Situated Models and Metadata for Learning Management from an Organisational and Personal Perspective

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Abstract: This paper depicts the interrelation between situated learning and learning management from an organisational and personal perspective. Based on this introduction we show how educational metadata can be used for approaches of situated learning and how we can take care of learning approaches and contexts using situated and context specific metadata and role-based models.

Introduction

Learning and educational management is still an ongoing challenge for organizations. In a flexible and rapidly changing environment both learning and educational management, together with knowledge management, become an integral part of strategic planning. This holds for the educational manager within an organization as well as for a self-organized life long learner. Learning within an organization has to face specific work organization, organizational structure, strategic intents, transformation processes, culture, diverse goals, different target groups, and divergent needs. Learners themselves have to develop the competence of reflecting their own needs within a context, which is dynamic and characterized by continuous change. They have to reflect both what and how they prefer to learn. Educational management not only has to deliver knowledge-assets, but also to enable learners to communicate and share knowledge, to develop competences, meta-cognitive skills, and capabilities to support the co-construction of shared innovative knowledge. Furthermore, educational management can be based on a large repertoire of pedagogical concepts ranging from models of instructional design to situated and humanistic approaches.

Current standards and concepts for educational metadata focus on content-centred approaches and models of instructional design rather than situated approaches. Scenarios, which concentrate on how to structure and organize access to learning objects (learning material presenting information), are mirrored in concepts such as content packaging [SC01]. Standards focus on search, exchange and re-use of learning material, often called content items, learning objects or training components

[Ci01]. LOM aims at metadata to facilitate the generation of consistent lessons composed of decontextualized and distributed learning objects (e.g. consistence in the level of difficulty). Its vision is *to enable Computer agents to automatically and dynamically compose personalized lessons for an individual learner* [LOM02]. The IMS Learning Design Specification [IMS02] provides a conceptual model which enables authors to describe processes and activities including social interaction. But conceptual models are limited to processes which are well-defined. Situated approaches engage learners in processes of knowledge construction. These processes are dynamic and ill-structured. Learners or groups of learners are seen as autopoietic systems actively interacting with their environment and transforming during the process of learning. Similar to this, knowledge management and organizational transformation processes are intertwined: the organization is changing. Metadata for situated approaches could broaden the view and add visions which are closer to the ideas of the semantic web outlined in a scenario by Tim Berners-Lee et al. [BHL01]. Actors in a scenario about learning services on the semantic web will be self-organized learners [ARN02].

Models of situated approaches such as Communities of Practice and Ill-Structured Problem Solving are characterized by specific elements and relations (e.g. roles acting). We will draft metadata which are relevant for situated approaches and which will facilitate learners and teachers to organize learning processes: Learners may want to find a suitable Community of Practice, someone to communicate with towards a certain goal, someone to perform peer-tutoring with, a coach, facilities to support collaboration, etc.

Situated Approaches in Educational Management

Educational Management faces diverse goals and needs. Learning on demand which concentrates on *just in time access to information* is only one aspect within a more comprehensive vision. Education within an organizational context has to facilitate procedural and pragmatic knowledge in addition to domain specific and predominantly declarative knowledge. The learning organization means more than individual learning of all its members [VR00]. Current concepts of corporate management contrast notions of Learning Organizations with concepts of knowledge based organizations. [Ny98]. Members of the organization are engaged in transformation processes which are complex processes of change by creating innovative and strategic knowledge.

An important distinction in this context is between adaptive learning and generative learning. Adaptive learning or *single-loop learning* [AS78] focusses on optimizing the action strategy while goals, values, plans and rules are operationalized rather than questioned. Generative learning is about creating – it requires *systematic thinking, shared vision, team learning* and *creative tension* (the tension between vision and current reality) [Se90]. Generative Learning or *double-loop learning* [AS78] reflects and questions objectives, underlying norms and assumptions. Organizational learning, which accepts the relevance of double-loop learning, respects that organizational processes are ill-structured problems.

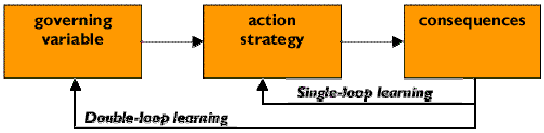

Fig. 1. Single-loop and double-loop learning. Source: [In03].

The need for procedural and pragmatic knowledge as well as the need for double-loop learning within an organization calls for the application of situated learning approaches. Jonassen discusses the significant difference of well-structured and ill-structured problem-solving in learning. "*Instructional designs for well-structured problems are rooted in information processing theory while instructional designs for ill-structured problems necessarily borrow assumptions and methods from constructivism and situated cognition"* [Jo97].

Ill-structured problems emerge from a specific context. The process of problem solving typically changes the context and therefore the problem itself. But the context also changes independently from ones own activities. The complexity of these problems can't be reduced without loosing information and therefore they require value-based decisions. Ill-structured problems are characterized by the absence of an objective problem statement, by an unknown set of operators and an unclear goal state.

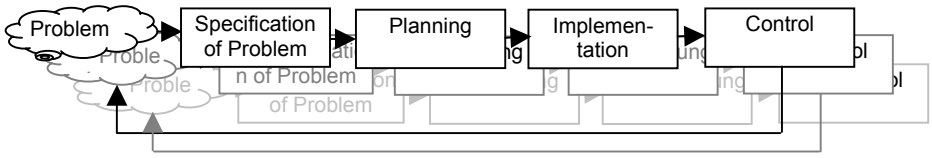

Fig. 2. Process model for ill-structured problems. Source: [RAN03].

Models of problem-based learning often address well-structured problems. These problems are typically found at the end of textbook chapters. They reflect the epistemic beliefs of information processing theory and *require the application of a finite number of concepts, rules and principles being studied to a constrained problem situation*. [Jo97]. Jonassen holds: *It is important to recognize that effects of well-structured problems in school contexts have limited relevance and transferablility to solving problems that are situated in everyday contexts*.

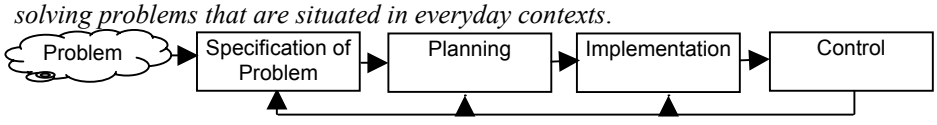

Fig. 3. Process model for well-structured problems . Source: [RAN03].

In the context of knowledge management it is crucial to point out the different types of knowledge and competences aquired in ill-structured problem solving. Hong summarizes: *In addition to domain-specific knowledge and structural knowledge, ill-*

structured problem solving requires epistemic cognition for developing an argument, metacognition (e.g., general strategies, monitoring, evaluation, planning), and non-cognitive variables (e.g., value, affect, emotionality) [Sh98].

We refer to well-structured problem solving as a model of instructional design, to ill-structured problem solving as an approach of situated learning. According to Herrington and Standen [HS00] an environment of situated learning should fulfil the following criteria: authentic context, authentic activities (resembling real-life activities with respect to the complexity and structure), access to expert performances (to be able to learn from expert solutions), multiple roles and perspectives, reflection, collaborative construction of knowledge, articulation, coaching and scaffolding (e.g., support which provides hints and structures the learning activities), authentic assessment within the context.

Metadata for Situated Approaches

The guiding principle of current standards and concepts of educational metadata are principles of instructional design. According to Reimann-Rothmann and Mandl [RM01], *goal and result of ID models are plans of instruction which tell instructors which strategy of instruction and method of teaching to choose according to given preconditions and prerequisites.* Therefore instruction can be formalized and automated. Content-units and learning objects are decontextualized.

Guiding principles and intended use of metadata for situated approaches are different: Learning processes of situated learning are ill-structured. Context plays a cruical role in situated learning. The context in which the knowledge is learned should resemble the context in which it is normally used. [HS00]. Metadata for situated approaches have to support tasks like the following:

- Learners search for a suitable Community of Practice.
- A Community of Practice annotates a content item with “lessons learned” or “best practice”.
- An Educational Manager looks for a tool which facilitates co-construction of knowledge.
- A teacher looks for cases and problem situations
- A learner who learns a language looks for a peer to communicate with.

From these very few examples we already can recognize that for situated approaches:

- Learning objects are less fine-grained
- Learning objects are less decontextualized
- Both learning objects and learning services (e.g., persons, tools) are relevant
- Suitability of a LO for a specific learning model is relevant.
- Learning processes are not well-defined

We think that metadata should meet both visions, and thus approaches of situated design as well as models of instructional design should be addressed.

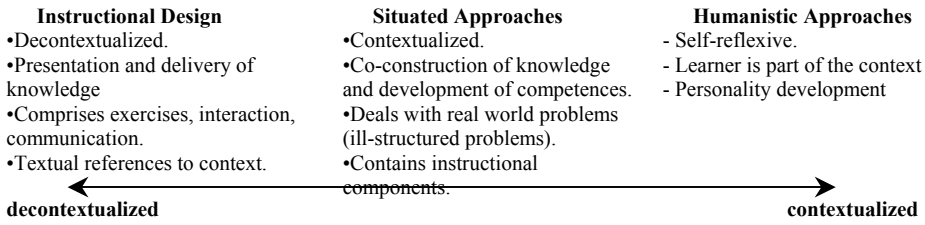

Fig. 4. Different approaches on the continuum of contextualization.

Learning Services

Under these assumptions, we say that a Learning Service is constituted and characterized by the learning context in which it is or can be used. Learning Services can be provided and offered on the web. Users such as learners, teachers, organisations may search and find Learning Services.

Definition of Learning. For our purposes we adopt the definition of learning proposed by Wittrock [Wi77] acc. to [GPS01]: *Learning is the term we use to describe the processes involved in changing through experience. It is the process of acquiring relatively permanent change in understanding, attitude, knowledge, information, ability, and skill through experience.*

This definition covers incidential as well as intentional learning processes. Bereiter & Scardamalia [BS89] use the term intentional learning to refer to cognitive processes that have learning as a goal rather an incidential outcome. We agree on these definitions on learning.

Definition of Learning Services. More specifically, then, a Learning Service is any entity which is able to fill a role within a learning context. For example:

- An activity within a learning context.
- A person filling a supportive role in a learning context.
- A videoconferencing session within a learning context. This means: a videoconferencing session is not yet a learning service. It does neither constitute, characterise nor induce a learning activity. The appropriate learning service is a session of collaborative learning in discourse using a videoconference, or a session of expository teaching transmitted by videoconference.
- As soon as arrangements such as MUDs and MOOs [RNRSSW02] are transported into the context of learning, they constitute Learning Arrangements. Learning Arrangements as well as entities used to realize these Learning Arrangements are Learning Services.

In the concept of *context-specific metadata for learning services* context and relation are key concepts: learning services are characterized and constituted by their context and relations (interactions with other learning services). Characteristics of a learning context are defined by existing and potential *Educational Roles*. Each *Educational Role* reflects a specific learning theory.

Role-based Metadata

It is therefore necessary to distinguish between static attributes (such as DC and vCard attributes) which are based on the type of a learning object or learning service, and context- or role-dependent attributes which are based on the roles a learning object or learning service can fill. Every educational resource can have one or more associated roles. Learning objects, persons, and other educational resources have some context-independent attributes; in the case of learning objects, these are mainly the attributes from Dublin Core and some further LOM attributes, like dc:title, dc:creator, etc. Persons are described with some vCard attributes like vcard:FN (full name) and vcard:EMAIL. Furthermore, context-specific attributes are attached to educational resources.

In the following we distinguish between class-type and role-type. For better readability we refer to role-type as *role* and to class-type as *type*.

Educational Roles

To model diversity we introduce the concept of *Educational Roles.* The concept of *Roles* we use is taken from the field of semantics and formal languages, see [St00a], [St00b]. Steimann recommends to introduce the concept of *Roles* into object-oriented modelling in order to make possible dynamic modelling approaches. He distinguishes natural types and classes from roles:

Table 1: Distinguishing types and classes from roles.

Natural Type/Class	Role
•Static	•Dynamic (Dynamic classifying)
•An instance of a class once and forever belongs to that class. It cannot change it without loosing its identity	•Founded (has context and relations) •Not semantically rigid – does not lose its identity when leaving the role [Gu92]
Well-known concept in object oriented modelling	

Roles are not semantically rigid but founded [Gu92], [GCG94]. We call roles in the context of learning *Educational Roles. Educational Roles* are meta-roles (meta-types in M2 in figure 5) which specify roles, interaction beween roles, and qualities/properties of roles. Instances of natural types can fill, adopt and leave a role without loosing their identity. Roles are defined by context and relation (interaction). Interaction is also an important characteristic of learning situations.

Each *Educational Role* reflects a specific pedagogical approach (of both instructional design and situated approaches). Learning services can fill roles temporarily which are specified by *Educational Roles* and therefore dynamically adopt properties from diverse *Educational Roles*. In a previous paper we proposed the concept of *Educational Roles* to specify educational attributes [ADN02]: a learning service may fill different roles in different instructional/learning contexts. Here we exemplarily draft two situated *Educational Roles*:

- The role '*Community of Practice'*
- The role '*Problem-Based Learning – ill-structured'*

Similarly to how ontologies are often agreed on by a community of knowledge such as ACM or IEEE we suggest to decide on relevant roles within communities (such as learning scientists, practitioners, consultants on educational and knowledge management). Comparable with ontologies *Educational Roles* can be seen as shared conceptualization: Communities will have to agree on relevant characteristics of specific models and specify appropriate metadata. This approach is different from best practices within IMS Learning Design. Here we outline the procedure.

Identifying Relevant Characteristics

Each approach of situated learning is constituted by characteristic elements.

Table 2: Relevant characteristics of learning model *Community of Practice* (exemplary & preliminary)

Educational Role Aspects for Communities of Practice (CoP)	
Person	Community Coordinator (Local) Activities: • identify important issues • plan and facilitate community events • brokering knowledge assets • evaluate communities-contribution to members and organization • …
	Community Coordinator (Global)
	Community Leader/Expert Activities: …
	Core Member
	Active Member
	Peripheral Participant
	Team Support
Technology	Web-site
	Knowledge Base
	Community Platform
Learning Arrangement	Meetings • local • distributed • synchronous • asynchronous
Strategic Intent	Helping Community
	Best-practice Community
	Knowledge-stewarding Community
	Innovative Communities

Content-Item	Best Practices
	Innovative Knowledge
	Lesson Learned
	…

Table 2: Relevant characteristics of learning model *PBL - ill-structured problem solving* (exemplary & preliminary)

Educational Role Aspects for Problem Based Learning (PBL)	
Person	Project Solver
	Project Coordinator
Components	Problem Situation
	Problem Domain
	Problem Constraints
	Cases
	…
Support	Support for Argument Construction
	Support for Coordinating Teamwork
	Support for Generating Strategies
	Support for Reflection
	Knowledge Base Made Available to Learners …
	…
…	…

These tables show characteristics of specific learning concepts and do not yet specify data schemas.

Identifying Relevant Types and Roles

From these characteristic elements one can identify relevant types and roles.

- Types: Person, Technology, Content-Item etc.
- Roles: Community Coordinator, Lessons Learned, Best Practices etc.

Now relevant learning services can be identified: What are relevant learning services? What is useful to be provided and offered on the web (semantic web). What do users search for in the context of learning? For example users may search for

- a person who is an experienced Community Coordinator.
- a community within a specific domain.
- technology that is useful to support a specific scenario etc.

Models

Now we can infer conceptual models: a template model and two (exemplary) specific models. Within the diagram a rectangle indicates a *class-type*, a cycle indicates a *role-type*.

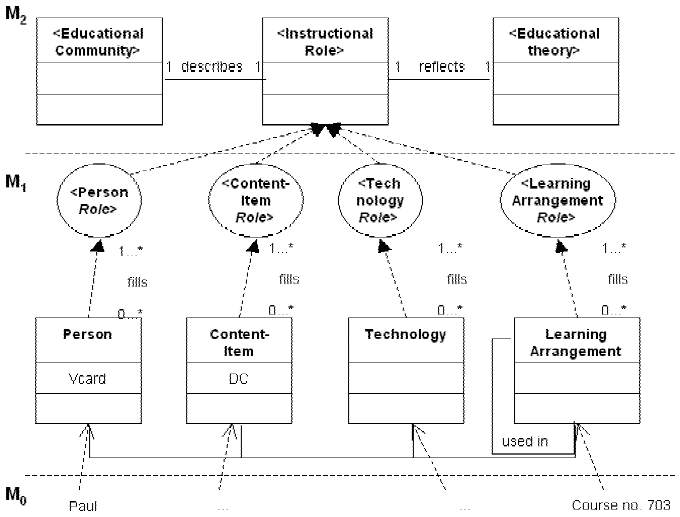

Fig. 5. Template Model.

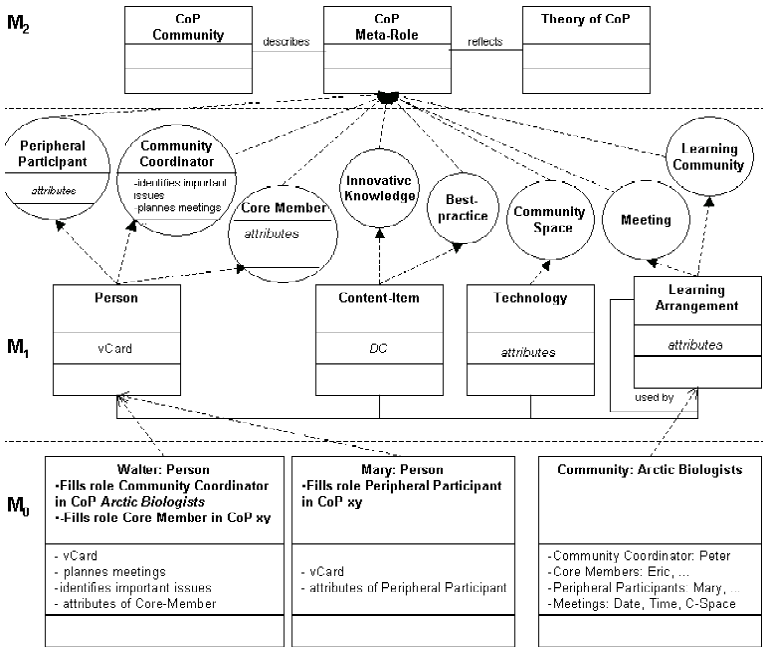

Fig. 6. Model *Community of Practice (CoP)* (exemplary & preliminary)

The dominance of roles which can be filled by persons in the CoP-Model reflects the characteristics of this learning concept: Point of crystallization in CoP is

communication among participants. Modelling the aspects of the 'PBL ill-structured model' visualizes another point of crystallization:

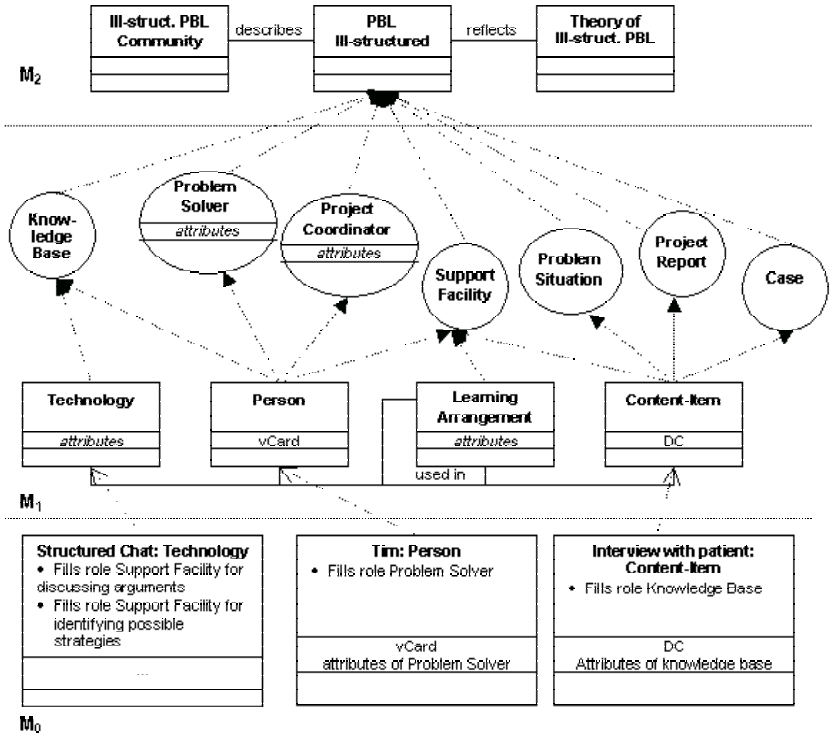

Fig. 7. Model *PBL ill-structured* (exemplary & preliminary)

Whatever entity is to be annotated one can ask, which type it is (person, content-item or technology) and can annotate this type with suitable metadata (vCard for persons, Dublin Core or reduced LOM for content-items e.g.). Additional educational metadata are derived from different *Educational Roles.* Therefore any entity will be annotated with static attributes and context-specific role-based attributes.

Practical Implications

An example: Business Process Reengineering defines specific demands on education and training. Specific competences are required to meet demands which result from different organizational structures: for example functional organizations, process-centric organizations, virtual corporations [DM92], hyperteyt organizations [NT95] or project-oriented ones. People themselves form interfaces between different organizational structures [NT95], for example between former functional units and current process-centric teams. They are allocated to create and share innovative knowledge and transfer it within both layers.

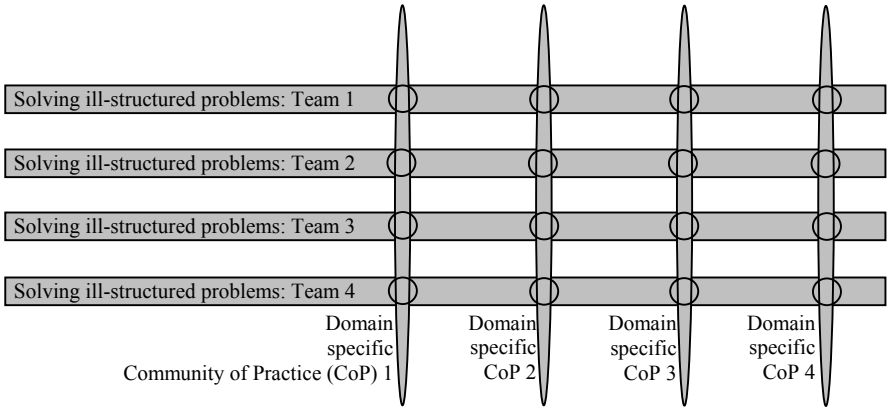

Fig. 8. Wenger proposes the cultivation of Communities of Practice as a key to a knowledge strategy. At DaimlerCrysler Tech Clubs (CoPs) provided the connections that kept the platform teams from diverging into islands. [WDS02]

Relevance of Role-based Annotation

Mapping this structure to learning concepts and *Educational Roles* means that each learning object or learning service can fill different *Educational Roles*. Peter is a person. Therefore his type is 'person' and the static attributes conform to the vCard standard. Peter is member of a problem solving team. Here he fills the role *Problem Solver*. Peter also is member of a domain specific Community of Practice. Here his role is *Community Coordinator*. Therefore the role-based dynamic attributes are derived from *Problem Solver* in the context of solving an ill-structured problem and *Community Coordinator* in the context CoP.

A content-item may fill the role *Best Practice* in a CoP context and the role *Example – Integrating Knowledge* at the end of an textbook chapter in an instructional learning arrangement. Prof. Pretorius may fill the role *teacher* in an instructional scenario and the role *Expert* in a CoP.

Annotating Learning Arrangements

Learning in practice often combines instructional and situated learning. Within a process of ill-structured problem solving often units of instruction are necessary and reasonable. Therefore attributes of different *Educational Roles* can be combined and mixed in annotating learning arrangements.

Further Work

A role-based approach is as modular as the field of learning models and enables us to easily model different kinds of educational settings using appropriate vocabularies.

Our futher work will ask the question: How will user profiles look like which are based in *Educational Roles*?

Acknowledgements

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