

# An Ontology-Based Framework for Authoring Tools in the Domain of Sustainable Energy Education

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## ABSTRACT

*This paper presents an ontology-based framework for the production of learning designs, focusing on the domain of sustainable energy education. An ontology of the sustainable energy development domain and educational model designed in compliance with widespread standards constitute the proposed framework to disprove the vagueness of “sustainable development” and enhance reusability and shareability of learning material respectively. The authors envisage this framework both as a means to support the authoring of learning scenarios and as a provisioning of a field for conversation about the appropriate authoring tool in this area. In this sense, an integrating approach for the representation of the learning design domain is kept, focusing on the concept of “mediating artefacts”.*

**Keywords:** *Authoring Tool, Education for Sustainable Development, Learning Design, Learning Object, Mediating Artefact, Ontology, Sustainable Energy Education*

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## INTRODUCTION

The efficiency of the development of learning scenarios highly depends on the ability to reuse existing materials and expertise (Pawlowski & Bick, 2006). Initially the issue of reuse in education was focused in content, in the form of basic independent units (Learning Objects or LOs) (Pasin, 2005), for faster, more economic, and

richer coverage of areas of a teaching course, capitalizing experts' work and ability around the world (Mohan & Brooks, 2003).

However the simple provision of codified knowledge as data does not safeguard its understanding and using (Pawlowski & Bick, 2006). Therefore there is a tension to move from content-oriented to activity-oriented approach, which promotes a model of the teacher as a designer and is enhanced from the parallel development of tools in the World Wide Web, stimulating the emersion of communities of

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practice for the exchange of learning scenarios and experiences (Brouns et al., 2005; Pernin & Lejeune, 2006).

As the production and consumption of LOs is distributed, many standards and specifications have been developed for their standardization and generally for data exchange and processes management. A widespread standard for searching, retrieving, evaluating and using LOs, is this of Institute of Electrical and Electronics Engineers Learning Object Metadata (IEEE LOM) (IEEE Learning Technology Standards Committee, 2002), even though, according to Ullrich (2004) it mixes pedagogic and technical information, and does not provide an adequate representation of pedagogical concepts. There are many languages and models for modelling activities in learning processes and is IMS Learning Design (IMS LD) that has been accepted as a specification (IMS Global Learning Consortium, 2003). Even though it provides a general framework for constructing learning designs, its use is hard to non experts. As a consequence, the need for limitation of design options in the sense of provision of specific frames, as patterns, templates, primitives, best practices and/or taxonomies for fast and easy reproduction of learning designs arises (Bailey, Zalfan, Davis, Fill, & Conole, 2006; Griffiths & Blat, 2005; McAndrew & Goodyear, 2007).

In general, to achieve interoperability and shareability, along with being usable, authoring tools must be compliant with specifications, without however being oriented to these but to the pedagogical task, that they have to support (TenCompetence Project, 2006). At any rate:

*It seems unlikely that one all-encompassing notation system for representing and documenting learning designs will evolve. Instead, a toolkit of a number of representations each used at different times during the educational design process for different purposes seems to be a more plausible option. (Agostinho, 2008, p. 13).*

In the context of learning design, ontologies usage covers a spectrum of roles. Ontologies can support more flexible handling of LOs as to

employ just some specific parts of a LO, to reuse the same learning design in different contexts with different LOs, to personalize content of the same LO, and to develop more extensive LO and learning design search and ranking services (Knight, Gašević, & Richards, 2006). According Mohan, Greer, and McCalla (2003) it is necessary to associate LO metadata with domain ontologies since both play an important role in locating relevant LOs for a course.

Based on these concepts the paper introduces an ontology-based framework for the production of Learning Designs (learning scenarios compliant with IMS LD) in the field of sustainable energy education. In the next sections, the rationale, the basic structure and the ontology development of this framework are presented, along with related work, an evaluation experiment, an exemplification of its potential usefulness and some concluding remarks.

## MOTIVATION AND RATIONALE

Sustainable energy education is expected to contribute to the solution of a series of challenges – problems related with the dominant developmental models, taking into consideration that the energy production and use should provide “adequate energy services for satisfying basic human needs” while “should not endanger the quality of life of current and future generations and should not exceed the carrying capacity of ecosystems” (Rogner & Popescu, 2000, p. 31).

Regarding the shape of the educational approach that this field should have, the following issues must be taken into consideration:

- a) The need for a practical and explicit definition of sustainability in virtue of the vagueness and the polysemous of the term (Robinson, 2004).
- b) The necessity for teachers’ training, which becomes more urgent in some European countries (e.g. Greece), as relevant reports demonstrate a teacher’s lack of basic education on sustainable energy development

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