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# **An Authoring Tool for Structuring and Annotating On-line Educational Courses**

**A thesis presented in partial fulfilment of the requirements  
for the degree of**

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in  
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New Zealand.**

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## **Abstract**

This thesis studies the design and prototype implementation of a new web-based course authoring system for the Technology Integrated Learning Environment (TILE) project. The TILE authoring system edits the course structure and allows the author to annotate the course structure with meta-data. It makes extensive use of XML technology to communicate structured data across the Internet, as well as for both local and web-side databases. The Authoring tool is designed to support development by multiple authors and has check-in and check - out, as well as version control facilities. It also provides an interface for adopting other multimedia tools such as AudioGraph. The tool has an easy-to-use graphical user interface.

The technical problems that have been solved in this project include issues such as cross-platform support, drag and drop functionality using JDK1.1.8, etc. System environments, such as relational database set up, XML database set up, Java swing set up in Mac also have been discussed.

The authoring system interface analysis, database analysis and function analysis have been completed for the complete the system as specified. An intermediate system, designed to a reduced specification, has been implemented as a prototype and details of this system, which can work independently of the TILE delivery system, are included. The Full TILE authoring system including InstantDB database access also has been partially implemented. The prototype application has also has been tested on the PC platform.

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# Chapter 1. Introduction to Web Based Distance Education

## *1.1. An overview of Distance Education*

### **1.1.1 What is Distance Education?**

Distance Education is instructional delivery that does not constrain the student to be physically present in the same location as the instructor. Historically, Distance Education meant correspondence study. Today, audio, video, and computer technologies are the more common delivery modes [10]. At its basic level, distance education implies that a certain distance exists between the teachers and students, and technology is used to bridge the instructional gap.

Today, we don't need to go to school and sit in the classroom to gain knowledge, because there are many alternative ways that provide us with choice in the best and most suitable way to gain our knowledge. Distance Education is not new for us. It gives those people who do not have time to go to school and sit in class a great chance to update their knowledge, skills, and to refresh information about their employment or even their leisure activities. People think that a comparison between Distance Education and traditional education is just like two ways that have a different path, but the same destination. Actually we know today that distance education has more flexibility and freedom. It is maybe more suitable for today's education environment, because it brings out a large potential education market; it provides more opportunities to people [15].

Specifically, distance education involves a complex and hierarchical system of interrelated sub-systems. Each part has its own internal complexities, but in general each affect the other parts and are affected by the other parts [14]:

- Hardware and software technologies are the base of this hierarchy. Other sub-systems include
- Means of telecommunications, which put the student and the teacher in contact with each other,
- The instructional and learning subsystems, which are usually defined in academic programs and courses,
- The management system, which keeps the entire enterprise together,
- The social system which provides funding, and regulates the operation of the entire enterprise and,
- The international systems, such as the World Wide Web, which allows people in different countries engage in teaching and learning at a global level.

To design a successful distance education system, we have to begin with a careful plan and to fully understand the course requirements and students' needs. We must also know the key players in the distance education enterprise.

These players include [26]:

- Students - The primary role of the student is to learn.
- Faculty - The success of any distance education effort rests squarely on the shoulders of the faculty.
- Facilitators - The instructor often finds it beneficial to rely on a site facilitator to act as a bridge between the students and the instructor.
- Support Staff - Support personnel are truly the glue that keeps the distance education effort together and on track.
- Administrators - They maintain an academic focus, realizing that meeting the instructional needs of distant students is their ultimate responsibility.

In fact, a successful distance education system really relies on the consistent and integrated efforts of students, faculty, facilitators, support staff, and administrators [26]. In following section we discuss why today's education system needs distance education.

### **1.1.2 Why Distance Education?**

Why do we need distance education today? What's the different between traditional education and distance education? Is it really just people who have the same destination going with a different way?

No wonder the technology is changing so fast today, with our rapidly changing technological base, gaining knowledge has become a task of *lifelong learning*. The learning environment and learning technology has developed according to the society's requirements. People required a new way to gain knowledge without going to school and that could be done anytime and anywhere. These requirements give a major challenge to traditional education.

First, we cannot deny there are certain fundamental problems that have been solved by distance education. These kinds of programs can provide adults with a second chance at a college education, reach those people with limited time, distance or physical disability, and update the knowledge base of workers at their places of employment [26]. The problems that have been solved by distance education we can find out in the Diana Oblinger's paper [15], they are:

- Expanding Access  
Distance education improves access to education, reducing the barriers related to geography, economics, time constraints, and physical or leaning disabilities. Also as we all know, the Internet is a very popular medium to achieve this.
- Alleviating capacity constraints.  
We would say distance education is more focused on "student centered" learning; the students select learning space, time, and location. They also can revisit the learning materials as they desired, initiate the communication. Also distance education is providing adequate resource and information for students.
- Capitalizing on emerging market opportunities.

As gaining knowledge is becoming lifelong learning, the demand of higher education among the people who is out of the traditional educational age range is increasing, like working adults and students who might seek further education. This shows us a potential market, maybe more lucrative than traditional markets.

- Serving as a catalyst for institutional transformation.

“Higher education institutions are being challenged to adapt rapidly to an increasingly competitive environment. Distance education can catalyse institutional transformation.” [15]

## ***1.2. Web -Based Learning***

### **1.2.1 Information Superhighway and World Wide Web**

“The Internet is perhaps the most transformative technology in history, reshaping business, media, entertainment, and society in astonishing ways. But for all its power, it is just now being tapped to transform education” [12]. The Internet [18] brings us a revolution of Education. It gives the possibility of learning of all kinds, all levels, for men, women and children. It is a fresh way of teaching and learning; it connects the people, communities and resources; it extends the learning day and learning spaces. The cutting-edge technology, such as the World Wide Web and online conferencing systems, enable universities to provide a open learning environment for students 24 hours a day and 7 days a week. It is quickly becoming the one facet most commonly used for delivery of principal course content.

The World Wide Web is one of the fastest growing information resources. The Web provides a graphical friendly user interface and enables the display of rich graphical images, pictures, full motion video, and sound clips [18]. The educator can use the Web to build an educational home page, which can cover information about the virtues of a class including the syllabus, exercises, literature references, and instructor’s biography. “The instructor can also provide links to information on the WWW that would be useful to students in the class (e.g., research data on agricultural markets, global climate change, or space missions)”[27]. “Use of the Web for delivery of distance learning is finding an audience in the current *just-in-time* education environment, where customized programs and convenient professional development opportunities are valued by today’s lifelong learners”[20]. Also the students in traditional facilities -base courses are seeking the convenience to access their resources, information and communication via the Internet.

There are many studies about web-based learning point a common benefit that web based learning involved more active participation by students. Students take responsibility for their studying, and great equity of participation. To design a quality web-based education system is a costly, formidable task. “It requires division of labour, integration of different technologies, professional managements and political governance” [34].

As we all know, the Internet covers all the things that any person might need in their ordinary day, because the type and extent of information found on Internet sites is so diverse. The Internet also means that anyone can become a publisher of information, even

if it is only publishing their family photograph album. Whatever that is published, then available to the whole Internet community. They are seven basic types of Internet sites listed in [28], these are:

- Personal
- Commercial
- Archive/References
- Current/News
- Informational
- Persuasive / Propaganda
- Educational

Given proper selection, this provides a valuable resource for educational purposes.

Compared with traditional education, on-line learning presents some similar points with face-to face education. As a computer is involved, the learning environment has become socialized. Not only do students learn independently, but they also learn interactively and collaboratively with peer groups. Harasim [13] stated five important characteristics for online education:

- Many to many communication
- Place independence
- Time independence (that is time-flexible not atemporal)
- Text-based communication, and
- Computer mediated interaction.

These five points clearly illustrate that today's web-based education environment takes the significant advantages from the traditional education, and use these features to construct a new education environment. But as the technology grow rapidly, especially for online education, there is another important online education feature has been widely used today. It is multimedia communication. It combines video, audio, image, and text together, delivery courses in a rich communicational way. Multimedia communication makes the way of delivering course is much close to the conventional face-to-face class.

### **1.2.2 The challenges of Web-based learning and potential benefits**

“Although using the web to deliver instruction provides many benefits to instructors and students, substantial challenges persist which must be overcome before high-quality learning experiences can be offered” [17]. The tool constructors have to understand how the new technology affects both the educator and the learner, how these new technologies can be used to their maximum advantage and ways in which to compensate for their limitation.

The challenges for the educator are [17]:

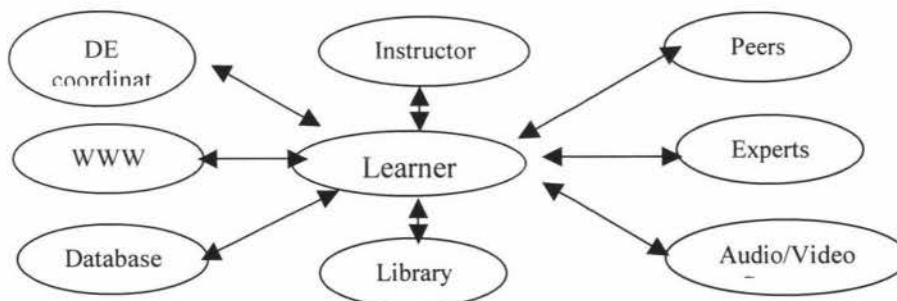
- High cost of delivery system technology

- Bandwidth and the limitations of end user technology
- Dealing with authoring for delivery in HTML
- Moving to a learner-centered instructional model (see Figure 1.1)
- The need to learn and utilize new skills
- Misconceptions amongst educators
- Challenge of developing Hypermedia
- Challenge of making instructional content interactive

Nowadays people are working on these challenges, some problems have been solved, and some are still addressing. Like dealing with Bandwidth and the limitations of end user technology and dealing with authoring for delivery in HTML that listed in the challenges, the people developed AudioGraph [75-79] has tried to overcome these problems. They are offering low bandwidth delivery of multimedia and also by simplifying the authoring model to make authoring multimedia HTML pages accessible to the non-expert. More recently they have tried to tackle the last point [80] that is making instructional content interactive. I am sure there are a lot of people work on the problems in the distance education field today, to make the technology is more useful and stable.

The challenges for the learner are [17]:

- Student Access to requisite technology
- Loss of face-to-face interaction with the instructor
- Psychological pitfalls – In the conventional classroom, students and lectures have rich communication, which transmitted by facial expressions, posture, gaze and gestures, voice volume, inflection and tone. Online distance education is mainly delivered by text and images, merely transfer this kind of information.



**Figure 1.1 Learner – centred instructional model [19]**

Studying these challenges can help developers to understand the base requirements for web-based learning delivery and authoring systems, and increasing their understanding of the principles and practices that support universal design.

It has also been found that there are a number of potential benefits that web-based learning could bring to us with its wide spread adoption. These benefits include [20]:

- Flexibility in the pace of learning,
- Material can be presented in redundant, reinforcing or alternative formats e.g., speech, print, graphics, etc.,
- Student can clarify, rehearse and review supporting materials without interrupting the flow of the learning session for classmates,
- Issues of distance, transportation and physical accessibility are reduced,
- Equal participation for students who use augmentative or alternative communication methods, as the method and rate of communication is transparent to fellow classmates,
- Greater opportunities for peer interaction and collaboration, and for student-instructor interaction and assistance,
- Material can be adapted to various learning styles [73, 74]

Other potential advantages include encouraging the development of technical skills and sophistication in learning, for example: learning to search, evaluate, and synthesize information; and learning basic computer skills, which are a prerequisite for on-line learning. Of course these benefits cannot conceal certain pitfalls, e.g. the redundant, reinforcing or alternative formats of material would raise the cost of development. According to Noriko Hara's work [35], a web-based distance education course would frustrate students as they might feel being isolation in a virtual classroom that would not be present in a face-to-face environment.

### ***1.3. A Comparison of current software tools***

There are large numbers of Web Authoring tools that have been developed since Web Based Distance Education has become a topic of great interest. The varieties of web-based learning are usually defined by the technology used, or by the approach to learning that the technology supports [21]:

- Self-Instructional and Instructor led/Collaborative
- Synchronous Learning and Asynchronous Learning
- Built in Authoring, Third Party Authoring and Content Assembly
- Rich media and Lean Media
- Low interaction and High Interaction
- Course Delivery, Course Management (CMI) and Learning Content Management
- Learning and Performance Support

We see the current generation of general WWW tools and servers was designed for browsing and information retrieval, and not as components of an active learning system. Therefore, they currently lack a number of features that an advanced educational environment requires [22]. Through the study of various existing software tools for



educational delivery, which are now appearing on the market, we can try to find what else we need to add to this newborn clutch of applications if we decide to develop a better web-based education system. Examples we have studied include LearningSpace, TopClass, Web Course in a Box, and WebCT, etc. We also have to know what general features the software should provide to a user and indeed who those users are, because we must satisfy a range of different users. These include the administrators, the teachers and the students. Good web-based education software should possess a number of the following features. They includes [23]:

- Ease of use by faculty
- Ease of use by student (intuitive interface)
- Include various media (text, graphics, video, audio)
- Support alternate character sets (mathematics, foreign languages)
- Various communication models (one to many; one to one; many to many)
- Threaded discussions
- Full text search
- HTML links within courseware
- Application links within courseware
- Student tracking
- Student registration
- Quizzes and online testing
- Automatic student reporting
- Tracking of time/hits/etc. per student
- Free client programs for students
- Ability to access remotely (faculty and students)
- Cross-platform delivery
- Ease of updates/revisions
- Security and password access
- Real-time communication (chat, videoconferencing)
- Online help and phone help (800 line)
- Time limitations feature (set display for 2 weeks, etc).

This is a daunting list of features and many of these have to taken in account when designing a web based education system. The TILE [1] project, on the other hand, which this project contributes towards, has considered different aspects of the problems in on-line education. TILE project is developing an integrated system for managing, authoring, and publishing on-line education. It looks at the different responsibilities, and provides architecture and procedures to solve some of the outstanding issues not listed above. TILE has considered four main issues, these are:

- Flexibility of use for students and staff
- The reuse of educational material in different courses
- The problems of the students' use of bandwidth
- Finally the system scalability

The TILE system includes basic two components: a course delivery system and an authoring system. This project has been investigating the latter, the authoring system. It should be emphasised that the authoring system is not for basic content production, as it is assumed that the learning objects are produced by other tools, such as HTML editors or multimedia authoring tools. This system is for authoring the content's structure, the prerequisites, the meta data and for ensuring that the system integrates with other commercial tools for content production.

Before we talk in detail about the TILE course delivery system, we need to know something about existing delivery systems. There are various types of software for course delivery, basically there are three types of system that have evolved into courseware environments, these are [30]:

#### *Groupware*

Groupware, also know as “computer-supported cooperative work (CSCW) can link people on different computers using the same software program (such as Lotus Notes) to perform a variety of functions” [30]. Usually groupware supports the following functions:

1. Face-to-face meeting facilitation
2. Group decision support
3. Computer-based telephony extensions
4. Presentation support
5. Project management
6. Calendar management
7. Group-authoring
8. Computer-supported face-to-face meetings
9. Screen sharing
10. Computer conferencing
11. Text filtering
12. Computer-supported audio/video teleconferencing
13. Group memory management
14. Spontaneous interaction
15. Comprehensive workgroup support
16. Nonhuman meeting participates (using intelligent agents)

#### *Listserve*

A listserve is a system that allows a group of people to discuss issues in a common environment, usually by email. The listserve software will provide functions to organise and browse a threaded discussion on a given topic. “The listserve can be supplemented by electronic mail, the World Wide Web, and the telephone --- as well as ... audio, multimedia, 3D models, form-based surveys, videoconferencing, etc” [30].

#### *Multi-user environments*

“A Multi-User Environment is a real-time, text-based communication; it's similar to Internet Relay Chat, except that it takes place in an imaginative context described via text and participants are usually playing some sort of role” [30].



We can see that these different classes of software have points in common, namely that they all provide interaction in an on-line mode. Student accesses the study material through the Internet or an intranet. Although the Internet or intranets are very popular today, we have to consider the situation, where a student is outside the range of a network connection. What can they do without a connection in order to get the resources they require? That question was a leading one in the design of the TILE [1] project delivery system. This new generation of delivery system does provide an on-line mode but it also covers the shortcoming of a lack of a network connection. In TILE the course delivery system provides both on-line and off-line modes. Moreover, in the offline mode it is possible to guide and track what the student is doing as the server functionality is distributed to the student's computer. It therefore has more flexibility and convenience as students can be monitored even when they are off-line. We will give more details about TILE [1] course delivery system in Chapter 2.

It must be emphasised here that learning is a bi-directional process in reality; the student is placed in a role of learning, and the teacher in the role of the educator, actually some times these roles are reversed. What must the teacher to support this role and what are the requirements of the authoring tools? These tools must provide a number of significant services for teachers to create on-line and manage the courses [70]. Some of these services are:

- Creating content of some description
- Creating a structure for the course
- Providing prerequisites that guide the student through the material
- Searching for and incorporating existing learning objects
- Providing a means by which courseware can be imported and exported for use from or in other delivery systems [71, 72].

In addition to these requirements the tool must be easy to use and the courseware must be easy to maintain. This authoring system must combine together these useful functions and provide a multi-service for teachers.

It is unlikely that any authoring tool can provide everything that a teacher will require. "Web-based educational systems, like other computer-based education (CBE) systems, must provide certain basic instructional functionalities" [29]. Usually the authoring tools can be classified into the following categories, according to what material they create:

- Voice recorder
- Text editor
- Image editor
- Video recorder
- Special purpose editor (e.g. XML editor, java script editor, mathematical equation editor, etc)
- Stand alone or on-line
- Data management tool

Some of these tools are very familiar for us, like Microsoft word, PowerPoint, Excel, QuickTime, PhotoShop, PowerBuilder, etc. But there are still plenty more authoring tools that provide excellent functions for teachers, e.g. ClassMaster 3.0 [24], AudioGraph [2], Mathematics TestBuilder [24], Site Central [25], etc. These authoring tools focus on a different aspect of authoring function, the content production or the creation of learning objects. We will not give a detailed comparison of these tools, as the project is concerned only with the last category above, that of a data management tool. Such a system must allow content created by the above tools to be integrated into a course but must also provide a means of navigating it, possibly doing this adaptively, depending on the student's preferences and knowledge. Because this information is held in a database, the authoring tool is used to manage the relationships between learning material, just like a database management tool.

#### ***1.4. Work related to this project***

A lot of research has been completed in this project that is related to the TILE project. In particular, this includes:

- TILE Authoring Interface analysis and design
- TILE Authoring Interface functionality
- Java cross-platform research
- Set up JDK 1.1.8 on Mac
- Studying the use of an XML database to describe the meta data and the possibility of using this document as a replacement for a relational database on the users computer. This avoids having to install database software.
- Analysis and design of the database schema for the TILE authoring system
- Set up relational database on the client side for the full TILE authoring system
- Design the system framework and Intermediate authoring system
- Complete a prototype implementation of the intermediate TILE authoring system

This research, design and implementation work will be discussed in the following chapters.