E-Activities in Re-Usable GIS Applications

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***Abstract**: The e-Learning well known benefits will be heightened when the learning procedure is personalized. Hence, e-learning should be dynamically personalized to both groups and individuals and in this case the same "digital" courses will be presented with different content variations to different virtual groups. As learners move through the content, the course content and the flow procedure will alter. For course designers, the idea of learning objects requires an immense change in thinking. Instead of looking at learning as a fixed linear progression with a restricted functionality, the research has to look at learning as clusters of independent, stand-alone objects of knowledge. These learning objects should be dynamically selected and sequenced by computer agents to form an individually tailored course. In this paper - supported by The Archimedes 2-2-17 Initiative - a set of XML schemas is introduced, that can be used as basic templates to wrap and tag reusable learning objects with enhanced GIS functionality.*

***Keywords:** e-Learning, reusable learning objects, courseware GIS authoring, cognitive GIS styles.*

1. Introduction

E-learning is increasingly being integrated into organisations and universities as a new means of teaching and supporting learners. In most cases e-learning is used to support instruction led classes in a blended learning environment; however, e-learning is also sometimes used as the sole method of instruction [Nichols, 2003]. Moving from a classroom-training environment to an e-learning environment is a vast undertaking within an organization both for employees and mangers alike. The transition involves migrating training functions or training components from a static, physical environment to a dynamic, virtual environment. This, in itself, causes a substantial change in the training function and in the technical infrastructure of the organization. Therefore, it is necessary that this transition is planned, controlled and co-ordinated, prior to, during and following its migration [Parihar, 2004].

Today's requirements for cost reduction in learning resources for both industry and academic institutions are becoming increasingly high. Therefore ways of reducing cost of e-learning systems development without sacrificing quality have become a popular area of interest [Urdan & Weggen, 2000]. One way that both cost and development time can be reduced is by improving re-usability [Downes, 2001]. This can be accomplished by ensuring that all content created is formatted into small reusable pieces that are each responsible for teaching one core concept, and are in a form that is independent of any specific implementation. These pieces of content are referred to as learning objects and in particular for the proposed schema as GIS learning objects [Mallick, 2004].

When course content is being developed, the course provider is not always looking at how the content could be re-used in future courses. Obviously, there is more concern with producing the content as quickly as possible even if this means imbedding the course content directly into the display of the course, i.e., placing all content directly into the HTML platform [Butler et. al., 2002]. In order to start organizing content into re-usable (GIS) learning objects, a definition of a (GIS) learning object needs to be established that includes the purpose it is being used for [Hamel &

Ryan-Jones, 2002], as well as a schema or set of schemas in XML that need to be created before the content development stage [Walsh 1998].

2. THE XML Schemas

The basic framework for an GIS e-Learning system is based on the definition of a GIS learning object and the appropriate schema in XML. A library of learning objects with metadata and spatial functionality forms the basis of this system. In order to construct personalized courses for learners, a data model of a learner is needed to provide background information to describe the learner's needs [Karnik, 2004]. The Learning Management System (LMS), including a search engine, uses the learner's interests to select appropriate learning objects and then pieces together courses based on the organizational structure and instructional design information [Wiley, 2000].

In the Archimedes 2-2-17 project (ATEI of Thessaloniki, Greece), the following aspects are defined to implement the XML schema:

- The Content Packaging for the learning structure, including information about sequences and alternations of the learning objects;
- The Learner Model, including the learner's personal properties, such as: skills, prior knowledge, background information, etc.

It has been decided to avoid spending time researching metadata since there are existing detailed standards or specifications for learning object metadata, the content packaging specification and the learner information specification that have been developed by IEEE, IMS, CanCore [CanCore, 2002] and Dublin Core [Dublin Core, 2005]. However, it should be noted that some modifications are needed to make the schemas more suitable for a reusable and adaptive e-learning system. Moreover, the concept of learning object has been re-defined and a schema has been developed for it according to the new GIS features with spatial functionality that have been introduced. This new schema and the underline Learning Management System form the foundation of the proposed GIS e-learning system [Mallick, 2004].

2.1. Schema for Content Packaging

In a GIS e-Learning system, instructional content must be collected and packaged in some electronic form to enable efficient aggregation, distribution, management, and deployment. The content packaging from LMS may be used to enable the encapsulation of the required learning resources, simple course structure information, and other supporting information such as metadata, which promotes the flexibility and interoperability of learning materials [Parihar, 2004].

However, one of the major weaknesses of the LMS content packaging specification is that it only supports a simple structure, and does not include any instructional design information. Therefore, it is necessary to add new approaches, such as hierarchical branching, or custom learning paths with conditional branching, if they are required. In this research, the basic structure of the LMS content packaging specification is adopted, and then some new features are introduced to make flexible generation of an individually tailored course possible. Every content packaging file includes a top-level <manifest> element. It is a mandatory element describing the package itself. It may also contain some sub-manifests [Karnick, 2004].

Each instance of a manifest includes the following categories:

- metadata – an element describing a manifest as a whole. It can use any element in the metadata schema;
- organizations – an element describing zero, one, or multiple organizations of the content within a manifest;
- resources – an element containing references to all of the actual resources and media elements needed for a manifest, including metadata describing the resources, and references to any external files;
- (sub)manifest – one or more optional nested manifests.

Amongst those categories, the <organizations> element is the most important one. This element may contain several <organization> elements, each representing one separate course. The problem here is how to define a set of specific elements, into the <organization> element, to describe the course sequencing information. To describe such a course, the structure of the <organization> element may contain several <item> elements; each represents a point in the course structure.

An <item> element may contain sub-ordinate <item> elements or may appear on the same level as other <item> elements. Each <item> element has an "identifier" attribute, which is assigned a unique string to distinguish this item from others. Also an "identifierref" attribute for <item> element may be used to reference a resource in the <resources> element, which indicates the GIS learning object that should be put at this point [Table 1], [Table 2].

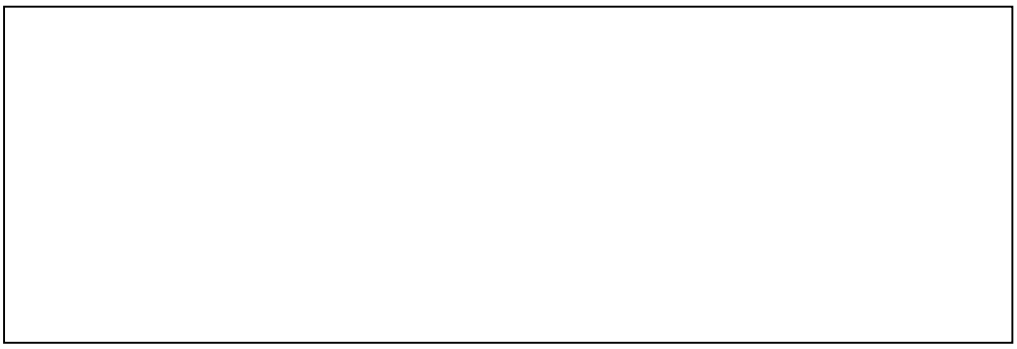

Table 1: *Schema GIS Object Types with Underlying Topology*

X is not disjoint from Y
X meets Y
X overlaps Y
X is a subset of Y
X is inside Y
Y covers X

Table 2: *Topological & Set-Oriented GIS e-Learning Operations*

At some points, the <testItem> element may be set to indicate a quiz for evaluation of learner's performance. The <branches> element in <item> can be used to define the different instruction approaches in a same course. Each approach is described by a <branch> element that represents a separate instruction sequence. A <branch> element uses <condition> element to present the rules, on which the selection of one approach can be determined.

In this research (Archimedes 2-2-17 project), four types of learning elements, separately or in combination, can be used to distinguish each learning approach. So, in the <condition> element, the <difficulty> and <semanticdensity> elements describe the difficulty range and the comprehensiveness range of each path, which extends from, say, one (1) to five (5), representing the range from low levels to high levels. Therefore the <min> element and the <max> element may illustrate the range of difficulty and comprehensiveness for the particular chosen learning path. Moreover, the <prerequirement> element specifies the prerequisite if any, which requires the learner to get some scores range at a quiz to go through this learning path.

Inheritance Hierarchy of Spatial e-Learning Objects

Fig. 1: The Structure of the Content Packaging for GIS e-Learning

2.2 Schema for Learner Information

User modeling is an important research topic for many online systems, however in this project it is not a major one. The purpose of establishing a learner model in this project is just to ensure that a defined set of information about a learner can be recorded, tracked and communicated between clients and servers [Butler et. al., 2002]. In the LMS learner modelling specification, a learner model in XML that describes those characteristics of a learner is needed for the general purposes of:

- Recording and Managing learning-related history, goals and accomplishments;
- Engaging a learner in a GIS learning experience;
- Discovering GIS learning opportunities for learners.

In this research (Archimedes 2-2-17 project), a simple schema for learner profile information is developed based on the learner model defined by LMS for GIS lecturing [Fig. 1]. This learner information is used by the GIS e-learning system to manage, organize and evaluate the learner's progress and performance. For this purpose, four core-learning elements (i.e. learner information categories) are included:

- Identification – This element contains all of the data for a specific individual or organization, such as names and contact information.
- Accessibility – This element describes the studying capabilities of the learner. The <eligibility> element use a set of vocabulary, {very low, low, medium, high, very high}, to indicate the level of learner's capabilities.
- Goals – This element consists of the description of the personal objectives and aspirations.