A Story Environment for Learning Object Annotation and Collection

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Abstract

With the increase in computer power, network bandwidth and availability, e-learning is used more and more widely. In practice e-learning can be applied in a variety of ways, such as providing electronic resources to support teaching and learning, developing computer based tutoring programs or building computer supported collaborative learning environments. Nowadays e-learning becomes significantly important because it can improve the quality of learning through using interactive computers, online communications and information systems in ways that other teaching methods cannot achieve. The important advantage of e-learning is that it offers learners a large amount of sharable and reusable learning resources. The current approaches such as Internet search and learning object repository does not effectively help users to search for appropriate learning objects.

The original story concept introduces a new semantic layer between collections of learning objects and learning material. The basic idea of the story concept is to add an interpretative, semantically rich layer, informally called 'Story' between learning objects and learning material that links learning objects according to specific themes and subjects (Heinrich & Andres, 2003a). One motivation behind this approach is to put a more focused, semantic layer on top of untargeted metadata that are commonly used to describe a single learning object. Speaking from an e-learning context the stories build on learning objects and become information resources for learning material.

The overall aim of this project was to design and build a story environment to realize the above story concept. The development of the story environment includes story metadata, story environment components, the story browsing and authoring processes, and tools involved in story browsing and authoring. The story concept suggests different types of metadata should be used in a story. This project developed those different metadata specifications to support story environment. Two prototypes of tools have

been designed and implemented in this project to allow users to evaluate the story concept and story environment. The story browser helps story readers to read the story narrative and look at a story from different perspectives. The story authoring tool is used by the story authors to author a story. The future work of this project has been identified in the area of adding features of current tools, user testing and further implementation of the story environment.

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Chapter 1 Introduction

1.1 Research Background

With the increase in computer power, network bandwidth and availability, e-learning is used more and more widely. The definition of e-learning generally refers to "learning in a way that uses information and communication technology" （Clarke, 2005). This is a broad definition. Different people, groups and organizations have created different terms that generally narrow the scope of the e-learning definition. In particular, e-learning can be defined as "training delivered in an electronic form, whether via a CD-ROM, DVD, the Internet, or a company intranet. It can occur synchronously (all learners participate learning at the same time and interact each other even if not in the same place) or asynchronously (learners take the course at their desktops at different times)" (Smith, 2004, p22). In practice e-learning can be applied in a variety of ways, such as providing electronic resources to support teaching and learning, developing computer based tutoring programs or building computer supported collaborative learning environments.

Nowadays e-learning becomes significantly important because it can improve the quality of learning through using interactive computers, online communications and information systems in ways that other teaching methods cannot achieve (Clarke, 2005). In comparison with traditional classroom based learning, e-learning has the following strengths:

- Learner-centered and self-paced: traditional classroom-based learning centers on instructors who have control over class content and learning process. E-learning offers learners centered, self-controlled learning environments in which learners control learning content and progress at their own pace.
- Time and location flexibility: e-learning is available anywhere anytime as long as learners have digital equipment such as computers and/or network connections.
- Access to a large knowledge base and archival capabilities for knowledge reuse and

sharing: Taking the advantage of computer power and high speed networks, e-learning is able to provide learners with a large collection of learning resources in diverse formats such as text, image, sound and video. Furthermore, learning resources in e-learning are stored in electronic format which allows for easy sharing, exchange and reuse in different e-learning applications.

As described above, one of the important advantages of e-learning is that it offers learners a large amount of sharable and reusable learning resources. In general learning resources have following the potential:

- Generativity - generative from primitive objects rather than pre-composed.
- Reusability - reusable in different applications.
- Adaptability - adaptive to the individual.

An instructional technology called "learning object" has been introduced for the next generation of instructional design, development, and delivery (Wiley, 2000, p3).

The IEEE Learning Technology Standards Committee (an IEEE organization which develops accredited technical standards, recommended practices, and guides for learning technology) (LTSC, 2004) defines learning object as

> "Any entity, digital or non-digital, which can be used or referenced during technology supported learning. Examples of technology supported learning include computer-based training systems, interactive learning environments, intelligent computer-aided instruction systems, distance learning systems, and collaborative learning environments. Examples of learning objects include multimedia content, instructional content, learning objectives, instructional software and software tools, and persons, organizations, or events referenced during technology supported learning" (LTSC, 2004, chapter1).

This is a general definition of learning objects which includes almost everything related to learning. Accordingly different groups outside the Learning Technology Standard Committee have explained this definition from their own perspectives. For example:

- The Multimedia Educational Resource for Learning and On-Line Teaching (MERLOT) project defines learning objects as "Online learning materials" (MERLOT, 2004).
- Wiley defines learning objects as "any digital resource that can be reused to support learning, this includes anything can be delivered across the network on demand, be large or small" (Wiley, 2000).

Wiley (2000) also has identified and categorized learning objects into five different levels. These are:

- Fundamental: an individual, digital resource; commonly used to exhibit and display. Examples of fundamental learning objects are images and figures.
- Combined-closed: a small number of digital resources combined to one object, for example, a video clip that consists of images and sound. Combined-closed learning objects may also contain a small amount of logic such as the sequencing. Combined-closed learning objects generally have a single purpose for instruction or practice.
- Combined-open: a large number of digital resources combined when a request for a learning object is made. A web page is a good example of combined-open learning object, because its component images, video clips, text and other media are combined into a learning object at the request time.
- Generative-presentation: the logic and structure provided to combine learning objects of the lower-level types (i.e. fundamental and combine-closed). A generative-presentation learning object is mostly used in reference, instruction, practice and testing. For example, a piece of Java program which can generate an online test depending on learner's choice.
- Generative-instructional: the complex logic and structure provided to combine learning objects types (fundamental, combined-closed types, and generative-presentation) and evaluate students' interactions with those combinations. For example, a tutoring program which can deliver the knowledge, offer the practice and evaluate learner's performance with feedback.

Based on the above explanations, in this research the term 'learning object' is defined as any simple and basic reusable and sharable multimedia digital source that is used to support e-learning. Learning objects in this project are limited to three types: fundamental, combine-closed and combine-open from Wiley's classification. Examples of the learning objects include electronic course materials, digital pictures and figures, multimedia video/audio clips and so on. The reason of restricting learning object definition to the above three types (fundamental, combine-closed and combine-open) is that those low level learning objects are basic and simple learning objects which can be easily reused and combined to make complex learning materials. Generative-presentation and generative-instructional learning objects normally have complex structure and are used individually rather than components of other learning objects.

1.2 Motivation and Objectives for the Research

1.2.1 Background & Motivation

With the popularity of e-learning, more and more learning resources will be converted to digital format as learning objects and accessed through the Internet. An individual teacher or instructor needs to collect appropriate learning objects to support himself in compiling learning materials for students. In this research, the term of "learning material" is defined as a complicated learning object which falls within the categories of generative-presentation and generative-instructional learning objects from Wiley's classification. To create learning material one usually selects appropriate basic and fundamental learning objects (fundamental or combined-closed or combined-open learning objects) under a certain topic and includes the logic or instructional information for arranging those learning objects properly and providing context background. Examples of learning materials are lecture notes, study guides and lab exercises and computer-based teaching programs. Usually learning materials are produced by teachers

or instructors. High quality learning material requires teachers or instructors to find suitable learning objects for the learning material's subject and educational purpose. In order to compile the learning materials, teachers or instructors should be able to identify the appropriate learning objects. Learning objects in the learning material need to be closely related to the learning material's topic and contribute to the realization of its educational purpose.

However, for an individual teacher, the task of collecting learning objects for learning materials is very difficult based on the following reasons:

- Lack of specialized learning object repositories/collections: A learning object repository is a searchable database that houses digital resources and metadata that can be reused to search and identify collected learning objects (Daniel, 2004). Metadata is broadly defined as 'data about data'. Generally speaking, metadata provides 'hooks' by which resources can be extracted from or discovered within a repository or a database (Haynes, 2004). The traditional library catalogue index card is a classic example of metadata. The card catalogue identifies what books are in the library and where they are physically located. It can be searched by subject area, author, or title. By showing the author, number of pages, publication date, etc, the catalogue helps people determine which book will satisfy their needs. Following the same principle, metadata in learning object repositories help users to decide which learning objects fulfill their needs. Although most learning object repositories have a reasonable amount of learning objects, they usually contain learning objects in various subjects and domains, which are not specialized for a small topic or subject. Furthermore most current learning object repositories only can provide general and surface metadata description about learning objects rather than description and explanation from a specific subject point of view. Hodgins (2005) suggests that learning objects should be put into context to meet the individual needs of learners in different locales and cultures. The subject or domain context descriptions of the learning objects would definitely assist teachers or instructors to select learning

objects in different situations. Without the specialized knowledge and context description of the learning objects, it is difficult for teachers and instructors to reuse the learning objects in their areas.

- Lack of learning-focused specialized knowledge collections: Specialized knowledge collections such as online museum collections normally contain a large amount of learning objects under a single subject or topic. Learning objects in specialized knowledge collections are carefully selected and described by domain experts to ensure the authenticity. However the problem of specialized knowledge collections is that specialized knowledge collections do not focus on teaching and learning environments. Commonly, specialized knowledge collections provide sufficient descriptions of learning objects from a subject point of view but ignore explaining how learning objects would be used to teach students. Instructional and pedagogical information is quite important for teachers or instructors to correctly reuse learning objects in their teaching context. Due to the educational purpose of learning objects, instructional information must be incorporated in any learning object implementation that aspires to facilitate learning (Wiley, 2005).

- A teacher may not have sufficient and highly specialized domain knowledge to find the best learning objects. Lots of learning objects on the Internet have not been evaluated, assessed and approved by domain or subjects experts. The individual teacher or instructor might lack the specialized knowledge to select and identify learning objects of high quality.

The story concept (Heinrich & Andres, 2003b) has been developed and introduced to address these issues. The basic idea of a story is to add an interpretative, semantically rich layer, called 'Story', between learning objects and learning materials that links learning objects according to specific themes and subjects. A story collects different learning objects under a specific subject and also provides the context narrative and explanation for those collected learning objects. Speaking from an e-learning context

the stories build on learning objects and become information resources for learning materials.

A story consists of three main elements: the narrative, links to learning objects and story metadata.

- The narrative is what the author of the stories writes to describe the collected learning objects. The author can use the narrative to tell facts, provide interpretations, make comparisons, draw attention or similar.
- A link is a connection between a part of the textual narrative and related learning objects. The link can refer to a particular part in a learning object or a whole learning object.
- The story metadata is to make it possible to search for a story and customize a story according to a user's point of view.

1.2.2 Research Objectives

The main objective of this research is to develop and implement a story environment based on the basic story concept. The objectives of this research can be summarized to the following points.

- Design and develop the story environment: The story environment will implement the story concept. The design and development of the story environment include identifying the components in the story environment and demonstrating the functions offered by the story environment. The following issues need to be concerned by the story environment:
  - Classify different roles and components in the story environment and their responsibilities.
  - Identify different functions and processes in the story environment.
  - Specify different applications involved in the story environment.

- Further extend the concept of the story metadata and develop the story metadata specification: The original story concept only introduced and suggested the story metadata on a conceptual level. It is necessary to further extend and design the story metadata to achieve the following purposes:
  - Find appropriate stories from story collections.
  - Find appropriate learning objects in a story.
  - Annotate the story narrative from different perspectives.
  - Provide instructional information to the story narrative.

- Develop and implement applications to support the story environment: In order to evaluate the story concept and the story environment, it is necessary to develop and implement applications in the story environment. Basically, two applications should be developed at first.
  - An application to create and author a story including linking learning objects, editing story metadata data and writing the story narratives.
  - An application to browse a story including viewing the story narratives, searching for learning objects and narratives by story metadata.

1.3 Work Included in This Thesis

The objectives of this research have been identified in the previous section. To realize the research goal, the following work has been undertaken and reported in this thesis.

- Review literature. This part reviewed and discussed the original story concept and other learning object search methods such as learning object repositories, specialized knowledge collections and general Internet search. By reviewing the existing methods and story concept, it can explain advantages and strengths of the story concept and create the literature background to develop the story environment.

- Conceptualize story environment. This part developed and conceptualized the story environment. In detail this part explained the story environment components and their relations and discussed issues to be developed and implemented in this research.

- Develop and implementing the story environment. Story metadata have been specified in detail with a specific metadata specification. Applications involved in the story environment have been designed and implemented in this part as well.

- Evaluate the story environment. The story environment has been evaluated by users from different areas to approve its usefulness and efficiency. Applications implemented in the story environment have been tested by users to evaluate the functions and interface design.