SCORM e-Learning Course and Learning Management System Application and Probe

TING-SHENG WENG
Department of Management Information Systems
National Chiayi University
580 Sinmin Rd., Chiayi City 600
Taiwan
politeweng@mail.ncyu.edu.tw   http://www.mis.ncyu.edu.tw/english/Tea_weng.php

MING-HSUN LEE
Department of Human Resource Development
Hsiuping Institute of Technology
11, Gungye Rd., Dali City,Taichung
Taiwan
mhlee@mail.hit.edu.tw   http://www.hrd.hit.edu.tw/teacher.asp?Tid=1259&types=view

Abstract: - Technology development promotes the application of computer in recent year. Learning is no longer restricted in classroom and textbooks. Learning through computer network becomes more and more popular. Computer network offers efficient and flexible environment for anyone to reach different kinds of information that gives a feasible tool for students to get the required knowledge anytime and anywhere the computer network is available.

The essence of this study is to set up an e-Learning system whose cost is comparable lower than the existed systems. This system offers an easy and flexible platform for teachers to build this learning manager system in accordance with the SCORM standard. That also gives the students a friendly learning environment.

Key-Words: - Learning Management system, SCORM, e-Learning, Digital content

1 Introduction

Science and technology developed and network expanded have made computer and network popularization rate higher and higher in recent years. Teachers' teaching materials are no longer confined to book and schoolbook, and continual teaching material augmented to promote the abundance of contents through searching at network. As a result, more and more teachers are influenced by the network environment, and expect to promote their computer skills to enrich the teaching content for increasing students learning effects and efficiency through matching the online learning and traditional learning teaching methods.

There are two parts, Platform and Content, arranged in online learning (or E-Learning) system. Most platforms are using Learning Management system (LMS), emphasized on the management of teaching and technology development, such as the online registration, test, homework upload, application sharing. email. LMS can offer teachers and students an environment for online studying with digital contents. However, this kind of systems does not make e-Learning environment easily. Because of the complexity of designed teaching materials and expensive cost of LMS, they impeded some teachers adopted the e learning in the past. At present, many commercial vendors developed simple teaching materials software tools for teachers to make digital teaching materials by themselves. In addition, many universities try hard in constructing e-Learning website. Therefore, more teachers may require switching their traditional teaching contents into digital contents, which manufactures teaching materials with multimedia, in the courses in the near future.

E-Learning brought a novel learning mode for educators and students, and numerous conveniences of teaching processes. It existed a general phenomenon that most of students are used to learn through Internet, but most of teachers have less experience teaching through Internet and designing the teaching content for the network environment. For non relative Information department teachers may have difficulty to making the teaching package in accordance with the SCORM (Shareable Content Object Reference Model) standard. This study proposed two e-Learning practicing problems below.

The first problem is how to design the teaching materials. In general, teacher considers that digitalizing the teaching materials and uploading it online must have the knowledge and skills of computer and multimedia. The conventional ways to get them would be almost outsourcing by vendors or learning/doing by oneself. Outsourcing cost a lot of money, and the effect of the outcome maybe not satisfied with educators. Because educators wanted to add or modify content, they need to remake the teaching materials by the vendor or manufacturer. It would waste some time and money. If the design teaching materials are made by the educators themselves, it would be a lot of pressure to those teachers who do not well know in computer skills, and cause some teachers not willing to make the teaching materials.

Another problem is how to built and design a learning platform. There are some differences between a learning platform and traditional web site. A learning platform website are focus on for placing those multimedia teaching materials, and offers learners skim over and learning, and designing by professional programmers and educators together. Learning website offers quite more manage functions. If learning website would be fit the SCORM standard, the designer must be a professional programmer, not general webpage designer or ordinary group can do it.

Under the SCORM trend, there are many commercial companies, research institutes and open source software institutes which devoted to develop SCORM-compliant e-Learning platform and authoring software in the market. It would cause educators to have too much products to confuse his choice and consume precious time in experiment.

As mentioned questions, this study focuses on setting up reference resources for educators about integrating free open sourced educational systems including Dokeos, Atutor and Moodle and teaching materials authoring software such as Reload, Macromedia Captivate and Stream Author to find compatible combination. The e-Learning platform and teaching materials authoring software which mentioned in the study have a common character that whole software have be designed according to SCORM which is the international e-Learning standard. Educator can follow the instructional reference resources to teach on-line easily. It not only helps educator to save cost which implement commercial platform or learning materials, but also to spend less time choosing e-Learning platforms and teaching materials authoring software.

2 Related work

2.1 The difference of e-Learning and traditional learning

For traditional learning, face to face learning, to e-Learning, there were more advantages than e-Learning. But the prevalence of e-Learning had also more advantages which traditional learning was short of it. Teachers are the central of traditional learning. Learners receive knowledge passive and would like to independent learning. Teachers and learners must appear to instruct knowledge in the meantime and the same place, see figure1 which is a inverse way. Learners are the central of e-Learning. Learners learn active and step by step. Teachers are leaders and emphasizing group learning. Learners can learn on the go, see figure2. Table1 is the expression introducing comparison between these two different learning:

Table1: The comparison between two different learning

| Content	Traditional learning	e-Learning
Time/Place	Synchronize/The same place	Synchronize, asynchronous/Any place
Learning central	Teacher	Learner
Learning form	Independent learning	Group learning
Teaching materials display	Schoolbook	Multimedia
Learning attitude	Passive	Active
Progress control	Designed by teachers	Designed by learners
Learning path	Designed by teachers	Designed by learners
Learning effects	Teacher's teach ways and attitude	Leaner learning attitude and teaching materials
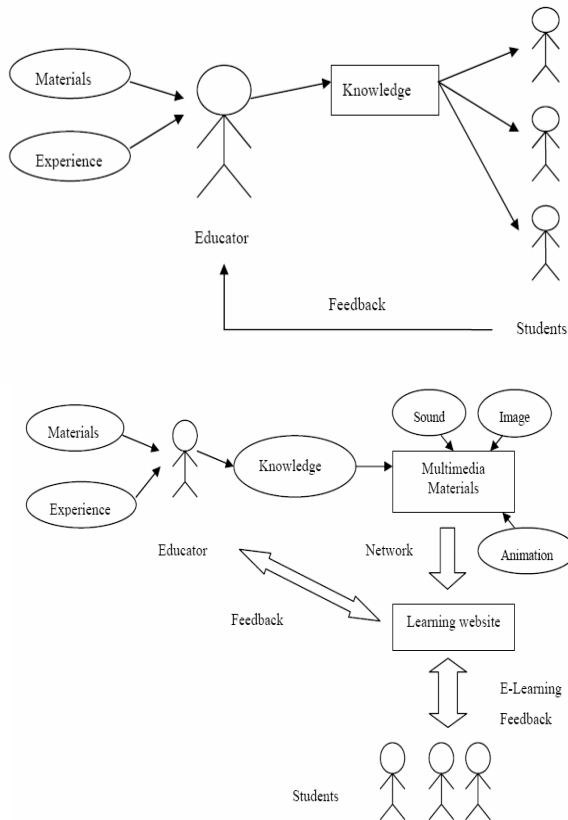
Fig.2, e-Learning

2.2 The origin of the SCORM standard

In 1997, United States Department of Defense and Office of Science and Technology Policy together advance ADL (Advanced Distributed Learning) project, bringing in SCORM (Sharable Content Object Reference Model) standard. ADL united industry, academic and military to bring into ADL Co-Laboratory together and become global organization and formulated unit about common standard.

The role of ADL and SCROM in e-Learning assists in defining the technology which is about e-Learning environment, referring to correlative technology standards, specifications and guiding principles and making learning contents and system much accord with exceptional requirement.

2.2.1 The main characteristics of SCORM

● Accessibility: learners all over the place can have access to teaching materials.
● Adaptability: learning materials should be flexibly adjusted to fit learners' needs.
● Affordability: learning materials can be economically and effectively developed.
● Durability: with technology being changed, application programs or teaching materials don't have to be re-modified.

● Interoperability: teaching materials can be used in any development systems or instructional platforms.
● Reusability: teaching materials can be reused under different circumstances.

2.2.2 ADL network hypothesis

ADL believed network offer the main chance to reuse learning contents, its hypothesis is following:
● The rapidly development of network technology and relevance tool provides fundamental learning technology.
● The technology standards of e-Learning are invariable.
● Learning contents can deliver with any medium.

2.2.3 The operative ability of SCORM

SCORM uses network hypothesis to expand learning technology, its operative ability is following:
● LMS(Learning Management System) can be putted in teaching materials and used in any development systems or instructional platforms
● Different LMS can be putted in the same teaching materials and exchanged each other.

In figure3, LMS is basic environment based on server and manage to transport a teaching material to learners. The main functions are coping with executing teaching materials for learners, the delivering, tracking reporting and process in turn with teaching materials and learners.
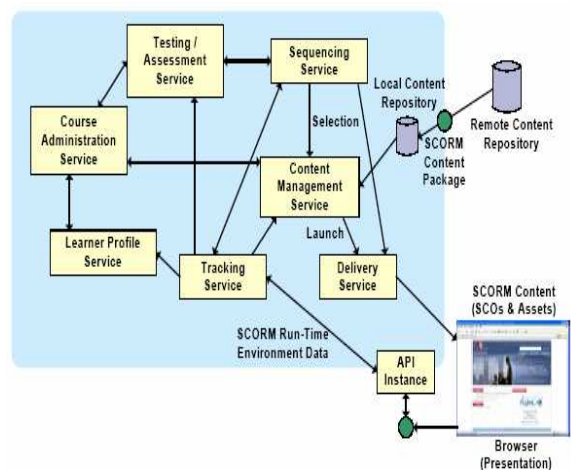

Fig.3, Ordinary LMS model

3 Research method

The research used related literature searching to

know and analyze network service, e-Learning framework and the existing requirements or questions. We used three developing learning platform abroad to set up three different learning platform to experiment and used three teaching materials software which accord with SCORM standard to manufacture multimedia learning package which fit in with SCORM standard the same. After that, we put the learning packages into learning platforms to construct the environment which can offer online assistant learning.

Lastly, analyzing the relationship between learning systems and multimedia learning contents and the result which system could correspond with SCORM and making the building processing about e-Learning environment reduce from figure 4 to figure 5.
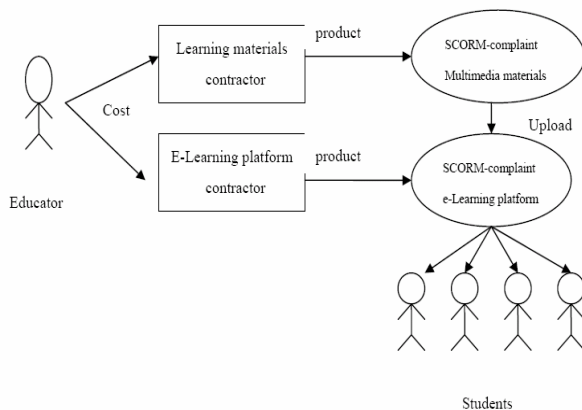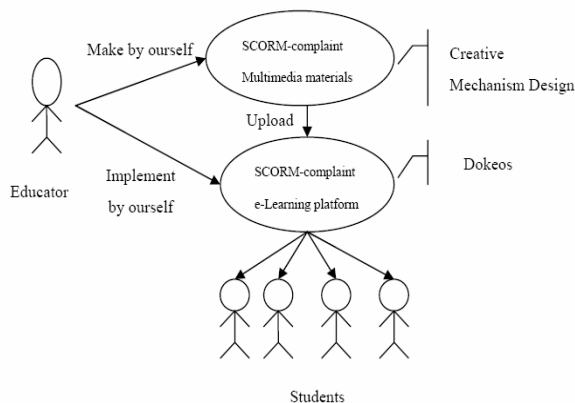

Fig.4 Structure flow of tradional on line teaching

Fig.5 Structure flow of concide on line teaching

3.1 System implement environment
- Operating system: Microsoft Windows XP (Microsoft Windows XP Professional Version 2002.Servic Pack 2).
- CPU and memory: Pentium(R)4 CPU 2.8GHz 512MB RAM.

- Web server: Apache Web Server Version 1.3.31.
- Programming language: Personal Home Page.
- Database: MySQL Database Version 4.0.20.

3.2 The choice of teaching materials authoring software and e-Learning platform

3.2.1 Teaching materials authoring software

The study will practically manufacture the learning package by the authoring software. Under the SCORM specification, the teaching package is the format of ZIP which contained teaching information, teaching content, architecture and the relationship of every learning component. The authoring software which the study adopted could produce the learning materials followed SCORM1.2 specification.

The study considered that the teaching content displayed diversity and close to the situation of classroom. At present, the mode which showed image, sound and slide simultaneously is the famous mode. Under the mode, student can see and listen to contents like in a classroom. The study made use of three authoring software as experimented software, including Reload, Macromedia Captivate and Stream Author.

RELOAD is a JISC-funded project, developing tools to facilitate the use of emerging Learning Technology Interoperability specifications such as those produced by ADL and IMS(Instructional Management Systems). RELOAD tools include a Metadata and Content Packaging Editor and a Learning Design Editor. The lead software developer is Phillip Beauvoir, with development contributed for SCORM support by Paul Sharples and Roy Cherian. The tools have proven to be the de facto standard for creating and previewing IMS files.

Adobe Captivate is a screen cast program that outputs Flash swf files using a Microsoft Windows computer. It can also convert PowerPoint files to Flash files. This software lets the operator build and edit interactive program demos and lessons very quickly. It has an efficient screen-capture movie mode that snaps a sequence of still images and then builds mouse movement simulations to create the appearance of a running program. By using Adobe Flash Tweening technology, Captivate is able to create screen cast in a much smaller file size than

needed for a real full-motion screen capture movie. Captivate is often targeted toward the corporate e-learning departments, industry trainers, and professional educators, but is helpful to anyone who wants to capture and edit screen recordings. For the educator, the product comes with several pre-built exam configurations allowing you to test a student's learning using multiple answer and fill in the blanks exam questions. Captivate supports the automatic sending of a user's exam results to the test giver's email. Additionally, the product supports many e-learning standards such as SCORM and AICC(Aviation Industry CBTv(Computer-Based Training) Committee).

Stream Author is a powerful tool for creating effective presentations by synchronizing video with PowerPoint or other document files. Stream Author enables presenters – such as teachers, trainers, or sales people – to create informative, persuasive and stylish presentations featuring synchronized PowerPoint files, narration and video. Stream Author features a multi-chapter architecture allowing more flexibility and manageability while editing or browsing content. The powerful new automatic chapter setting feature saves production costs by dividing individual chapters according to time, length, video or slides. Multiple choices of output formats allow the entire multimedia presentation to be exported as a single file or as individual chapters. Additionally Stream Author allows the creation of executables with or without encryption. Stream Author supports the latest international e-Learning standard of Multiple SCOs from SCORM 1.2 and SCORM 2004, allowing content to be more easily shared and reused.

3.2.2 E-Learning platform

The study adopted the open source e-Learning platform as our experimented platform such as Dokeos, Atutor, Moodle. There were written in PHP and uses MySQL as adatabase. The development of Moodle continues as a free software project supported by a team of programmers and the user community all over the world, meaning that users are free to distribute and modify it under the terms of the GNU General Public License. They also adopted SCORM specifications to design website and learning activity. There were some brief introduction about Dokeos, Moodle and Atutor.

Dokeos is an e-Learning environment and course management web application and also a collaboration tool. Its development is an international, collaborative effort. It is also OSI certified and can be used as a content management system for education and educators. Its features for course management include content distribution, calendaring, progress tracking, text/audio/video chat, test administration, and record keeping. Dokeos is an easy-to-use authoring system and a simple videoconferencing interface. The main goals of Dokeos are to be a very user-friendly and flexible system with an easy to use interface. It wants to be a tool for good learning, so that users have minimal notice of the tools and maximum attention for the content.

Moodle is a course management system and Open Source software package designed using sound pedagogical principles, to help educators create effective online learning communities with opportunities for rich interaction. Its open source license and modular design means that many people can develop additional functionality, and development is undertaken by a globally diffuse network of commercial and non-commercial users.

ATutor is an Open Source Web-based Learning Content Management System (LCMS) designed with accessibility and adaptability in mind. Administrators can install or update ATutor in seconds, develop custom templates to give ATutor a new look, and easily extend its functionality with feature modules. Educators can quickly assemble, package, and redistribute Web-based instructional content, easily retrieve and import prepackaged content, and conduct their courses online. Students learn in an adaptive learning environment.

Table2, The comparison of Dokeos, Moodle and Atutor

Dokeos	Moodle	Atutor
Dokeos	Martin Dougiamas	Adaptive Technology Resource Centre University of Toronto
1.6.5 / July 2006	1.8/31 March 2007	1.5.4 / 16 April 2007
Cross-platform	Cross-platform	Cross-platform
Course Management System	Course Management System	Learning Management System
GPL	GPL	GPL

http://Dokeos. com	http://Moodle. org	http://www.atu tor.ca/

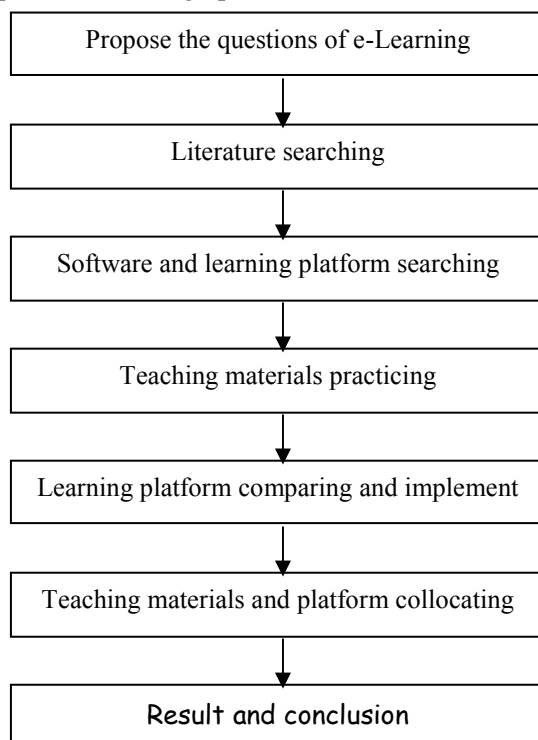## 3.3 The process of implement e-Learning conformed to the SCROM standard

In the whole architecture of e-Learning distribute into two main parts. The first part would be made learning content to multimedia learning content compressed files which conformed to SCROM standard. The second part would be established a SCORM-based learning website. Finally, we took the compressed files into the learning website all follow the SCROM standard, and combine the other functions in the learning platform to a learning course.

3.3.1 SCORM-based teaching materials

We look over the literatures and collect the software information to make a decision is choosing three software of multi-function and SCORM-based, and used it to make the SCORM-based testing package of the research.

3.3.2 SCORM-based learning platform

We know the development of e-Learning in foreign is earlier than us from searching the process of learning platform. There were more groups that spread e-Learning making free learning platform to everyone to use in early periods. Most of these were developing a space, passing through improving constantly and popularizing the SCORM standard. It was quite complete with assistant learning functions in learning platform and spread to use over the world. The research used three popular learning platforms in foreign for testing platforms and analysis the difficulties facing in the learning platforms setting up.

```
┌─────────────────────────────────────────┐
│      Propose the questions of e-Learning │
└─────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────────┐
│            Literature searching          │
└─────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────────┐
│  Software and learning platform searching│
└─────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────────┐
│        Teaching materials practicing     │
└─────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────────┐
│  Learning platform comparing and implement│
└─────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────────┐
│ Teaching materials and platform collocating│
└─────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────────┐
│         Result and conclusion            │
└─────────────────────────────────────────┘
```

3.3.3 Collocating with multimedia teaching materials and learning platform

Finally, we linked up the learning packages which made by SCORM-based teaching materials software with the learning platforms which is free model in foreign established by us, and compare the condition collocating with each other.

Fig.6, The procedure of study

4. Research results and analysis

At this stage, the research used SCORM-based teaching material software to make different SCORM-based learning packages, took it into learning platforms which established advance successfully and finished the courses setting. In the whole of courses collocating, we detected a question. Although three SCORM-based teaching materials software had be professed that can make the SCORM-based learning packages and access SCORM-based learning platforms, it is not prospective that learning packages and learning platforms couldn't access with each other. In other words, some learning platforms can access the learning packages made by some software, and some can't.

After the experiment, the study proposed that Dokeos and Stream Author were the best combination. The learning materials which made by Stream Author could be operated smoothly on Dokeos e-Learning platform. The result would be adopted and put in practice by many universities such National Cheng Kung University, National Formosa University, Southern Taiwan University and Kun Shan University. The study also verified the satisfaction about learning materials and Dokeos by questionnaire. The result revealed that almost teachers believed the software combination was helpful for themselves to design an e-course. Most of students learned on Dokeos considered the Dokeos was user-friendly and esthetic in course structure and interface design. With regard to learning materials, they pointed out multimedia learning materials certainly attracted their attention and felt much interesting than textbook. Briefly, teachers and students whom have used Dokeos and learning materials considered the combination of Dokeos and Stream Author would be contributive to teach and learn.

After the experiment, there were some result

about e-Learning platform and Teaching materials authoring software as following:

4.1 The three learning platforms proposed by the research meant only one learning platform can access all SCORM-based learning packages made by three SCORM-based teaching materials software. It purported that compatibility of the learning platform is high. Besides the learning platform with high compatibility, others can access one learning package at least. It proved that other learning platforms were fitted in with the SCORM standard. The table 3 is about compatibility of learning platform and learning packages.

Table 3, Compatibility of learning platform and learning packages

Platform software	Atutor	Dokeos	Moodle
Reload Editor	compatible	compatible	uncompatible
Captivate	uncompatible	compatible	compatible
Stream Author	uncompatible	compatible	compatible

4.2 The software and learning platform which proposed by us all fit in with the SCORM standard. The utility rate of learning platform is high and famous in foreign, Moodle especially. But it could not access three SCORM-based learning packages successful and the possible reason is the difference with developing group of learning platform and teaching materials software and lead to code the different form with the SCORM standard.

4.3 After testing in the research, we know learning platform support traditional Chinese. But if the learning package's name which made by SCORM-based teaching materials software is traditional Chinese, it couldn't connect with learning platform successfully. We must change the learning package's name into English first in order to upload to learning platform to produce the courses.

4.4 Although Dokeos supported traditional Chinese, its traditional Chinese module was developing. So, some function items still displayed in English. At present, the degree of traditional Chinese is 40.07% in Dokoes. The main difference is that would be hash code when imported the course items for courses. It just only

needs some basic course data to establish a learning environment and convenient to use.

4.5 Although the functions in Moodle learning platform were full and perfect, it needed more and more requirement setting in designing courses. It is guidable to set courses and need thorough course plan and design. Through the detailed course plan, teachers can supply different learning topics for learners to study in any time rather than make all learning authorities open to public access when learners get into the learning platform.

4.6 Atutor also only needs some basic course data to establish a learning environment. The main advantage is that the website provides the function to make teaching materials itself, even if do not make SCORM-based teaching packages beforehand. After finishing SCORM-based teaching packages, we can use it directly. If we want to share it to other learning platforms, it also has a function to transform the teaching materials to SCORM 1.2 teaching packages. Moreover, Atutor has a drawback corresponded to SCORM-based teaching package at present. That is if the website content structure of SCORM-based learning package is a type of framework. It can not display the content when the content of the web page is composed by two or more sub-page.

4.7 The research suggested making teaching materials using Reload Editor, because we though the application of Reload Editor which is suited to the teacher who already has the webpage. It only needs to converge on the webpage. The main effect of the abundance teaching materials is putting content in while designing webpage. We could take PowerPoint into the form of webpage for the teacher who just has PowerPoint files. And then put it to completely imitate to Reload Editor. It is suited for the teacher who just started to contact the SCORM-based teaching materials. Atutor and Dokeos are the better choice of more learning platforms.

4.8 The research utilized Captivate to make teaching materials. We thought Captivate suit with operating learning on screen and learning content in PowerPoint. Captivate can transcribe all operational steps. Every click or trochoid of mouse would be record and could explain every

action on the side. It is quite suitable to transcribe teaching materials. Additionally, Captivate can import PowerPoint files directly, effect of Flash animation and annotations in different forms to improve vitality of PowerPoint effectively.

4.9 We thought Stream Author suit with courses which had planned. Stream Author supply quite multiform content arrangement. After importing the PowerPoint, we used sound recording tool to tape scholar's voice that is the process of explaining content. Afterwards, we inserted appropriate photographs or animations in every section in the PowerPoint. It would need the preparation of teaching materials and the detailed explanation in advance.

5. Conclusion and further work

E-Learning is not only an indispensable auxiliary but also one of the main methods of studying in the future. The standard of e-Learning will be a trend applicable to the entire world. Through the standardizing of teaching material resources of the network, teaching material resources of the network would be shared to everywhere. To upgrade the common using and reusing could help us learning without borders. Although there are quite good ideas in standards of e-Learning, according our research we still found that some platforms and some teaching material software can not cooperate very well because their environment of teaching materials software and learning platform is at the stage for developing.

In the study, we proposed a model which integrated teaching materials authoring software and e-Learning platform to look for a quite matching set as a teaching reference. After the experiment, we acquired the exhilarating result that Dokeos was compatible with all teaching materials authoring software demonstrated in the study. Furthermore, we found Dokeos and Stream Author were the best combination. The result had been adopted with National Science Council project in Taiwan and implemented by four universities simultaneously which were National Cheng Kung University, National Formosa University, Southern Taiwan University and Kun Shan University. The part of learning performance is fine and acceptable.

Even thought our study has offered an easiest e-Learning realization and reference. No matter how easy and convenient the tool is to make teaching material or the learning platform offers how perfect function, the most important material is the e-Learning. There is a norm of general course, but how to make the course put in use with the internet curriculum will be a direction of development in the future. By designing a course and combine to the internet course effectively is the only way to improve the quality. As long as there is a good teaching material, it could make up an excellent e-Learning environment.

6. Acknowledgements

References:
[1] Abramowicz, W., Kowalkiewicz, M. and Zawadzki, P., 2003, "*Towards User Centric e-Learning System*", Web Services, E-Business, and the Semantic Web, pp.109-120.
[2] ADL(Advanced Distributed Learning), http:// www.adlnet.gov/index.cfm (Date: 2006/5/2)
[3] CyberLink, StreamAuthor 3.5- The Complete Tools for Creating Rich-Media e-Learning Content, http://www.cyberlink.com/multi/ products/main_7_ENU.html (Date: 2007/4/24)
[4] Ching Yi Chang, Ming Chao, *The Experience inDesigning Portfolio Analysis and Grading Mechanism for Distance Learning Systems*. GCCCE/NEIF 2002, Beiling, Beiling Normal University, pp. 74-81.
[5] Magdalena Stoeva, Asen Cvetkov, 2005, "*e-Learning system ERM for medical radiation physics education*", Medical Engineering & Physics 27, pp.605-609.
[6] Pin Hung Ko, 2002, *Research on integrating Information Technology into Instruction to promote teaching performance*, 2002 Computer and Network Technology in Education Workshop, pp. 193.
[7] Rosenberg, M. J., 2001, "*E-Learning: strategies for delivering knowledge in the digital age*", The McGraw-Hill Companies.
[8] Trace A. Urdan, Cornelia C. Weggen, 2000, "*Corporate e-Learning- Explore a New Frontier*", WRHambrecht+Co March 2000 Equity Research.