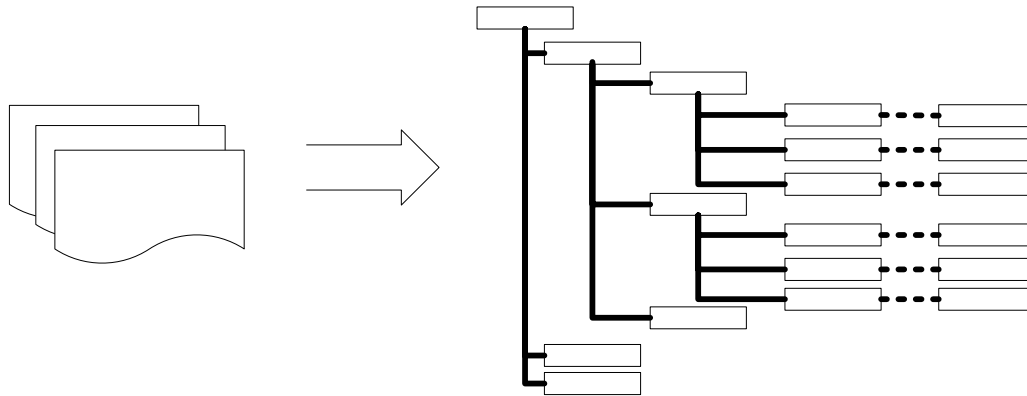
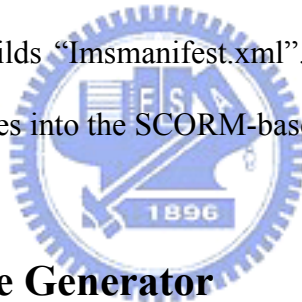


Figure 5.5 The Concept of Building a SCORM Organization Tree.

5.2.3 BuildPackage()

This function includes two sub-functions. They are FormatSCORM() and PacketZip(). FormatSCORM() transfers the tree in the component of TreeView into SCORM organization and builds “Imsmanifest.xml”. PacketZip() will compress the Manifest File and Physical Files into the SCORM-based course packages.



Physical Files

5.3 Multi-level Course Generator

Our Learning System provides an easy way for an expert teacher or program director to generate the Multi-level courses. When a teacher runs the classified course function, it will load the whole course into a web page. Every chapter and its sections will be listed on the page and each chapter will follow with a Multi-level classifying radio button. The teachers just need to click on the level or type of course to define what they want to teach. After a teacher finishes the required action for every chapter listed on the page, the function will generate several files as shown in Figure 5.6, and the Multi-level course is ready for the student to use. The student can then register the course and join a certain level or type (‘in classroom, online, or combined).

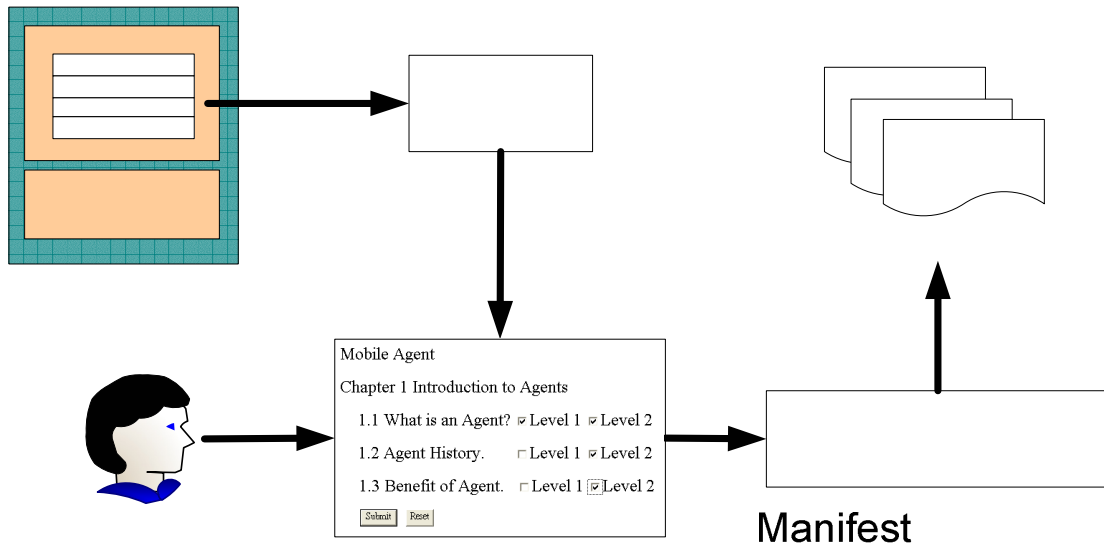


Figure 5.6 Generating Multi-level Courses.
 Meta-data
 Organizations
 Resources
 (sub)Manifest(s)

5.3.1 XMLToForm()

XMLToForm() parses the structure of the matched level of “Imsmanifest.xml” into a Leveling Web Page. The Leveling web page is the list of outlines in a course. Every section will be followed by some checked boxes. The number of the checked boxes depends upon the number of levels that the administrator wants to use. If the box of a level is checked, this level will be added to the course. As shown in Figure 5.7, line 1 is the declaration of XMLToForm(). The input of XMLToForm() is the Organization-node of SCORM. Line 3 and line 8 is the for-loop input and it will run as many times as the number of ‘children’ of the Organization-node. For every ‘child’ of the Organization, line 4 checks if the ‘child’ is an Element-Node and Line 5 checks if the name of this ‘child’ is “item”. If both line 4 and line 5 are correct, then ParseNode() for this ‘child’ can be run.



Figure 5.7 The Algorithm for XMLToForm().

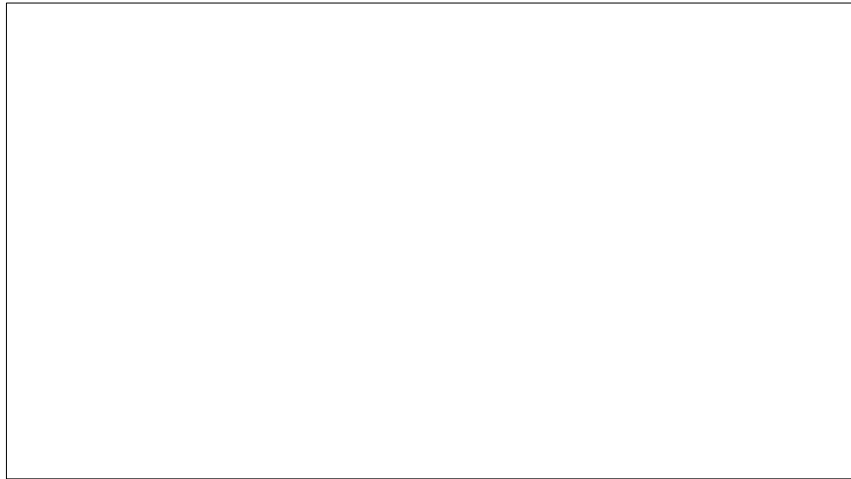


Figure 5.8 The Algorithm for ParseNode().

```
1 int XMLToForm(  
  {  
  for(int i = 0; i < OrgList.Count; i++)  
    if(OrgList[i].OrgType == OrgType.Section)  
      if(OrgList[i].OrgType == OrgType.Section)  
        ParseNode(OrgList[i], htmlFormatOutputString);  
  }  
  }  
8 }  
9 }  
10 return htmlFormatOutputString;  
11 }
```

As shown in Figure 5.8, the ParseNode() is a recursive function. Line 1 is the declaration of the function. Its input is a XML node. Line 3 and line 4 check if the node is a section node. If both lines check correctly, the ParseNode() will add a checked box to the html format output string. Line 7 to 11 run a ParseNode() for every 'child' if the node has 'children'. Line 13 is the return function.

5.3.2 GenerateMultiLevelXML()

GenerateMultiLevelXML() generates some of "Imsmanifest.xml" files according

to the outputs form the Leveling Web Page. Every level will come with an “Imsmanifest.xml.” A section will be added to the level-n “Imsmanifest.xml” if its box of a certain level is checked. As shown in Figure 5.9, line 1 is the declaration of GenerateMultiLevelXML().nThe inputs of the function are levelingarray, numberofchapter, numberofsection, and numberoflevel. Levelingarray is gotten from the Leveling Web Page. The value will be set to 1 if the box is checked. The numberofchapter indicates how many chapters are in the course, the numberofsection indicates how many sections are in that chapter and the numberoflevel indicates the number of levels being generated. Lines 3 to 4 are the for-loop to run for every section in each chapter. Line 5 loads all chapter sections of the Organization-nodes into the organization array from original “Imsmanifest.xml”. Line 6 loads all resources of all chapters in the Resource-Nodes into resource array from the original “Imsmanifest.xml”. Line 7 to 12 copy the organization and resource data into the “level-k.xml” if that section is checked. Line 15 returns 0 to exit function.

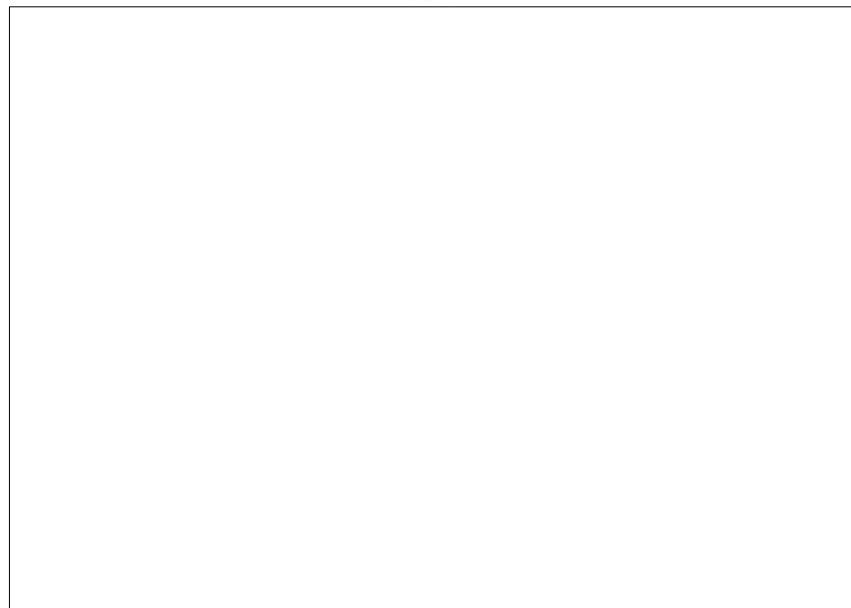


Figure 5.9 The Algorithm for GenerateMultiLevelXML.

5.4 Loading Multi-level Course and Learning Activity

This section describes the function of how to dynamically load a Multi-level course and the flow of the learning activity.

5.4.1 Dynamic Loading a Multi-level Course

The feature of our Learning System is that we can use the same course material to achieve the purpose of a Multi-level course. We only keep a copy of the course material into the Learning System. When a student starts a course, the `AssessmentLevel()` will assess his/her level, then the XML parser will dynamically parse the course setting from “`Imsmanifest.xml`” into the indexing database according to the student’s learning ability. Then the `LoadMultilevelCourse()` will load the Physical Files according to the indexing found in the database to provide the adaptive learning content as shown in Figure 5.10.

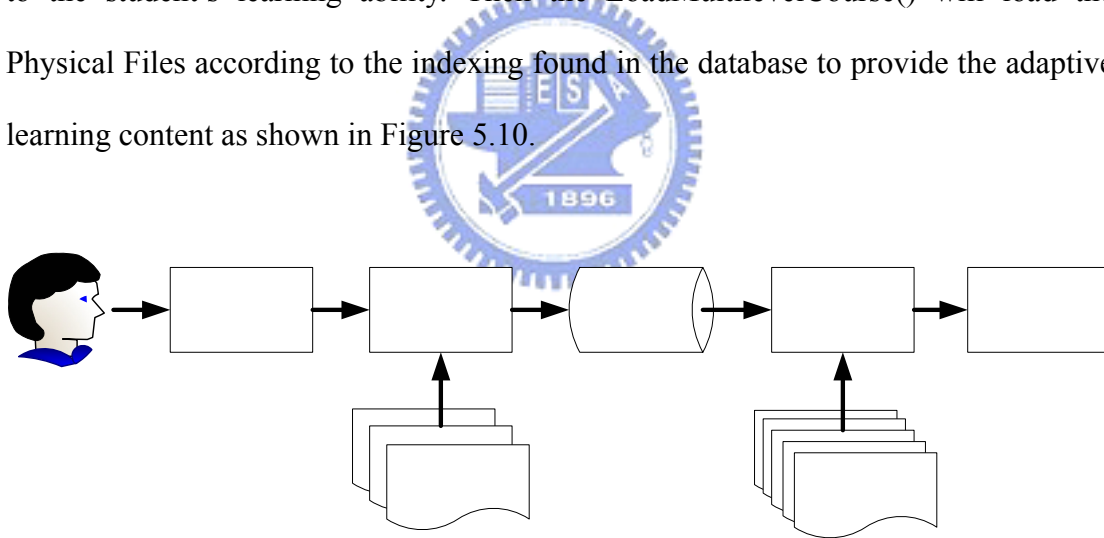


Figure 5.10 Dynamic Loading Multi-level Courses.

There are three different ways to decide the learner’s level in our implementation as shown in Figure 5.11. First, the user makes the decision to choose a level or type of course. Second, the administrator of the system decides which level and course type can meet the user’s needs. And 3rd, the system can provide an assessment exam for

the learner and load the corresponding level of a learning content. The benefit of the assessment system is that a student can choose to take a lower and a higher level of the same course simultaneously for various reasons: 1) if he/she is pressed for time, 2) passed a higher level but wants to review more content at a lower level, and 3) passed a higher level but is unfamiliar with the course material and wants to take a lower level.

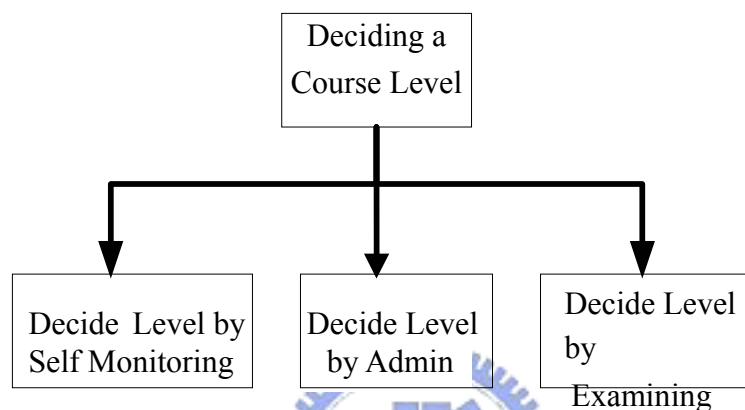
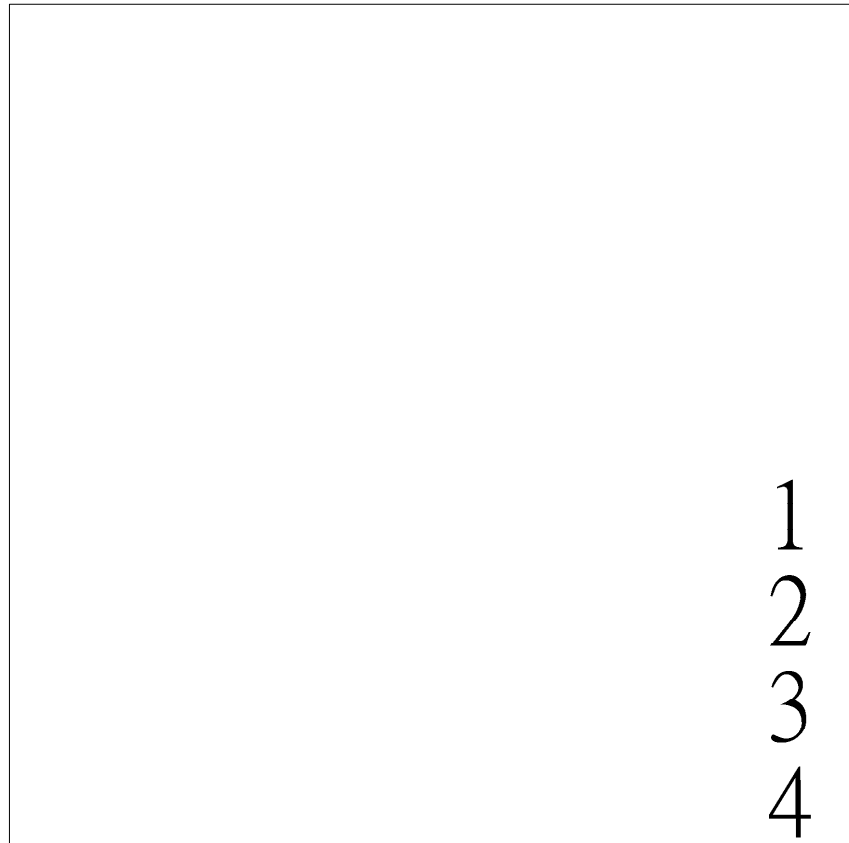


Figure 5.11 The Ways of deciding a student's Level.

XMLParser() will parse the matched "Imsmanifest.xml" of a user's level and save all the useful information. Then, using a JSP web page one can put the data into an Indexing Database. As shown in Figure 5.12, line 1 to 5 run XMLParseData() for the 'children' of Organization-node. XMLParseData() extracts useful data for every chapter. Line 10 contains the ID of the node, line 11 the type of resource, line 12 the title of the resource, and line 13 contains the location of the resource.



```
1 public void  
2 for(int i=  
3 XMLPa  
4 }  
5 }
```

Figure 5.12 The Algorithm for XMLParser().



5.4.2 The Learning Activity

As shown in the Figure 5.13, when a learner logs into the system, the system will check if he/she has registered for any courses. If the student is registered, then he/she can select the course that he/she has already registered for. If not, he/she can register a new course. The assessment sub-system will give the user an exam to help the student determine which level of the course he/she should register for, and then the Learning System will dynamically load the course accordingly. Now a user can continue on to the learning process. The Learning System will keep the status of what the student does in the course so that he/she can study the course at a particular level until it is finished.

```
6 public void  
7 if(xmlNo  
8 if(xmlN  
9 if(xml  
10 ite  
11 typ  
12 titl  
13 lau  
14 }  
15 )
```

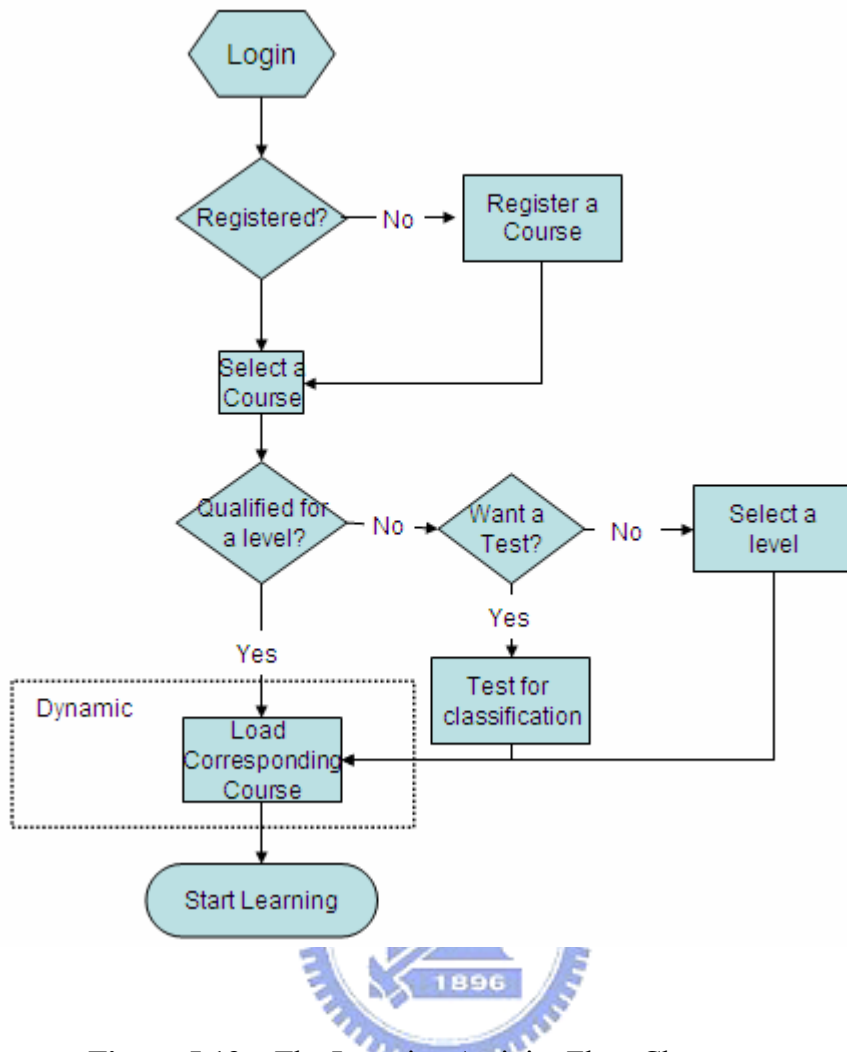


Figure 5.13 The Learning Activity Flow Chart

5.5 System Scenarios

To better serve the needs of different students and to decrease the stress and extra work of teachers facing a difficult learning environment (ex: an international learning environment) we also implemented certain prototypes besides an assessment testing system for choosing a course. Such system as shown bellow can help the student choose a course for an online, ‘in classroom’, or a combined program of ‘in classroom’ and E-learning environment according to his/her needs. One scenario can be; if an ‘in classroom’ course taught in English proves to be too difficult for some students, a lower level version of the same course can be set up by an administrator

partially online and partially ‘in classroom’ or combined. This way a student can get proper knowledge and develop listening skills gradually when learning in a language other than his/her native language, rather than being overwhelmed all at once by a very difficult course of ‘in classroom’ environment. Although the available options or scenarios using Multi-Level can be many and benefit learning in numerous ways, a general view of its uses are shown through the various other scenarios described in this section.

Other scenarios of the Multi-level Usage of SCORM presented here include the following prototypes: 1) “Transferring an Existing ‘in classroom’ or online Course to a SCORM-based Multi-level Learning System,” 2) “Application of Learning by a Given Level,” and 3) “Application of Learning by an Adaptive Level”.

5.5.1 Transferring an Existing Course to a SCORM-based Multi-level Learning System

We will transfer an existing ‘in classroom’ and/or E-learning course to our SCORM-based Multi-level Learning System. We use the Mobile Agent Learning web site as our sample. The Mobile Agent course is composed of html files, graphic files and flash files. The steps are as the follows: (1) Transferring a Course to a SCORM-based Course Package, and (2) Making Multi-level Courses.

5.5.2 Transferring a Course to a SCORM-based Course Package

We implement a tool to organize contents into a Manifest File. As shown in Figure 5.14, we provide some templates for the sequencing control. The users just need to drag and draw the content to the editing area in the left side of the window and specify its outline to finish the editing. After editing, the users can select the “Build SCORM Packet” item and the SCORM-based course is therefore created. If

the users want to modify the outlines, they can click on “Load Existing File” to load the Manifest File that was previously created. When files are selected, their contents will be displayed in a window so that a user knows what’s being edited.

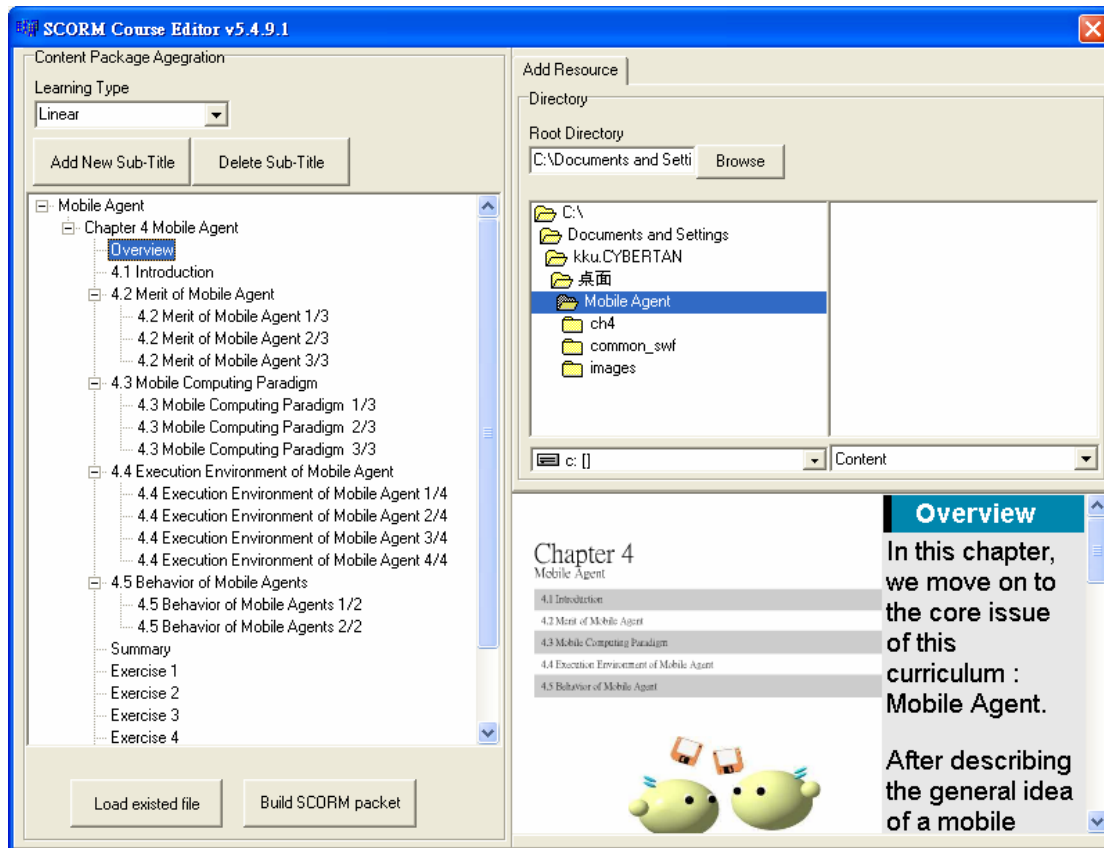


Figure 5.14 The Manifest File Editor.

5.5.3 Making Multi-level Courses

This application shows how an administrator can make up a Multi-level Mobile Agent course. An administrator needs to import the SCORM-based Mobile Agent course into the web site. Before an administrator can do this, he/she needs to log into the website as shown in Figure 5.15. After the administrator logs into the system, he/she can import the course as shown in Figure 5.16. An administrator may be a program director, a teacher, or an assistant who has the ability to define what kind of teaching material and course type is suitable for the level of each course.

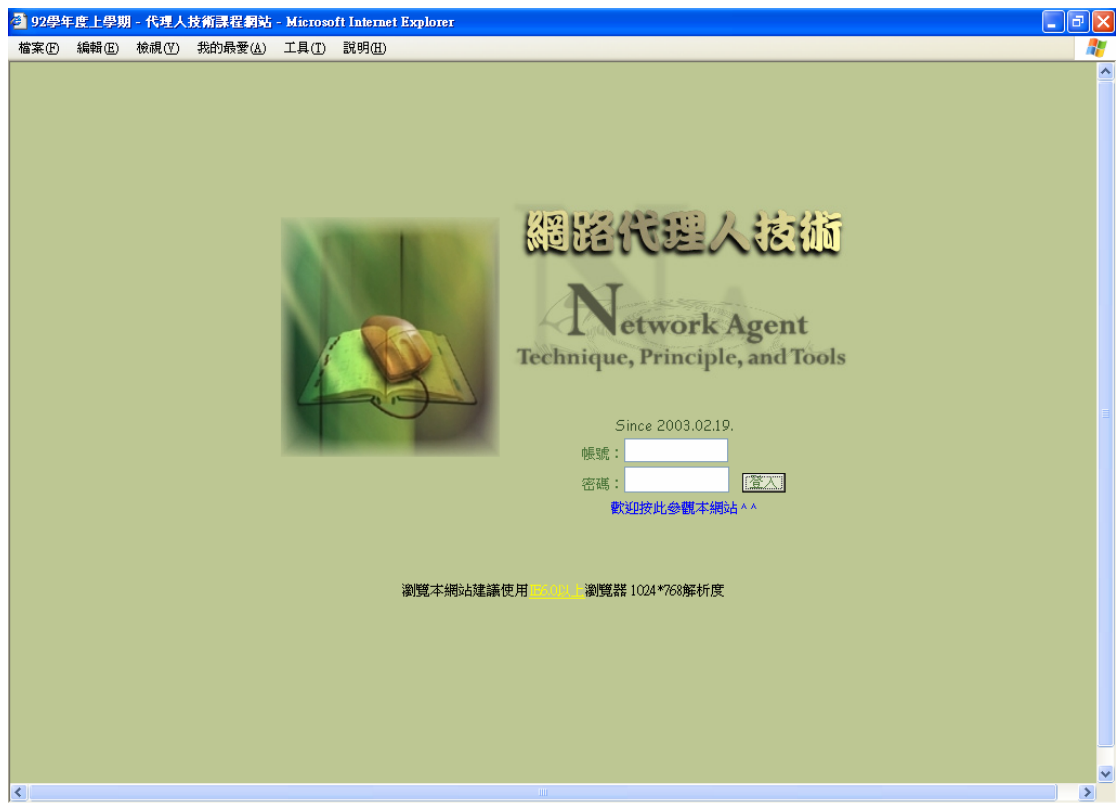


Figure 5.15 The Login Page

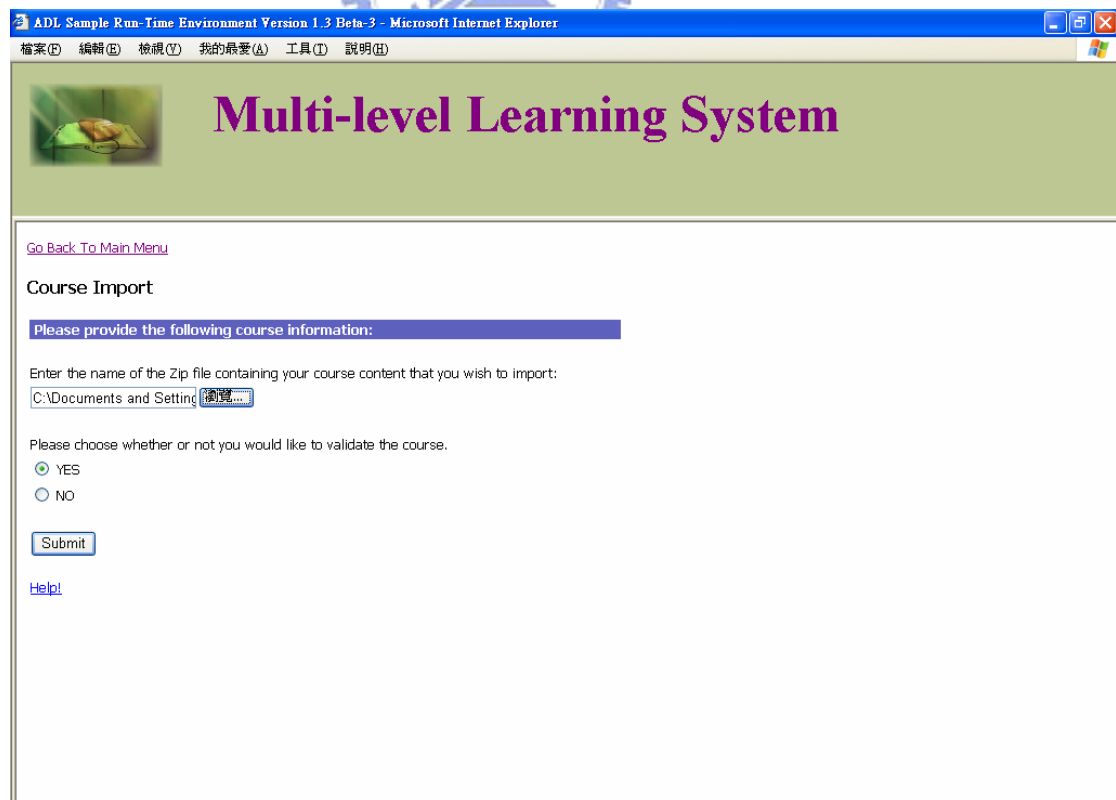


Figure 5.16 Importing a new SCORM package into the system.

Every course has its default level setting such as the overview of a book. When an administrator wants to choose the level of a course, he/she may choose to use the default level setting or to level a course at will. He/she may design how many levels the course needs to have. After the administrator fills in the number of levels, the system will load the profile of the course and provide a friendly page for him/her to define the level of every section. What he/she needs then to do is check the boxes with the corresponding level, as shown in Figure 5.17. Then the system will generate the Multi-level system for a course.

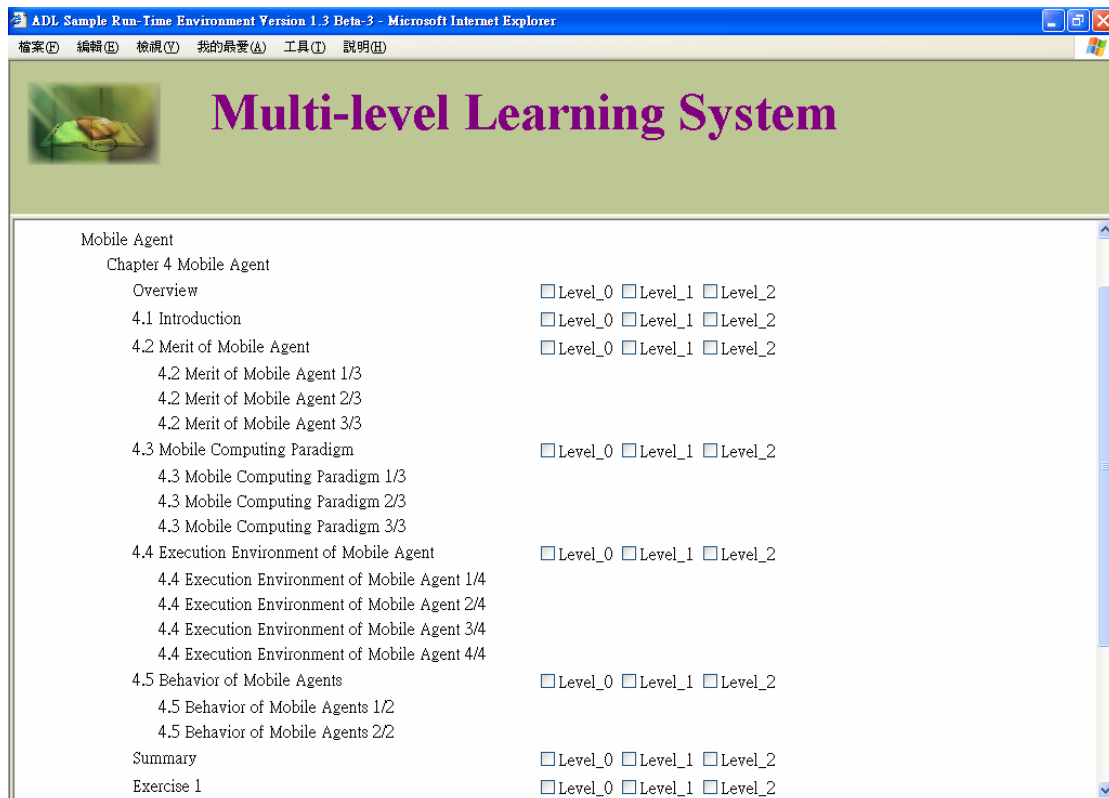


Figure 5.17 A Friendly Interface for setting up a course level

5.5.4 Application of Learning by a Given Level

One of the purposes of Multi-level Learning System is to provide the proper level of learning content to meet a student's real needs. We don't need not provide

him/her with too much or too difficult learning material. This will help the student to study a course better and easier. The Learning System provides an account management sub-system. The sub-system will record the user's learned activities and other relative information. After the administrator creates the account, the user can log into the system, change its password, register for a new course, and view the registered course, as shown in Figure 5.18.

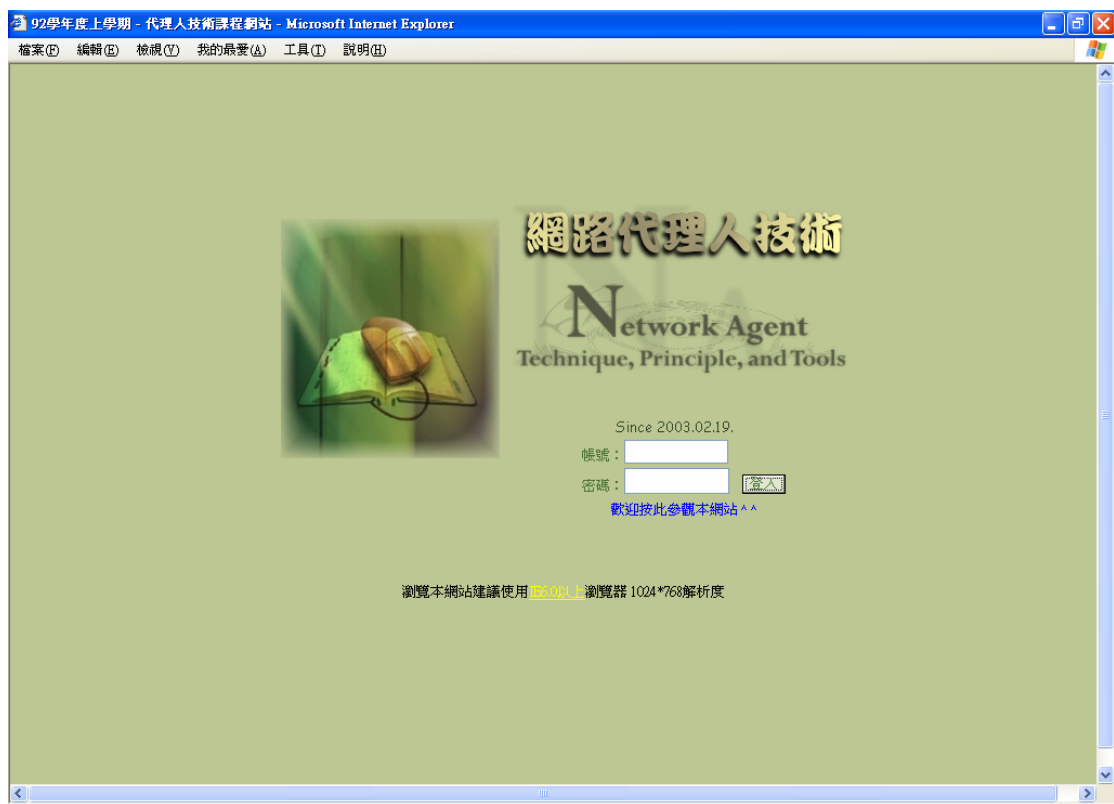


Figure 5.18 The User Login Page

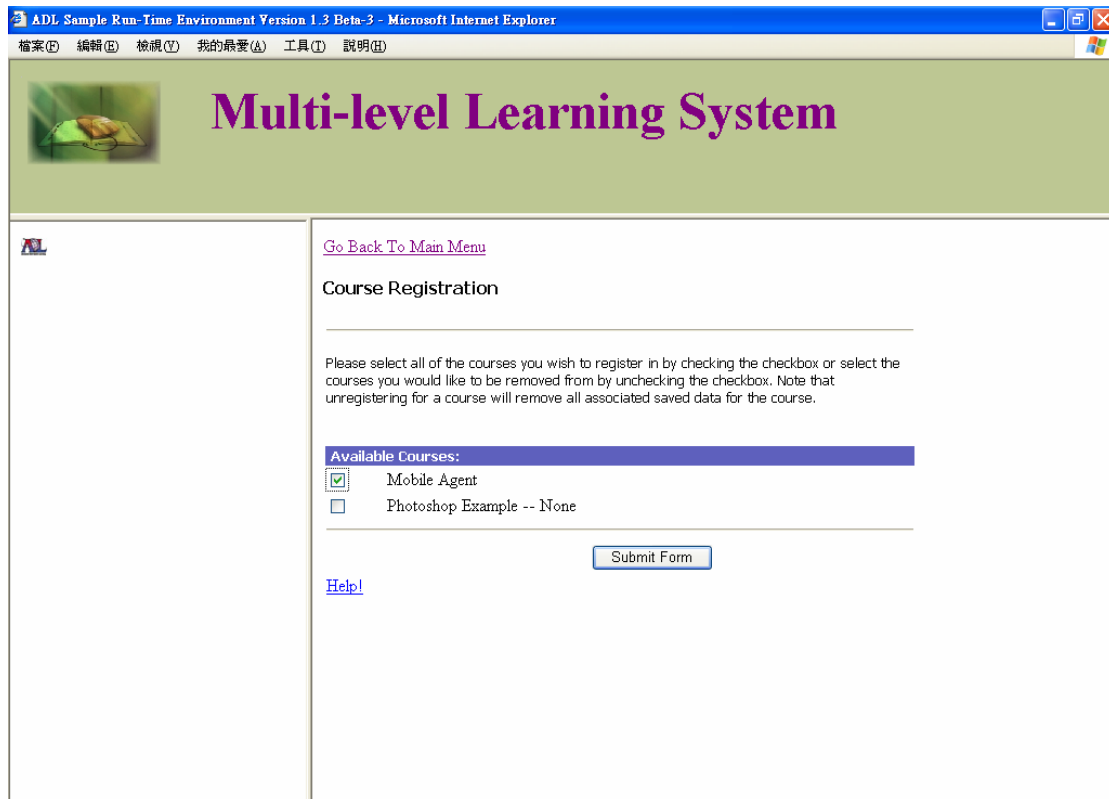


Figure 5.19 The Registration Page

Before a user can begin studying a course he/she needs to register for the course of choice as shown in Figure 5.19. After registering, the system will provide him/her the test for proper level or type of course according to the placement of that test. Figure 5.20 to Figure 5.22 show examples of three level courses.

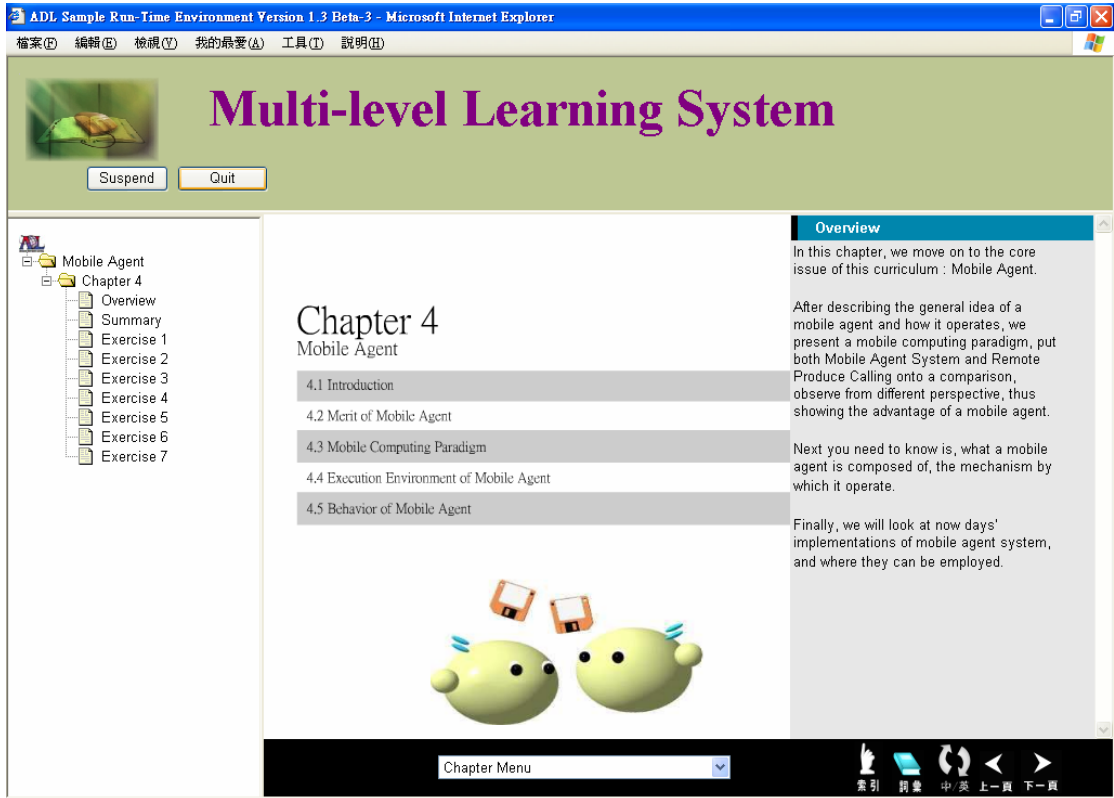


Figure 5.20 Example: Level 1 of a Three-level Course

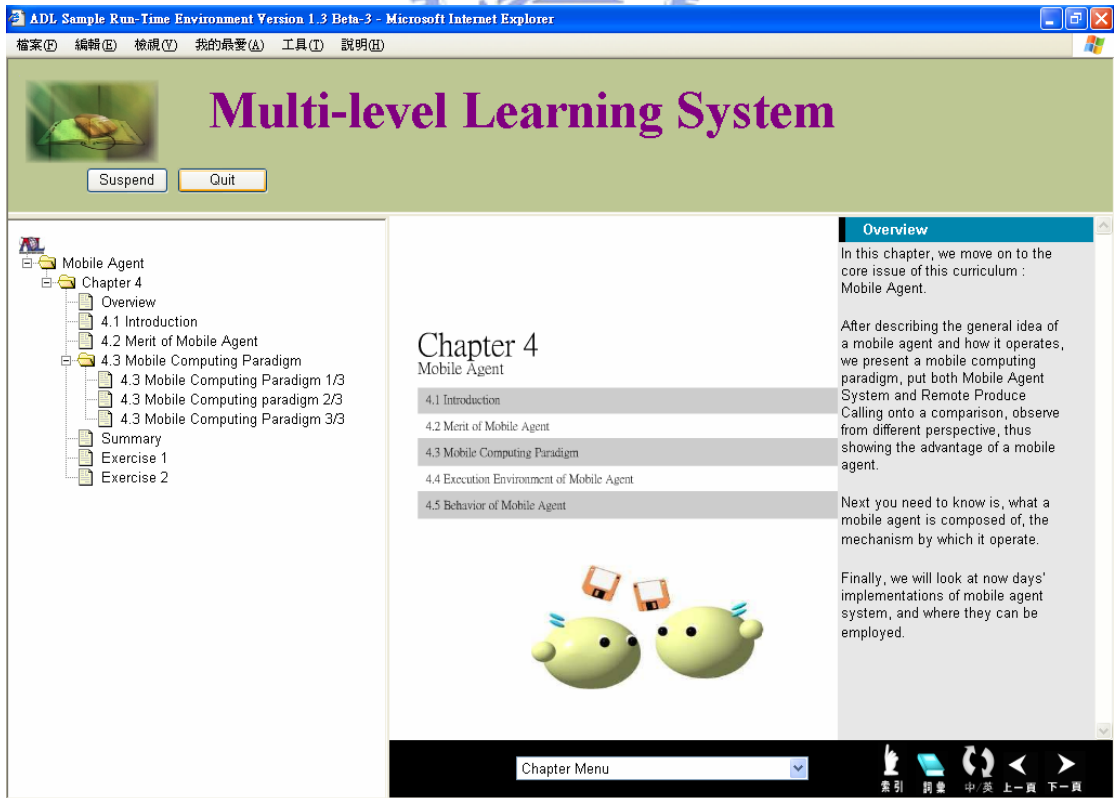


Figure 5.21 Example: Level 2 of a Three-level Course.

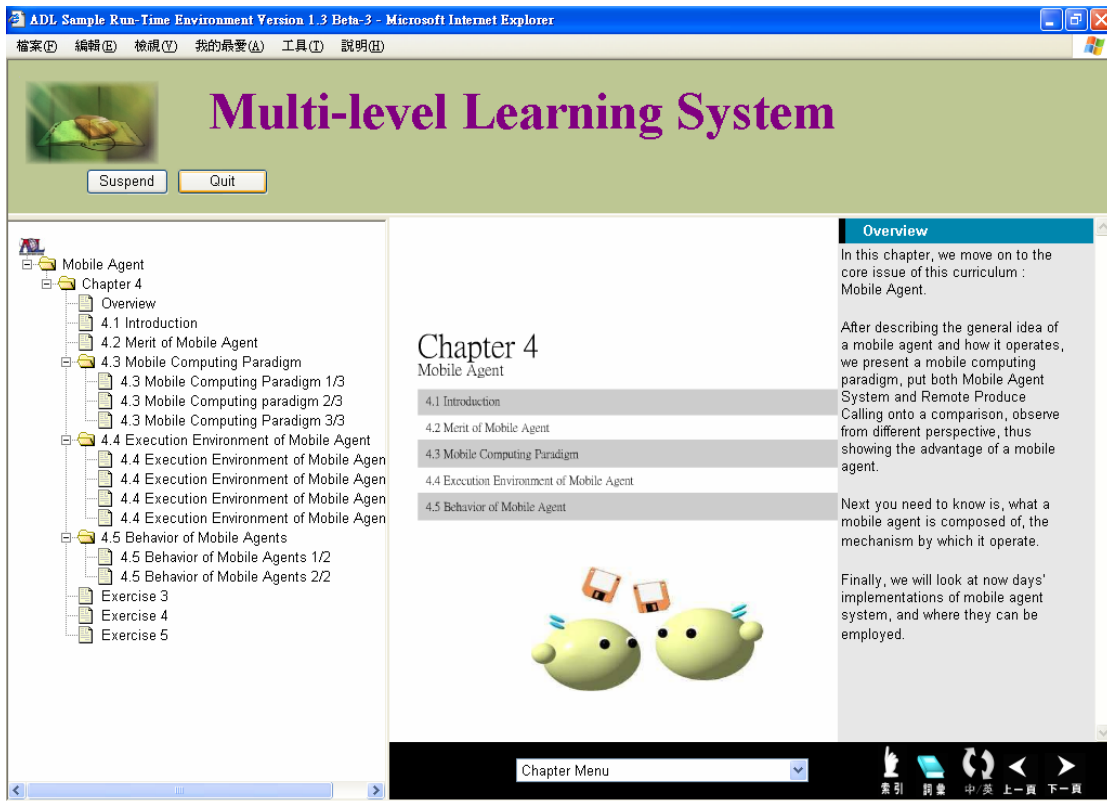


Figure 5.22 Example: Level 3 of a Three-level Course.

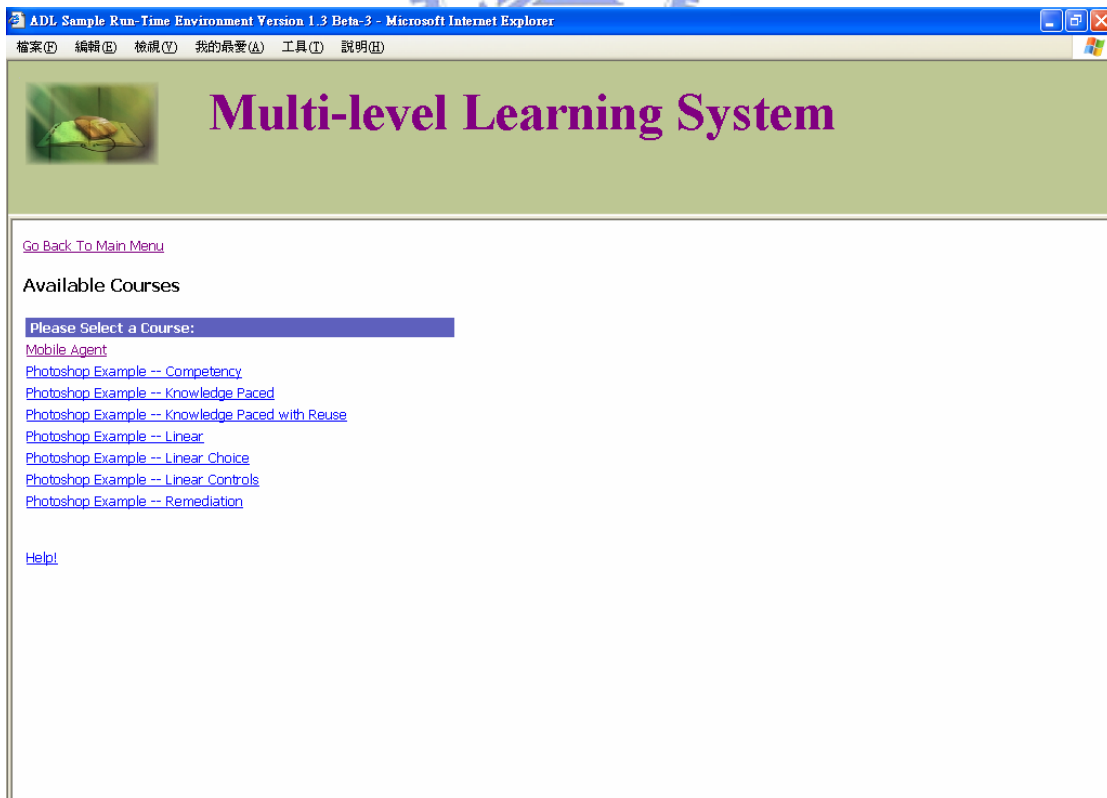


Figure 5.23 The list of available courses.

5.5.5 Application of Learning by an Adaptive Level

When a student logs into the system, it will show a list of the available courses to choose from as shown in Figure 5.23. After choosing a course, the system will give the user an exam to measure his/her level for the chosen course as shown in Figure 5.24. A course can be either 'in classroom' or online. Then the system will load the matching course level for the student as shown in Figure 5.25.

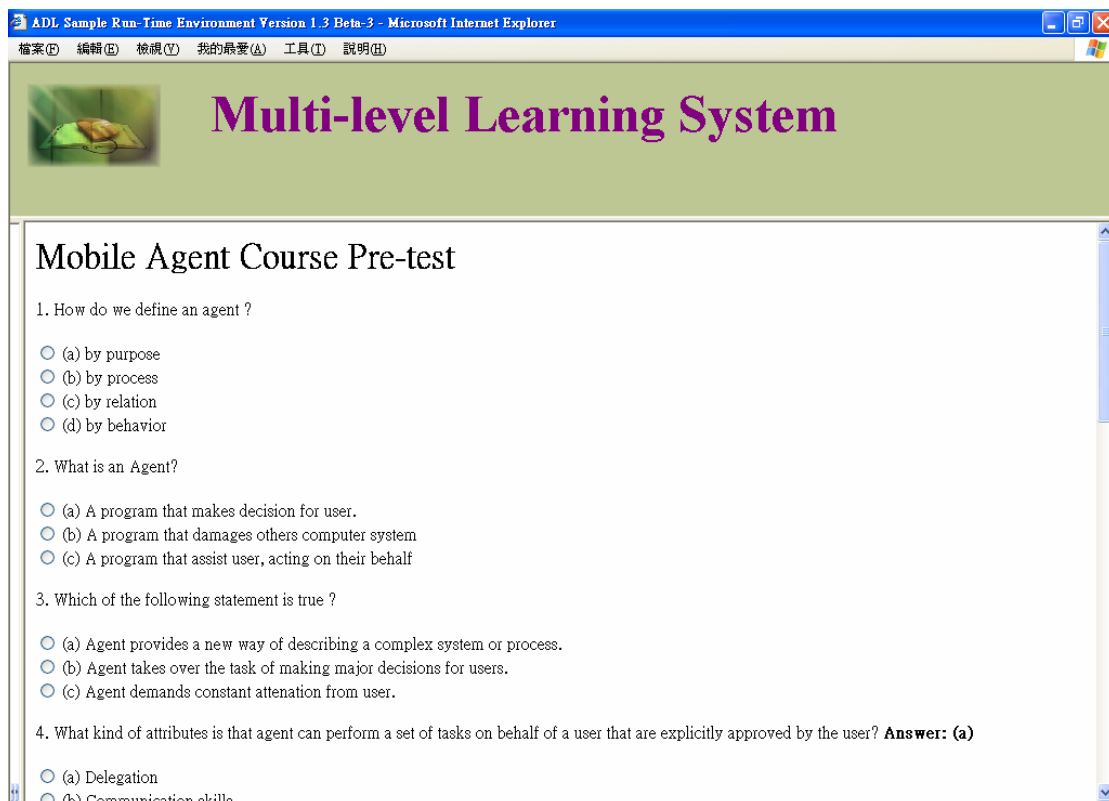


Figure 5.24 An assessment example

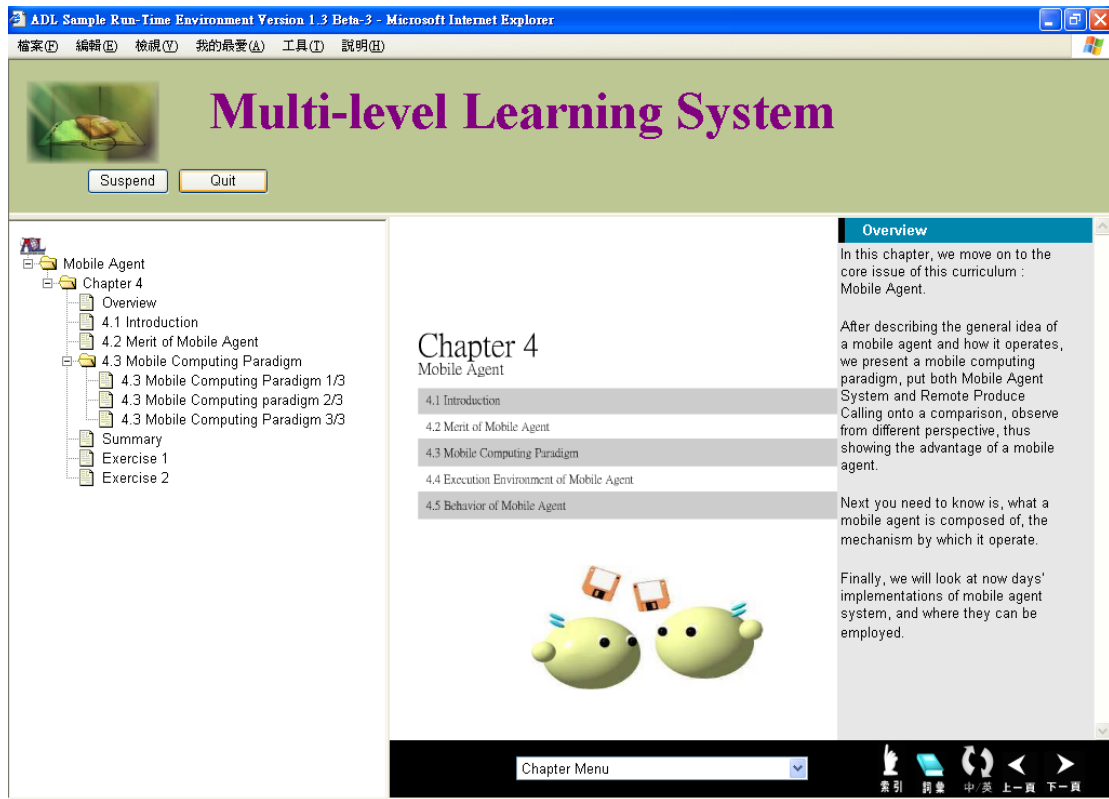


Figure 5.25 The Adapted Course



Chapter 6

Conclusion

6.1 Summary and discussion

This work presents a SCORM-based Multi-level system of education. We provide the web-based interface for a learning platform that can be easily used and distributed. The teachers can set up courses on the web and easily generate different levels of a course while choosing the appropriate type of learning environment (‘in classroom or online) for their students. They can manage the account of students to check their status and help them to finish a course. The students can join a course according to their proper ability level. This will help students to study in an easier way and avoid studying more content than what they really need. Students can also study higher and lower levels of the same course simultaneously for various needs if the assessment test for a higher level was passed.

The Learning System’s prototype achieves the Multi-level Usage but only keeps one copy of the Physical Files for easier management of the content. It can dynamically parse the level setting into a database and load the course of this particular level. The course is based on the SCORM standard so that the Learning System can import any SCORM packet as resources. Teachers can get the package from Internet, or from the content providers. They can also make up the course content by themselves.

Our system focuses on the Multi-level function and learning activities. In the future, we can extend our functions. For example, we could make the Assessment System more powerful and selective. It may provide some reminding information

when a learner is taking the exam, be able to give more descriptive and complete information, and select specifically from large samples. The questions of an exam can be dynamically loaded according to the previous score that a testee gets. This way, students don't need to answer too many questions that may be too easy, too difficult, or unnecessary. It can repeat the same questions or similar questions at a later time of the exam to prevent him/her from guessing answers often. It can give a different weight to every question according to the average score of a user taking the test. These ways will help the Assessment System to assess the level of a user more correctly.

We can also integrate the Learning Content Management System (LCMS). The courses can be reused and we may easily generate a new course without editing the content ourselves. We can extract the digital content from the other courses to create a new one. The way of leveling a course in our system is by having an expert teacher or administrator defining it. We can extend this function to let the system automatically form or execute the leveling. The system can collect the information of the learner's level, and then it can calculate the level of a chapter with some algorithm according to the weighted average of a user's level.

6.2 Contributions and Future Related Research Topics

To implement a combined Multi-level system, it requires both time and resources to make the necessary assessments and observations. Our investigation and work have only covered a small portion of how to implement a Multi-Level Usage in a higher education learning environment. Therefore, to continue the investigating work of Multi-level Usage in Higher-level education, further assessments and research should emphasize on the following:

- 1) Conduct another feasibility study as the one in this research using a larger sample

of teachers to see if preference for Multi Level is affected by different sample sizes.

2) Conduct a similar type of feasibility study as done in this research but this time only to college students, graduate students, and/or any students that study in a higher education system especially if they study in an international schooling system. Explain the benefits of a combined Multi-level educational system ('in classroom' and online). Then ask them various questions (similar to the questionnaire for the teachers) regarding their preference for different levels of the same course, online, and 'in classroom' environments and issues regarding their ability to learn in a language other than their native language. This kind of a research will allow for better understanding of students' needs and preference for a type of course and level.

3) Set up an experimental project where students and teachers with English language problems and any other learning or teaching obstacles considered can be selected indiscriminately for Multi-level 'in classroom' and online classes. The teachers should design the particular courses and their level accordingly and then have the students take the most suitable courses according to their needs and abilities.

4) Check the responses or results of the experiment above, conduct an analysis between the results obtained from the experiment, and build a conceptual/mathematical model to verify if the benefits of this proposed project stand as reliable and worthy to be applied. This may help find out more exact details of how implementing such a system can do all the proposed objectives: 1) make learning easier, faster, and better, 2) save time, 3) save money, and 4) save resources.

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APPENDIX A

About 30 samples of the questionnaires bellow were sent out and given to professors and lecturers that teach at universities and technical schools. 12 respondents out of about 18 returned questionnaires returned to us gave complete and useful information for developing and completing our feasibility study. The questionnaire for the developers included the following questions bellow:

- (1) What kind of school do you teach in?
- (2) How could you use Multi-level courses in different kinds of schools and programs?
- (3) How many levels do you feel are necessary for a particular course?
- (4) Do you need to change the index of chapters or sections after separating the course into levels for different programs or classes?
- (5) How do you feel about teaching the same course in both 'in classroom' and online environments?
- (6) How can you use Multi-level courses for different class types and environments?
- (7) If you taught a course in another language, what kind of teaching method would you prefer (online or 'in classroom') and would you prefer different levels?
- (8) Would materials differ for the same course which uses different environments or methods ('in classroom' or online) at the same school?
- (9) How would you separate the content of materials for different levels of the course?
- (10) How do you want to separate the content of the material for different classes that teach the same subject?
- (11) How would you use Multi-level courses for different students in a class?
- (12) How many levels of a course do you need for different students in a class?
- (13) Do you need to change the index of chapters or sections after separating the courses into many levels for different students in a class?
- (14) Do you think if it is difficult for making digital contents?
- (15) Would it be helpful if you can get some digital courses with 'in classroom' and E-learning standard?

