Learning processes and processing learning: from organizational needs to learning designs

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Abstract

Purpose – *The purpose of this paper is to provide a model for a process-oriented view on learning in organizations, and to link this model with IMS Learning Design (LD), a language for the description of pedagogical arrangement of multi-role activities.*

Design/methodology/approach – *This article exploits conceptual modeling techniques and a literature review.*

Findings – *A tentative mapping of the GOAP model to LD constructs is sketched, and some tentative aspects that suggest the need for an extended specification embedding LD are discussed.*

Research limitations/implications – *This paper describes a model for a process-oriented view on learning in organizations, and sketches how that framework could be integrated with IMS Learning Design, a language for the description of pedagogical arrangement of multi-role activities.*

Practical implications – *The paper promotes the role of conceptual modeling as a key process for learning design.*

Originality/value – *The paper presents an exploitation of learning processes modeling towards effective learning designs.*

Keywords *Learning, Learning processes, Competences, Modelling*

Paper type *Research paper*

1. Introduction

Learning events are *actions* that some intelligent agent performs and that involve a sequence of *mental* events. Such mental events eventually produce *knowledge*, which can be considered a kind of *improvement* from the agent's perspective (Wilson, 2002). In our complex societies, learning, in many cases, materializes in planned, non-accidental and purposeful activities. Learning plans result in learning *processes*, and these are ontologically something that occurs, so that their properties and outcomes can be subject to examination and rational inquiry. An important step in such inquiries is a proper formulation of the ontology of learning that is considered as a supporting theory (Sicilia, 2006).

A part of the learning processes that occur in organizations are not completely self-planned, but directed by organizational needs or other kind of forces external to the individual. Further, the outcomes of the processes influence the capabilities and behavior of the organization. Learning processes have thus an interest as value-creating activities inside organizations (Lytras and Sicilia, 2005), and this is why there is also an interest – from an information systems perspective – to ''process learning processes'' in the following sense: systems could plan learning processes based on some inputs (including the *capabilities* of the individuals), and produce some outputs (including improvement of those *capabilities*). Current learning technology is near to be able to automatically start (or at least suggest) that some learning process could be interesting for the objectives of a social group or

organization, and it is also able to support the delivery and realization of these activities through networks as the internet. This kind of processing requires concrete ontologies of the inputs, outputs and main activities inside the concrete organizational situation. This is not to say that we adhere to some ''computer metaphor'' for learning, since any existing theory of learning (behaviorist, constructivist, socio-cultural, etc.) can be formalized in ontological terms (Sicilia and Lytras, 2005) to some extent and be subject to the kind of ''processing'' or ''planning'' we are talking about.

This paper provides a model that links learning activities with a view on the organizational forces that drive knowledge creation. This is complementary to related efforts that connect learning objects with knowledge management (KM) concepts (Sicilia *et al.*, 2006), and KM processes to learning designs (Sánchez-Alonso and Frosch-Wilke, 2005). Then, the main elements of the model are mapped to IMS Learning Design (LD), a language for the description of pedagogical arrangements of multi-role activities. Such mapping enables new technology reusing LD units of learning in a broader context, driven by organizational behavior.

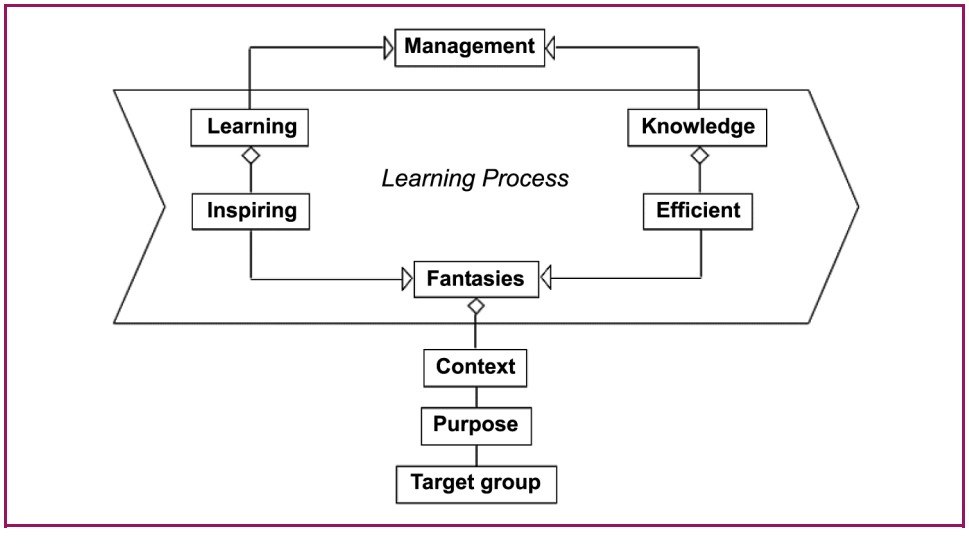
The rest of this paper is structured as follows. Section 2 describes the essentials of the process model that integrates a process view of KM with learning activities. That model attempts to explain how individual knowledge acquired through learning activities propagates to become organizational learning, with an emphasis on competencies as observable, inter-subjective behavior as one of the important measures in workplace learning. Then, Section 3 provides the details on how such a model can be used as an extension of the model of Learning Design (IMS, 2003) that is able to enable *processing* of learning plans in the sense of planning and arranging them towards organizational objectives.

2. Linking pedagogy and epistemology

Naeve (2005) defines (mental) knowledge as consisting of *efficient fantasies* and describes (mental) learning as based on *inspiring fantasies*. Each fantasy has a context, a purpose and a target group, and it is only when we have described how we are going to measure the efficiency of our fantasies – within the given context, with the given purpose, and against the given target group – that we can speak of knowledge in a way that can be validated (see Figure 1). In consequence, epistemology is connected to *measurement and observability.*

In a service-oriented environment aiming for reusability of service components, the ''process-object'' – or ''process-module'' – is of vital importance[1]. In the Astrakan™

Figure 1 Learning and knowledge management perspectives of the learning process: transforming inspiring fantasies into efficient fantasies



process modeling technique[2], which underlies Figure 2, a *process module* has certain *process goals*, produces *output resources* for different *stakeholders*, refines *input resources* and makes use of *supporting resources*. Moreover, the difference between an input and a supporting resource is that the former is refined in the process, while the latter facilitates this refinement.

Figure 3 depicts a kind of (= subclass of) process module, called a *learning process module*, with its corresponding learning (process) goals, and its input, output, and supporting learning resources.

Observe that Figure 3 describes the crucial connections between learning resources (LRs), which include so-called learning objects (LOs)[3], learning process modules (LPMs) and learning goals (LGs). Hence it becomes possible to describe *why* we are using a certain LO in a certain LPM, i.e. what pedagogical aspects that we are trying to support and what LGs that we are trying to achieve. Apart from the never-ending debate about their definition, a major criticism against learning objects is that they are too often considered in isolation from the learning context within which they are supposed to be used (see, for example, Feldstein, 2006). Hence it becomes difficult to connect LOs with the social and pedagogical dimensions of the learning process, and answer the crucial pedagogical/didactical questions of why LOs are being used and what one is trying to achieve by using them.

Figure 2 A process module with its process goals, and its input, output, and supporting resources

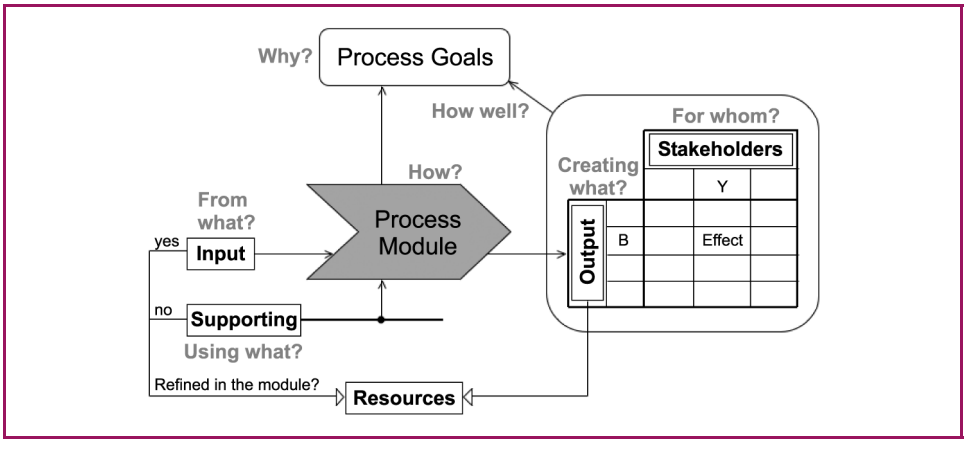
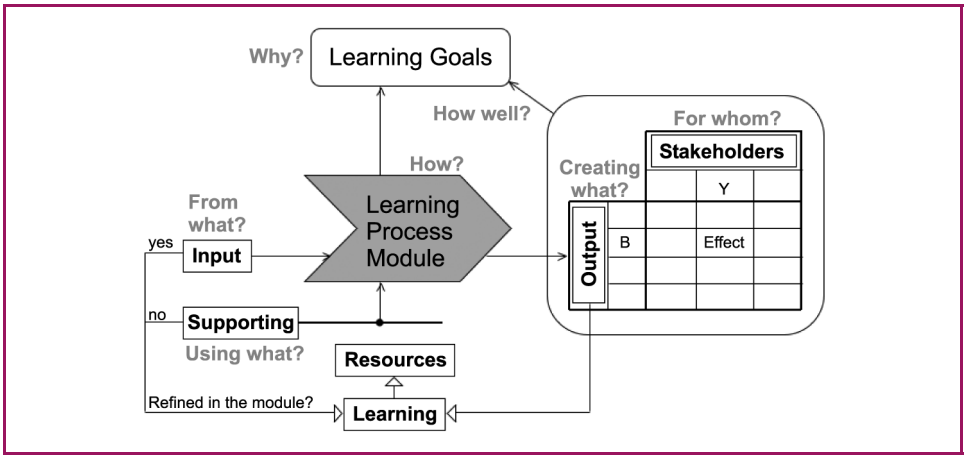


Figure 3 A learning process module, with its learning goals, and its input, output and supporting learning resources



Using the modeling techniques introduced here, such questions can be answered, which is illustrated in Figure 4. Here an abstract learning process is broken into four different parts, each of which is supported by a number of pedagogical aspects and tools. By instantiating this abstract framework and concretizing the entities in a top-down manner, we can describe how different learning process modules are supported by different pedagogical aspects and resources (e.g. tools). Moreover, from such ''concrete descriptions'', commonalities can be identified and different learning process ontologies can be constructed in such a way as to facilitate reuse of learning objects ''in context'', i.e. within a specific learning process module that is connected to a set of learning objectives (goals).

2.1 The GOAP approach to process modeling

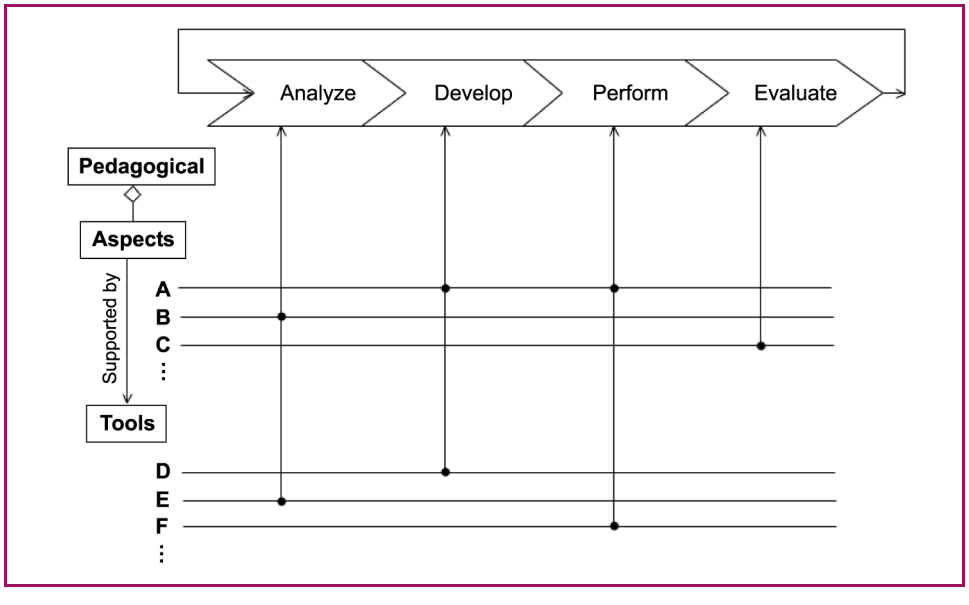
The processes in an organization are related to different goals, obstacles, actions, and prerequisites (GOAP). We will now describe the main elements of the GOAP approach to process modeling (for more details, see, for example, Eriksson and Penker, 2000).

To start with, relationships between goals as dependencies and associations are introduced. The *dependency* should be interpreted as stating that the fulfillment of the smaller (partial) goal contributes towards the fulfillment of the larger (dependent) goal. A goal that has been completely broken down into partial goals[4] indicates that the goal will automatically be fulfilled if all of the partial goals are met.

In connection with describing the goals we also describe the *obstacles* that stand in their way. An obstacle is a problem that hinders the achievement of a goal. By analyzing the problem, new goals or partial goals are discovered that attempt to eliminate the problem. An obstacle is therefore always linked to a goal. Similar to a goal, an obstacle can also be broken down into partial obstacles. Obstacles are eliminated (overcome) by *actions*. An *action plan* can be formulated from the goal/obstacle model, where temporary obstacles are resolved as soon as possible, and the goals linked to the continuous obstacles are allocated to processes in the business. The action plan should contain:

- a list of the goals and partial goals;
- a list of the obstacles for each goal/partial goal;
- the cause of each obstacle;
- the appropriate action for each obstacle;

Figure 4 Abstract learning process (broken into four different parts) supported by pedagogical aspects and tools



- the prerequisites for each action to be effective; and
- the process module responsible for carrying out each action.

Finally, for each process module, *prerequisites* take the form of input resources or supporting resources. The outcomes of the process module are relevant to different stakeholders in the organization, and the connection of the outcomes of concrete activities with the inputs and support of others provides a way to explain the transition from the individual to the organizational behavior. Figures 5 and 6 illustrate this idea.

2.2 Stakeholder matrices – connecting process modules into service networks

In the Astrakan™ modeling technique, stakeholder modeling is used for the output of processes, as illustrated in Figure 3. Here we expand this idea and make use of what we call *stakeholder matrices* in the description of every aspect of a process module, as shown in Figure 4. This means that we model not only who has an interest in the different output resources of a process module, but also who has an interest in its different goals, its input resources and its supporting resources.

As mentioned above, the idea of modeling the stakeholders of each aspect of a process module provides a way to connect these modules into service networks. This is illustrated in Figure 6, where the output resources from the process module to the left function as input- and supporting resources to the two process modules to the right. The ''interfacing questions'' that must be answered in order to set up these connections can be summarized as follows:

- *Producing what?* – What output resources give which wanted effects for whom?
- *Why?* – Which needs for whom are being satisfied?
- *How?* – How should the process be performed in order to reach whose goals?
- *From what?* – Which input resources from whom should be refined in the process?
- *Using what?* – Which supporting resources from whom should support the process?
- *How well?* – How well did the output resources satisfy whose needs?

The modeling framework described provides a generic way to model organizational processes as linked to general goals, with a possible decomposition. Of course, the ''goal stakeholder matrices'' are connected as well (not shown in Figure 6) in a way that models

Figure 5 Process module with stakeholder matrices

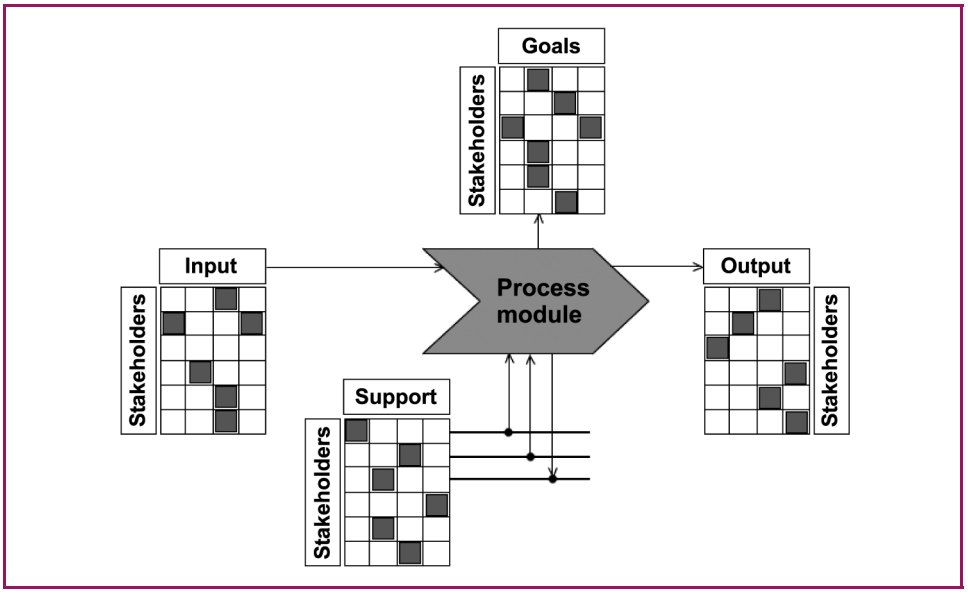
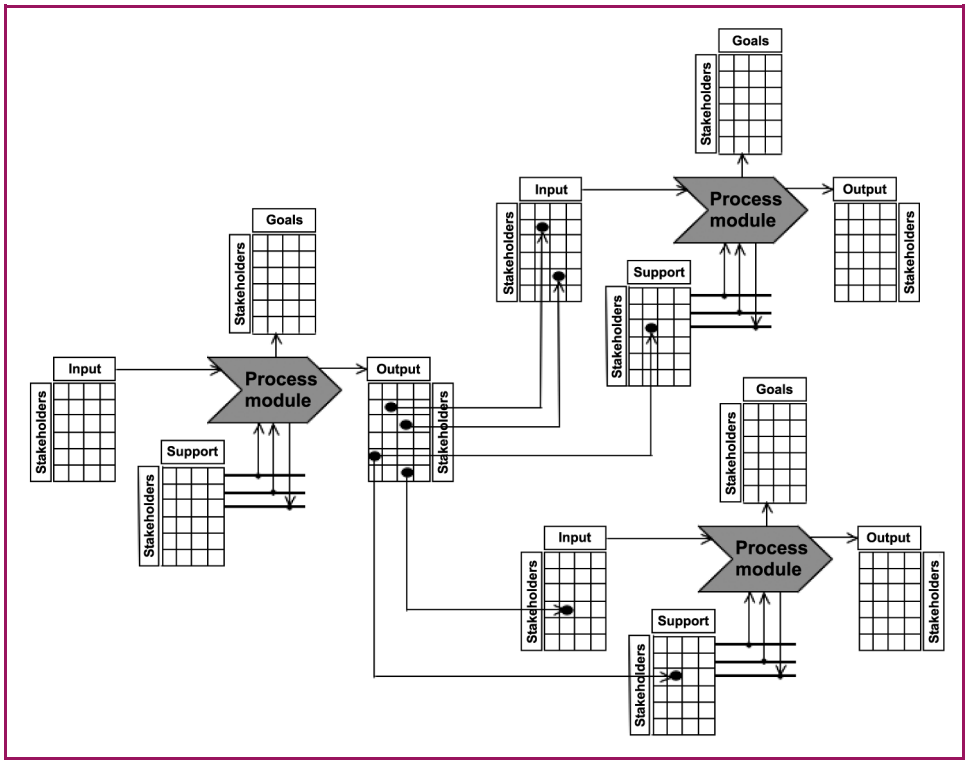


Figure 6 Service process network – connected through stakeholder matrices



how the different partial goals interconnect in order to support the overall goals of the service process network.

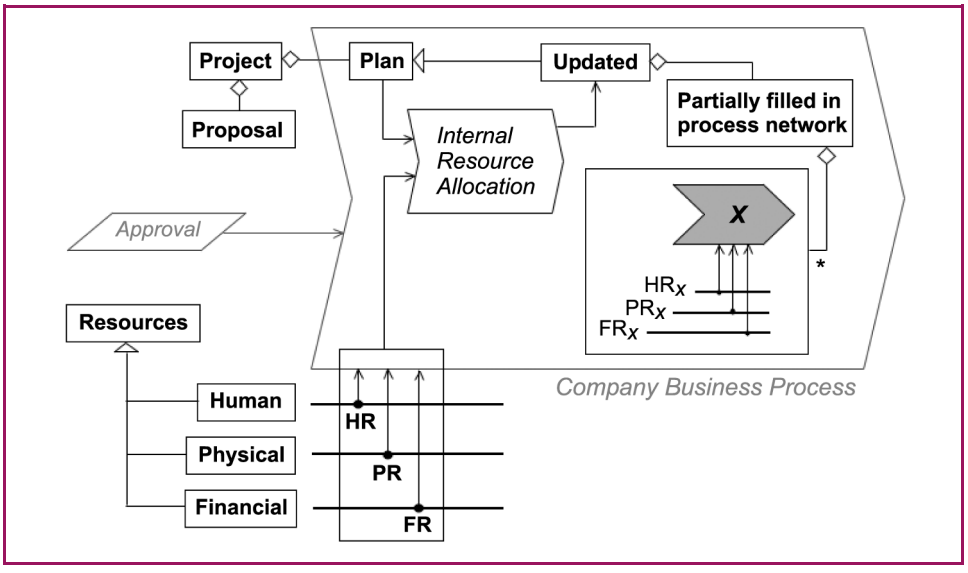
2.3 Operational learning needs from a business perspective

The learning processes in the workplace can be divided into *operational* and *strategic*, which reflects the two different levels on which a company operates. The operational level deals with the short range of everyday activities of the company, while the strategic level is concerned with the long range development of its future activities. Operational learning needs are mainly project-based (''What do we need to learn in order to handle the project that just got approved?''), while strategic learning needs are mainly competence-based (''What do we need to learn in order to secure the approval of future projects?''). ''Project-based'' here is understood as ''planned'' activities, with schedules, clear objectives and milestones, as opposed to *ad hoc* reactions.

In Figure 7 we illustrate how the project-based operational learning needs arise in the workplace from a business perspective. As shown in this figure, the overall *company business process* is supported by *human resources* (HR), *physical resources* (PR), and *financial resources* (FR).

In order to attract business, the company is involved in a *project proposal*, which involves the construction of a *project plan*. When the project gets approved, which is modeled by the occurrence of an *approval* event, this triggers an *internal resource allocation* (IRA) process, resulting in an *updated project plan*, which contains a *partially filled in process network* of the kind shown in Figure 6. In this IRA process, the available supporting resources (HR, PR, FR) of the company are distributed across the various process modules that describe the workflow of the project, and a suitable part of these resources (HR_X, PR_X, FR_X) are allocated to process module X. The learning needs arise from the ''competence-gaps'' in this process module network.

Figure 7 The origin of operational learning needs from a business perspective



3. Contextualizing learning designs

Learning designs are purposeful arrangement of activities intended to fulfill some specific `objectives`[5]. Thus, it is the consideration of objectives *external* to the individual, which come from the needs of the organization. In addition, since organizational learning is intended to result in accountable knowledge, a second requisite is that the outcomes are *measurable*.

Competencies are candidates to fulfill both requirements when considered as (Rothwell and Kazanas, 1992):

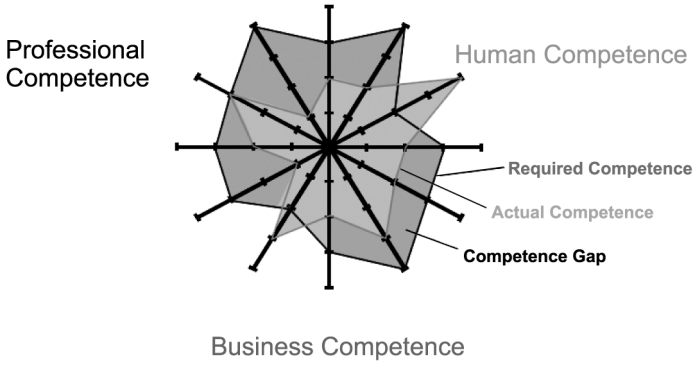
- the work situation is the origin of the requirement for action that puts the competency into play;
- the individual's required attributes (knowledge, skills, attitudes) in order to be able to act in the work situation;
- the response which is the action itself; and
- the consequences or outcomes, which are the results of the action, and which determine if the standard performance has been met.

Overall *competence* can then be assessed as *deficits* of competencies required. Figure 8 depicts this idea, which is in fact a formulation of the well-known KM concept of the ''knowledge gap''. Even though competencies do not subsume any possible desirable requirement, they cover the most common workplace situations. Since objectives need to be contrasted with the `outcomes` of the activities in LD, formulating both in terms of competencies provides a form of measurement.

Once the objectives of the learning units are expressed in external terms as competencies, the following step is the modeling of prerequisites. The inputs and outputs of the GOAP approach can be represented as objectives, but there are contributing inputs (*supporting* inputs) that can be modeled as `prerequisites` in LD. The description of the employee competency records could be modeled by the `property` mechanism attached to `persons`. Further the mechanisms of conditions can be used for the chaining of learning activities. Conditions in LD are defined as ''If-Then-Else rules that further refine the visibility of activities and environment entities for persons and roles'', so that they could be used for that purpose.

An additional interesting mapping is that of `learning-objects` with ''knowledge assets'', as items that go through continuous revision as represented in the KMCI model.

Figure 8 Example view on competence that needs to be developed



From the above discussion, it may be concluded that there is a one-to-one mapping from GOAP concepts to LD constructs, if we consider that processes are similar to the various granularities of activities in LD (method, play, act, activity, sub-activity). However, the following are essential elements that still require an extension for LD, or better, an ''application profile'' for the specifics of organizational learning:

Aspect #1.
The objectives and prerequisites of LD in the context of organizational learning need to be expressed in some language of measurable goals and outcomes.

The LD specification states that competency models as IMS RCDEO can be used for objectives. The problem is that models as RCDEO are not computable in the sense that they lack computational semantics. For example, there is not a concrete interpretation of ''competency components'' and how they should be handled (Sicilia, 2005). So, only a limited number of models could be used, with the requirement of having strict semantics. Such semantics are a requirement for the computation of ''competence gaps''.

Aspect #2. Learning activities are part of business processes of a different nature, which may include not only learning but also other KM activities as dissemination, knowledge validation or knowledge use.

This second aspect requires a higher level model that somehow embeds learning designs as a concrete kind of (sub)activity. Then, units of learning inside business processes should be combined with other activities. A strictly additive way of extending LD in this direction may create a higher level schema from existing models of KM (Sicilia *et al.*, 2006; Sánchez-Alonso and Frosch-Wilke, 2005). The common context expressed in terms of languages as those prescribed by Aspect #1 would provide a way to integrate the workflow capabilities of LD with orchestration languages for business processes, such as, for example, BPEL.

Aspect #3. From the viewpoint of the run-time environment, there is a need for *traceability* across several learning designs.

The third aspect concerns implementation frameworks. Since learning units are connected to others in a broader process context (see Figure 6), there is a need to trace the flow from one to another, possibly including non-learning activities.

Aspect #4. Learning objects require some additional metadata that is able to describe its degree of ''validation'' as understood in KM validation processes.

The fourth aspect implies that learning objects will be assessed during their usage, and also eventually as independent knowledge assets. This has an epistemological dimension, since

> **"In a service oriented environment aiming for reusability of service components, the 'process object' or 'process module' is of vital importance."**

such validation cycles make the object somewhat more ''credible'' with respect to its intended properties. From a KM perspective this is an important issue, even though it is not directly related to the LD model.

Aspect #5. Integration with project management and work calendars is required as an added feature for workplace learning.

LD units of learning are de-contextualized as generic arrangements of activities, but the environment of organizations requires constraining the run-time semantics of the flow of activities with common time and project management systems. This influences the decisions on selecting the persons fulfilling the roles for a given learning activity (that of course comes from some organizational goal), as pointed out by Lytras and Sicilia (2005).

4. Conclusions and outlook

Learning objects and learning activities can be connected to learning processes inside organizations by considering measurability and links to organizational goals. Competencies provide a possible language for the expression of goals, prerequisites and outcomes that link the network of learning activities.

A tentative mapping of the GOAP model to LD constructs has been sketched, and some tentative aspects that suggest the need for an extended specification embedding LD have been discussed.

Further work should address the specificities of such integration by reusing existing ontological models of KM (Holsapple and Joshi, 2004).

Notes

1. In fact, in order to construct a modular framework of interoperable services, we need to construct an ontology of process modules.
2. See www.astrakan.se
3. As well as other types of resources, such as human resources and physical resources (materials, tools, laboratories, etc.).
4. There may be incomplete breakdowns into partial goals.
5. Explicit mentions of IMS LD elements are provided in typewriter font.

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