

A community oriented approach to delivering learning services

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Abstract

In the past few years we have seen a growing interest in applying semantic web technologies to education. Much of this work has concentrated on the use of Learning Objects. This research is flawed in three ways: firstly, the notion of learning Objects (LOs) is deeply problematic, secondly, learners need more than ready access to pre-packaged fragments of knowledge, and, thirdly, a focus on LOs constrains the deployment of semantic web terminologies to the needs of providers and consumers of LOs. We propose an alternative approach which is not tied to LOs and which extends the use of semantic technologies as a means of providing learning services which are owned and created by a knowledge community.

1 Introduction

There is currently much interest in applying Semantic Web technologies to learning. Much has been written about how the Semantic Web can be used to provide easier access to Learning Objects, including many interesting proposals for infrastructures for sharing LOs and for interoperation among different repositories. However this work fails on three counts: firstly, LOs are deeply problematic, secondly, it pays little attention to the needs of learners, and, thirdly, it fails to make use of the possibilities inherent in semantic web technologies.

We propose an alternative model of the use of semantic technologies in learning which focuses on the delivery of certain high level learning services (such as sense-making, structure-visualization, support for argumentation, novel forms of content customization, novel mechanisms for aggregating learning material, and so on) but which:

- does not tie semantic technologies to LOs
- makes full use of the potential of semantic technologies

- is more appropriate for learners
- provides a means of contextualization and interpretation
- makes navigation through web resources easier

By learning services we mean the use of semantically augmented web services as a means of implementing support for certain educationally important activities such as sense-making. Our approach to the provision of learning services has three main components: Knowledge Charts, Knowledge Navigation and Knowledge Neighbourhoods. In the example below we illustrate this using a learning service which provides contextualization via structures representing scientific and other controversies. A Semantic Browser is used to (a) provide access to this service and (b) to navigate through the controversy structures as an aid to sense-making. Both of these represent forms of Knowledge Navigation. The learning service and the controversy structure (we call it a Knowledge Chart) are both owned and constructed by knowledge communities focused on particular disciplines, topics or interests inhabiting bits of the Semantic Web which we call Knowledge Neighbourhoods.

2 The approach in more detail

We are deeply sceptical of the value of LOs and of the social implications of their use. This does not mean that we eschew them altogether. LOs are one kind of web resource which we can use. At the same time we are concerned to get away from a model of learning which views it as the consumption of learning objects. We take a more constructivist, community-centred approach. For us much depends on the formulation of a prospective/story/narrative about a particular topic which captures a community perspective and which can be used in a variety of learning contexts.

However, our view of learning is broader than that taken by many educationalists since we see the semantic web as a location where learners of all types can acquire knowledge in a variety of formal and informal learning contexts. We

therefore do not address issues such as different learning styles, the details of pedagogic strategies or the possibility of pedagogy-specific metadata models.

We have the following problems with LOs:

- LOs are immature with many competing metadata schemes.
- These may not be flexible enough to capture relevant characteristics.
- There are costs as well as benefits of annotation.
- There is little likelihood of automatic aggregation.
- While reusability is claimed as a good it might act as a means of monopolizing a market.
- LOs can be seen as tied to a pedagogy which sees people as simple information acquirers.
- LOs are often generic, reproducible, standardized products largely for passive consumption by individuals.
- LOs are mainly for individual consumption.

2.2 Learning services

While LOs are annotated with metadata which is principally intended to facilitate discovery, for us, true learning requires the ability to situate a thought in its context within or across disciplines as part of a narrative, a scientific controversy, or an analogical argument. We therefore recognize a variety of possible learning services such as sense-making, structure-visualization, support for argumentation, novel forms of content customization, novel mechanisms for aggregating learning material, and so on, we will discuss a service which contextualizes via representations of controversies. This service provides sense-making support and, since it represents controversies, a means of visualizing an argument structure which could, in principle be extended by the learner as part of the knowledge community.

To provide learning services, we need: a set of ontologies; a set of representations of knowledge which use some of these (Knowledge Charts); and, a set of tools (including tools for Knowledge Navigation and supporting Knowledge Neighbourhoods).

2.3 Ontologies

Learning services require three main types of ontologies: for topics or domains, community-oriented knowledge structures (Knowledge Charts) and learning communities.

Ontologies for domains abound. However, we are particularly interested in the concepts which are regarded by community members as the most salient and foundational for a domain. In physics this would be notions such as relativity. In Semantic Web studies this would be notions such as ontology.

The ontologies for Knowledge Charts are less plentiful. Knowledge Charts include a range of high level representations of the most important or most controversial knowledge in a domain. For instance, we could have representations of the processes which underlie fossilization in palaeontology or the current controversy about global warming in climate science. We have identified three main sorts of Knowledge Chart: debates or controversies; narratives; and analogies. Each of these requires both a structural and a domain ontology. Debates require concepts such as *claim*, *ground*, *evidence* and *theoretical backing* while stories need *characters*, *events* and *motives*. Particular knowledge structures will also make use of ontological primitives such as *atmosphere*, *gas*, *pressure* and *energy* for the climate domain.

Finally, we need detailed ontologies for types of community and for the different roles individuals play in them. Thus there are communities with hobbyist interest in archaeology or the music of Mozart or professionals concerned to learn about the latest surgical techniques for hernia repair. Within these communities, individuals have different *statuses* (some are centrally concerned with the body of knowledge which the community creates and preserves while others have a more casual interest) and *roles* (some are teachers as well as contributors to the body of knowledge while others are solely consumers of knowledge).

2.4 Knowledge Charts

A Knowledge Chart is a partial, ontology-based representation of a story or a controversy about a topic for the purpose of supporting understanding. A knowledge chart normally makes use of one or more domain models providing the domain-level knowledge required for its formulation.

In Laurillard's work [Laurillard, 2002] on the use of learning technologies she identifies two important characteristics of learning: that it requires a means of seeing structure as well as the relations among structures. We thus need to provide a typology of knowledge charts (as indicated above) as well as a means of linking among them. This latter will be provided firstly by creating static and dynamic links from structure to structure (based on ontology mappings) and by using tools (see below) to carry out the linking.

As we have seen already we consider three types of knowledge chart to be crucial: debates/controversies, narratives and analogies.

Debates/controversies (most relevant for the SciControversy Learning service) are structured exchanges of positions, factual statements, rebuttals, attacks and so on. Controversies may be seen as a special sort of debate in which the exchanges are aimed at testing the validity of particular theoretical positions. Scientific controversies are a means to test and explore theoretical positions which are not widely accepted. For instance, Wegener's theory of continental drift was the topic of a scientific controversy in the last century. It is typical of controversies that they reach some sort of closure. No one now doubts that tectonic plates exist (al-

though some still argue about notions such as Darwinian evolution).

Narratives as we view them are the high level stories or meta-narratives which a discipline tells itself. For example, archaeology sees itself as currently a highly specialized, professional discipline concerned typically with access the 'archaeological record' rather than the discovery of buried treasures. It became this as a result of pioneering endeavours by individuals such as Worsaae in Denmark who moved the profession away from poorly thought out and experimentally inadequate excavations.

Analogies may be taken as a form of argument in which a discipline proceeds by mapping its state onto results or theories in some other discipline and using these to derive new results itself. For example, social sciences such as psychology often work by employing analogies from other, *harder* disciplines. For instance, cognitive psychology is a discipline which in large part derives its models from a central analogy between the working of the brain and the mechanisms of computers.

2.5 Tools

A whole range of ontologically-informed tools will be needed for the creation of learning services and knowledge structures as well as for the nurturing and support of knowledge communities. Central to these is the means of navigating knowledge structures — the Semantic Browser and the means of creating and updating the knowledge structures — the Knowledge Chart (KC) constructor.

Unlike most of the tools and representations mentioned in this position paper, the Semantic Browser already exists. The Magpie Semantic Browser [Dzbor, 2004] has been developed in the Knowledge Media Institute as a means of accessing complementary material initially for students interested in learning about climate change and prediction. Essentially, it works as follows. The community or resource designer provides an ontology for a domain (for example, for climate science). At the same time a set of learning services is created and made available to the Magpie tool. These services can be as simple as glossary-lookups or as complex as simulators for some aspect of climate science. The designer provides mapping between concepts and services. The user of Magpie can decide which parts of the ontology to concentrate on. Magpie finds textual elements in the current web document which match the concepts and highlights these. When the user selects one and right clicks, a menu provides access to the range of associated services.

While the tool is already available, it will need to be modified to some extent to enable it to navigate through Knowledge Charts since these include graphical as well as textual elements. However, the main points to be made are:

- Magpie uses ontologies to construct links dynamically.
- Therefore it does not require pre-annotated resources including LOs.

- It can be extended with arbitrary learning services.

The KC constructor does not exist as yet. However it is our intention that it should be modelled on the wiki interactive web page creation so that communities can browse and create Knowledge Charts using the same combined Browser and Constructor.

Support for Knowledge Neighbourhoods is also an active research topic. While we already have a range of tools for supporting discussion, in our view, what is needed to nurture and support communities are, firstly, a range of environments which 'understand' community dynamics, i.e., which are underpinned by community ontologies, and, secondly, a range of tools which are part of these environments and which allow the collaborative construction of knowledge, knowledge structures such as Knowledge Charts, and learning services.

2.6 The SciControversy Learning service

We can imagine that our learner is reading a web page/document/learning object on climate change as part of some course on environmental studies. While some mention is made of alternative and competing viewpoints, this is not dealt with fully in the text. As she reads, our semantic browser indicates portions of the text with which it has associated services. In this case it can offer a service which displays an interactive view of the scientific controversy about global warming.

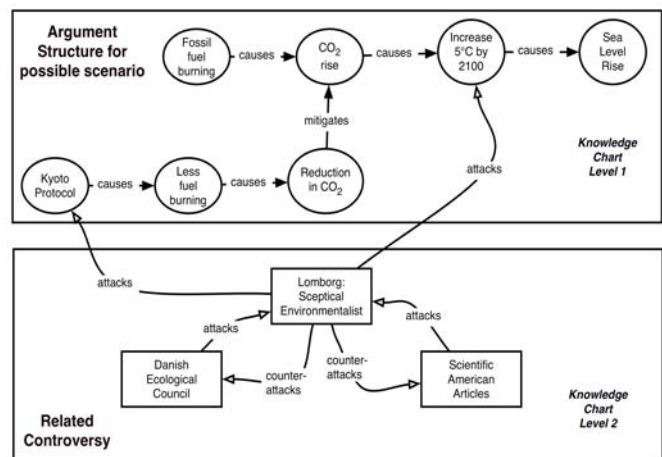


Figure 1 A schematic Knowledge Chart for the global warming controversy

Figure 1 represents this controversy in its barest essentials: a real Knowledge Chart for controversy would be much more complex. The figure shows two levels of Knowledge Chart. Level 1 shows the structure of an argument linking CO2 rise to climate change. Level 2 shows part of the ongoing scientific controversy about this linkage. If the learner clicks on the *Lomborg Sceptical Environmentalist* node, this will open up to provide a more detailed version of Lomborg's argument.

Since Lomborg's argument about models is based on a view of what statistical models can do, the learner can now opt to follow a link to either a description of statistical models or a deeper view of Lomborg's argument here.

And so on. At each point in the debate model, the learner can access the original web resources of which the model is a summary. Of course, any new document or Chart could have further Knowledge Charts associated with it, which the learner can pursue in turn.

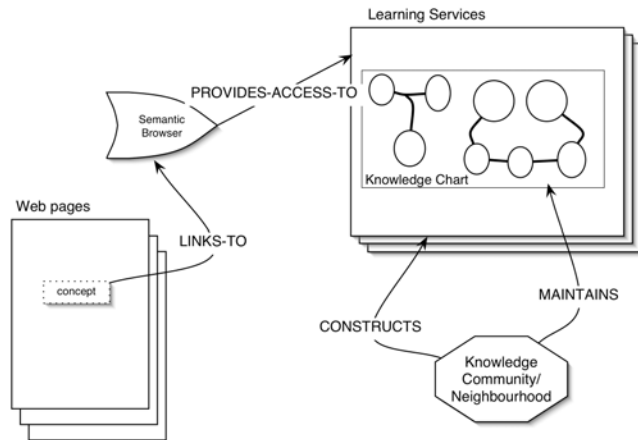


Figure 2 Our approach to delivering learning services

Figure 2 shows how the main components of our approach relate to each other to form the basis for delivering learning services.

2.9 Conclusion

We are currently working on realizing the framework outlined above. Our main aim is to have the SciControversy Learning service implemented within the next few months. At the same time we are trying to define a typology of possible learning services which would be educationally relevant and show the potential of the Semantic Web.

When it is operational, our approach will avoid the reductionism inherent in learning objects and related approaches and support users in making connections, in engaging in critical analysis, in locating the right knowledge and in making sense of pedagogic narratives. It thus stands a better chance of producing the sort of critical thinker able to deal with the complexity of the material available in any future knowledge based society.

References

- [Laurillard, 2002] Diane Laurillard. *Rethinking University Teaching: A Conversational Framework for the Effective Use of Learning Technologies*. RoutledgeFarmer, London, 2002.
- [Dzbor, 2004] Martin Dzbor, Enrico Motta and John Domingue, Opening Up Magpie via Semantic Services, In *Proc. of the 3rd Intl. Semantic Web Conference*, November 2004, Japan.