

Learning Objects on the Semantic Web Explicitly Modelling Instructional Theories and Paradigms

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Abstract: This paper presents a scenario which draws a vision of Learning Services on the Semantic Web. In this context we ask the question of ‘What are Learning Objects?’ and draft appropriate answers. We describe a datastructure which allows explicitly modelling diversity in the field of learning by including role-based attributes for Learning Objects.

Motivation

Various scenarios illustrate new possibilities enabled by the evolution of the Semantic Web, which is based on the assumption that each object on the web can be described appropriately and in a machine readable form. “A new form of Web content that is meaningful to computers will unleash a revolution of new possibilities” (Berners-Lee et al., 2001). But we currently recognize a lack of ideas and visions for the description of learning and teaching services within the Semantic Web. Up to now standards for metadata in the field of learning focus on search, exchange and re-use of learning material, often called content items, learning objects or training components (Cisco Systems Inc., 2000). Accordingly, training concepts focus on “*just in time access to training and information.*” (ibid.). Scenarios, which concentrate on how to structure and organize access to learning objects, are mirrored in concepts such as content packaging (SCORM, 2001).

Search, exchange and re-use of learning objects is a challenging intention, but only one aspect within a more comprehensive vision, based on how these learning objects are actually used in a learning context. We present a scenario which is guided by the idea of a mature learner and elaborate a theoretical model as well as a datastructure including role-based attributes for explicitly modelling specific learning theories and paradigms.

Scenario: *Learning Services within the Semantic Web*

Guiding principle of the scenario *Learning Services within the Semantic Web* is a learner, who does not only identify what he needs to learn right now (knowledge, skills, and competences) but also anticipates how he learns successfully (what conceptual/educational model meets his needs). Rautenstrauch (2001) explains: *Life-long learning will be a learners own decision (...) the learner is mature (...) he will identify and define his own needs and preferred ways of learning (...) he will learn to learn selforganized, self-determined, and independent from predetermined curricula and institutional forms of organization.* A scenario, which presents main visions of the Semantic Web and its services, written by Berners-Lee et al. (2001) inspired us to write the scenario of *Learning Services within the Semantic Web*:

--Steve is an employee at an insurance company. His boss asked him to assume the leadership of a group of seven people in the analysis department. He may spend a fixed amount of time and money on advanced training to prepare for this new assignment. Now, Steve is asked to draft a proposal on his further education. Steve reflects on this chance: obviously his boss trusts in his responsibility and planning skills regarding his further education. He is allowed to anticipate his own needs in both form and content. He realizes that he does not only have to reflect his requirements and needs regarding the content but also the way of learning, and the learning and teaching culture which is the most motivating to himself. The company does not run an own training department. Therefore he adjusts his agent to look for external courses offered. He anticipates the content he needs to learn: contract law, financial and personnel controlling [...] but also competences in planning, organization and communication. To define some more attributes he instructs his Semantic Web agent to trust the agent (and its set of attributes) of his colleague, who has often attended courses so far. But he still lacks attributes on the way of learning, learning and teaching culture.

After a short web search his agent informs him of an interesting consulting project on the internet, which offers learning services: The project provides some basic scenarios describing learning situations and context which are

written like stories and are easy to understand. Each scenario reflects a specific model, theory or paradigm of learning and teaching. He decides for one that best meets his assumptions, opinions, and beliefs on learning he has drawn from previous learning experiences both successful and unfruitful. He is impressed: there is a scenario which reflects a learning model that confronts learners with complex real world cases and claims that must be handled within a group of learners. Great, collaboration and communication are key issues! He decides to choose two scenarios, called: “Communities of Practice” and “Situated Learning – Case-Based”. The scenarios come with specific sets of metadata: the CoP-Profile and the SituatedLearning-Profile. Steve agrees to trust these profiles and adjusts his agent accordingly. His agent now searches for: specific content, a learning group to co-construct knowledge with, a tutor who acts as a coach, for suitable activities, and appropriate media-formats. The agent comes up with a few suggestions: organizations which can offer what he looks for as well as a skill-management-like database offering tutors, coaches, experts and learning material. Steve sends his agent to the human resource department of his company, to synchronize its results with the companys list of accepted organizations. [...] A few month later Steve reflects on his latest learning experience, which was fruitful, and revises the adjustment of his agent: During the last weeks he has learned much about his own preferred way of learning and learningstyle.--

What is a Learning Object?

Based on this scenario we identify an exemplary list of general Learning Objects:

- Tutors offering services, support and facilities according to specific concepts and models (depending on different learning theories, learning paradigms, instructional principles)
- Experts with their specific area of expertise and competence
- Learning groups to carry out collaborative teamwork enabling collaborative knowledge construction.
- Peers to perform peer-tutoring
- Learning situations: Points of Cooperations - POCs (Wessner & Pfister, in preparation) e.g.
- Learning activities
- Learning material
- Media enabling certain activities (Videoconference, workspace)
- Conceptual structures (these structures reflect specific instructional models/paradigms/principles)
- Instructional ideas (the community of teachers of primary education do not only effectually exchange learning and teaching material but also ideas of how to use them – how to teach and support learning)
- Feedback

The important aspect about these learning objects is their character of not being unspecific with regard to learning theories, learning paradigms (such as cognitivism, constructivism) and instructional principles (such as PBL, case-based, CoP etc). A videoconferencing session is not yet a learning activity. It does neither constitute, characterise nor induce a learning activity. The appropriate learning activity is a session of collaborative learning using videoconferences within project-based learning e.g. . The activity might be even more specific: the mode of dyadic collaboration and the kind of structural support that influences collaborative knowledge construction (Fischer et al., 2000) characterises the activity. Another example: There is not a single concept of tutorial support, but diverse concepts, diverse roles and tasks of a tutor, depending on the design of the learning situation. The design of the learning situation is guided by different learning theories/paradigms, instructional principles. Any theory, paradigm and principle reflects specific assumptions on learning. The term “tutor” therefore does not yet imply a specific task or a specific mode of support. Within a setting of collaborative problem solving the tutorial concept of support might be totally different from a training session guided by the instructional principle of drill and practice.

Explicitly Modelling Diverse Learning Theories, Paradigms and Principles

The basic principle of the Semantic Web is to bring structure to meaningful content as well as the ability to process semantics by automated means (Berners-Lee, 2001). Meaning of information is decoded within context. But the learning sciences per se cannot provide an unequivocal context, only specific theories can serve as centre of references and as context for expressing and decoding meaning. This becomes clear for example with attributes like the LOM Category *Interactivity Level* (LOM, 2001), which is hard to understand and use

appropriately, because interactivity within cognitivistic approaches is different from interactivity within constructivistic approaches. Standardization in the field of learning faces the diversity visualized in figure 1. Different approaches have been proposed to now. Initiatives like LOM (2001) aim at forming standards which are instructional unspecific while the Educational Modelling Language (Koper, 2001) forms a pedagogical meta-model. From the point of view of several approaches within the philosophy of science it is not possible to aim at being unspecific. Sets of metadata usually reflect specific learning paradigms and instructional principles (expository teaching e.g.).

In the field of learning we face valuable diversity. Standardization has to address and take into account different scenarios based on diverse requirements and assumptions on learning. The the context for standardization in Learning is well characterised by Lyotards comprehension of science which is explained by Beck as follows: There is need to emphasise in a postmodern manner the conflicting diversity of models, the competition of paradigms, and the impossibility of integrative and finally valid solutions. The failure of integrating theories is specified a characteristics of postmodernism (Beck, 1993). Standards that aim at instructional neutrality must fail from the point of view of the science of philosophy. They risk addressing a narrowed perspective on learning. Also the formation of a pedagogical meta-model (Koper, 2001) is not what we intend and view as a solution. We want to open the view on learning in standardization and propose an approach of *Instructional Roles* in Learning Metadata Standards, which supports the idea of explicitly modelling and annotating different paradigms, models and principles in learning. The concept of *Roles* we use is taken from the field of semantics and formal languages (Steimann, 2000). Steimann recommends to introduce the concept of *Roles* into object-oriented modelling in order to make possible dynamic modelling. In a previous paper we proposed the concept of *Instructional Roles* to specify educational attributes for different learning theories (Allert et al., 2002).

In this paper we present a simple datastructure which reflects the modelling of diverse theories, principles and paradigms. It also allows the mapping of different approaches and therefore the exchange and re-use across the boarder of diverse theories/paradigms/principles – a basic requirement for standardization. We do not propose sets of metadata for any available theory. But we suggest this datastructure in order to prestructure the field and allow communities of practice to suggest specific sets of metadata. As our group has expertise in the field of situated learning we currently work out a set which we plan to propose and bring into discussion soon.

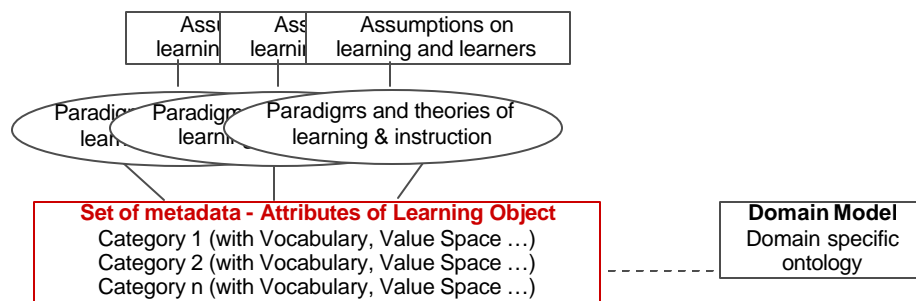


Figure 1: Standardization in the field of learning is confronted with diversity.

A Simple Datastructure to Describe Learning Objects

Building on previous work in IEEE LOM and IMS, we have those categories which are unspecific and mainly meant to facilitate mapping, search and re-use of Learning Objects independent of their instructional context: General (cp. Dublin Core), Technical, Annotation, etc.. Additionally, we then have those categories which give information on educational/ instructional attributes of Learning Objects, modelled along specific theories/paradigms/principles and are called *Instructional Roles* (*IR*). *IRs* allow explicitly modelling diversity, enable dynamic modelling, and serves as centres of reference. In order to allow mapping, search, exchange and re-use at this level as well, we present a common set-of categories. Each *IR* guides the set up of specific vocabulary within a category. As an example we contrast two *IRs*: *Expository* and *Situated* (Table 1). They have vocabulary in common, e.g.the *Tutor* is mentioned in both models. Only the specific *IR* defines the specific meaning of the term and serves as system of reference.

The categories and vocabulary presented here are very vague and not at all a final draft, they serve only to explain the structure of data. We currently contribute to the work at the German Institute for Standardization (DIN) which specifies these categories. The structure of data is on the one hand inspired by the Berliner Modell and the Hamburger Modell (Peterssen, 1994). These theories expose different fields of decisions within

educational settings. Pawlowski brought the Berliner Modell into standardization activities (Pawlowski, 2001). On the other hand we introduced layers of abstraction which are exposed by Klafki (1993), and Merrill (2001) and formed the *Instructional Roles* (Allert et al., 2002).

	Category	Vocabulary
General	Author	
	Subject	
Instructional Role:	Actor	Teacher (Trainer) Tutor Learner
	Expository	
	Intention/ Motivation	Learning Objective
	Topic/Skill/ Competency	
	Process	According to Ausubel
	Method	Inductiv Deductic Spiral Elaborating Differentiating
	...	
Technical	Media	Videoconference Knowledge Base
...		

	Category	Vocabulary
General	Author	
	Subject	
Instructional Role:	Actor	Peer Tutor Learning Community
	Situated	
	Intention/ Motivation	Input Case Problem Statement
	Topic/Skill/ Competency	
	Process	
	Method	Multi-perspective view on knowledge. Peer-Tutoring
	...	
Technical	Media	Videoconference Workspace Shared Whiteboard
...		

Table 1: Contrasting exemplary *Instructional Roles* with their categories and vocabulary

Further Work

We currently work on the consulting services in the field of learning mentioned in the scenario: different scenarios (such as best practice scenarios) reflect specific instructional and learning theories, paradigms and principles. They come along with specific sets of metadata. The scenarios help to identify ones own needs in learning and teaching even if one lacks specific terms of the learning science. The scenarios also serve as specification and characterization of categories and vocabulary for those who use and for those who annotate Learning Objects.

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