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Supporting Competency Development in Informal Workplace Learning

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Abstract. This paper seeks to suggest ways to support informal, self-directed, work-integrated learning within organizations. We focus on a special type of learning in organizations, namely on competency development, that is a purposeful development of employee capabilities to perform well in a large array of situations. As competency development is inherently a self-directed development activity, we seek to support these activities primarily in an informal learning context. AD-HOC environments which allow employees context specific access to documents in a knowledge repository have been suggested to support learning in the workplace. In this paper, we suggest to use the competence performance framework as a means to enhance the capabilities of AD HOC environments to support competency development. The framework formalizes the tasks employees are working in and the competencies needed to perform the tasks. Relating tasks and competencies results in a competence performance structure, which structures both tasks and competencies in terms of learning prerequisites. We conclude with two scenarios that make use of methods established in informal learning research. The scenarios show how competence performance structures enhance feedback mechanisms in a coaching process between supervisor and employee and provide assistance for self directed learning from a knowledge repository.

1 The Importance of Work-Integrated Learning

In order to operate economically in business education the ratio between outcome and investment needs to be maximized. Investment in business education consists of financial contributions for courseware, learning management systems, training hours, and costs for employees being away from their workplaces. Outcome in business education should be learning results that can directly be transferred to employees' workplaces and which have a high reinforcing impact on job performance. However, studies reveal that only a small amount of knowledge that is actually applied to job activities comes from formal training:

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1. Formal training is the source of only 10 – 20% of what we learn at work, although it accounts for about 80% of spending in business education [1].
2. Only 20% to 30% of what is being learned in formal training is actually transferred to the workplace in a way that enhances performance [2].
3. 80 – 90% of what employees know of their job, they know from informal learning [3].

At the same time companies invest large amounts of money in formal training initiatives. Haskell in [4] informs us that in 1998 $70 billion were spent on formal training. He argues that half of this has been misspent due to the fact that what people are taught in formal training is not sufficiently transferred to and applied to the job.

In spite of these findings, in current business practice and eLearning research projects most spending is applied to enhancing knowledge transfer of formal training interventions. These initiatives try to answer the question: "How much does the learner *know* after engaging in the formal training?" Instead, as suggested by the above numbers, the question which should be asked is: "To which extend can the learner *apply* the newly acquired competencies to improve her work performance?" This is why in our work we focus on *learning transfer***.** This is the effective and continuing application of knowledge and competencies to new (and often unexpected) contexts.

Let's now take a look at organizations in which both the content being created within the usual work processes and the changing requirements of the tasks employees are working in create a dynamic environment. Such organizations have been referred to as knowledge intensive; examples are R&D companies, consultancies, etc. In knowledge intensive organizations weakly structured work processes are predominant, leaving enough space for flexibility and creativity. In such environments, it is neither possible nor feasible to predetermine all possible "learning paths" employees may be pursuing. In order to ensure a high degree of learning transfer in such knowledge intensive organizations the focus of business education has to be shifted. The trend goes away from enforcing predetermined, general learning paths (as attempted by formal training) towards supporting individual, work task related learning paths (the goal of informal learning). We refer to this type of informal, work-integrated learning as *AD-HOC learning* [5], since it happens ad hoc during work.

In addition, the separation of working, learning, and teaching becomes blurred in knowledge intensive organizations. Increasingly interdisciplinary teams work together to perform a task. They all have to learn from each other (and thus also teach each other) to be able to solve the given problems. Most of the time, mutual learning and teaching happen unconsciously during work. Often "simple" work documents (such as reports, project plans, etc.) serve as learning/teaching content. This content already exists in knowledge intensive organizations (e.g. in the organizational memory) and is generated continuously during work. But unfortunately it is mostly not linked to the work processes where it is needed by other people to learn and within the content generation activities didactical aspects are not taken into account. In order to support informal learning related to individual work tasks a large amount, and especially a large variety of learning content is needed. Obviously this content can not be created solely for learning purposes. Instead, an environment supporting learning and

working can tap into an organizational memory and *reuse available content* for learning. Metadata associated with the content plays a central role in this pursuit.

Based on the argumentation given above we argue that what is needed is an environment which supports AD-HOC learning: the acquisition of new competencies in the context of the current work task, thus enabling the user to perform the task better, faster, or more reliably. Such an environment will support working as well as learning and will take into account the following aspects:

1. Provide available content for learning purposes: The environment should support a "learner" or a "teacher" in finding any existing content from an organizational memory which could be used for learning or teaching purposes.
2. Support learning interactions: The environment should provide support for interactions that take place for learning purposes. Examples are: a coaching interaction between employee and supervisor, a lessons learned meeting at the end of a project, or an interaction between an expert and novices in a certain topic.

In Chapter 2 we introduce the *AD-HOC concepts* which are the basis for creating environments to support specific work tasks according to the requirements given above. Chapter 3 serves to make the relation between effective competency development and workplace learning explicit. Chapter 4 illustrates the notion of *competencies as a conceptual layer*. This conceptual layer formalizes the tasks employees perform and the competencies needed to do so. Relating tasks and competencies results in a competence performance structure, which structures both tasks and competencies in terms of learning prerequisites. Chapter 5 then illustrates – using two scenarios – how competency performance structures can be applied within AD-HOC environments to support the competency development of the users.

2 AD-HOC Concepts and Environments

In order to create environments which support AD-HOC learning we have developed the AD-HOC methodology [6]. In this paper we will shortly introduce the main AD-HOC concepts and then (as one example) present an AD-HOC environment for project management.

2.1 AD-HOC Unifying Structure: Enabling Content Reuse for Learning

A typical workplace of a knowledge worker and its structure consisting of three separate spaces: a work space, a knowledge space, and a learning space.

Work space represents the user's desktop PC and shared document storage devices such as a common file structure or document management systems. It contains the work documents which are needed by an employee on a day-to-day basis, such as project related documents. In many knowledge intensive organizations this space is structured according to projects and their work packages.

Learning space stands for conscious learning situations, e.g. attending seminars and taking eLearning courses. The learning space is either completely outside any technical system or combined with an eLearning platform. Sometimes information about current seminars is available through the Intranet. The structures of learning

spaces mirror the structures of the learning topics as it is seen by course providers. It follows the didactical abstraction of the topic and provides generally no information about the relationship of work tasks to courses. In addition, the available course material is fairly general and has to be adapted to employees' work contexts.

Knowledge space represents unconscious learning, application of past experiences (own and from others) to new situations, spontaneous search for information and use of examples in order to understand how to apply newly found information. The knowledge space of an organization is often distributed over different systems such as the Intranet, a common file server, etc. Here the structure again is different: Organizational knowledge often does not have one clear structure, but mirrors the internal cognitive map of each person providing the knowledge. Often a mix of the organizations' processes, topics and department structures are found here.

Based on the description of these three spaces, two main problems can be identified when linking the spaces together and integrating teaching and learning support and everyday work:

- *Cognitive disconnection* between the three spaces: Each of the spaces has an inherent structure which mirrors to some extent the mental model of the people who are using it.
- *Structural separation* of the three spaces: Each of the spaces is implemented on different technical systems. And here the contents' structure is predetermined by the system's design.

The cognitive disconnection between the three spaces cannot be overcome as long as users are confronted with the structural separation all the time during their daily work. Thus, it is the structural separation that has to be changed first. In working towards that goal attention has to be paid not only to the properties of the content in

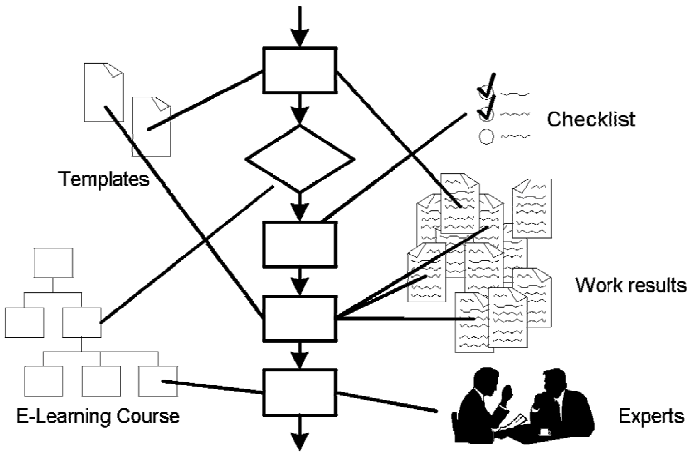

Fig. 1. Using the work process as unifying structuring element to link elements of the three spaces together

question, but also to the mental models of the users. This will ensure that the three spaces will not be connected in some arbitrary way, but in a way that is actually useful and intuitive for the target group.

In order to bridge the cognitive disconnection the AD-HOC method identifies one unifying structuring element for each AD-HOC environment. This unifying element is then used to reference the content from the different spaces. In Figure 1 the work process is used as unifying structural element. This has the advantage that (learning) content can be linked to the work task in which it was created an in which it will likely be used again. Choosing the work processes as unifying structure does not imply automatically that the processes will be used as navigational element. The structural element can be used for navigation (as is described in the case study) however it can also be maintained in the background simply providing implicit structure and using another navigation metaphor (interested readers can refer to the AD-HOC RESCUE environment [7].

2.2 AD-HOC Spectrum: Supporting Self-directed Learning

As motivated above the competence development process largely relies on the learners' own initiative. Within this work we refer to this process as *self-directed learning* [1], [8]. Autonomously defining learning goals and learning paths are important activities within self-directed learning. In order to perform these activities learners need to have a certain level of expertise of the knowledge domain learned. According to [9] there are five different levels of expertise:

- Novice: Learns from facts and context-free rules
- Beginner: Application of facts and context-free rules to other contexts, making first experiences
- Competent: Application of facts, context-free rules and own experiences to other contexts
- Versatile: Holistic perception of 'gestalt' and similarities
- Expert: Holistic perception of 'gestalt' and similarities, intuition

Novices and Beginners need to be supported and led during learning. Only up from the level Competency, learners are able to direct their own learning. Additionally, levels of expertise are dynamic in that one person can have differing levels of expertise in differing knowledge domains. In one domain, she might be an expert, thus behaving as a master (informally) teaching others, in another domain she may be a novice, thus incorporating the role of an apprentice. With informal self-directed learning, learners are able to change between levels of expertise and participate in groups of experts and other learners in order to gain the greatest advantage for themselves and for the community [10].

This illustrates that the needs of a learner are influenced to a large extend by the level of expertise she has reached within one domain. Also, as shown in the section above, the current work context sets certain prerequisites of which learning resources are perceived useful in a situation. In addition, the current personal situation influences immensely which learning content is needed: a person under time pressure is much less likely to read a long report or take an eLearning course than a person who has more time or a more in-depth interest in the subject.

Thus, an environment which aims to support AD-HOC learning must offer a variety of learning content to the user. The more this content is already tailored to the user's situation, the better. We believe however, that it is always useful to get an overview of the different learning resources available within the organization. That is, Novices and Beginners – who still need guidance in their learning activities – will be made aware of formal training offerings (such as seminars and eLearning courses). But at the same time other learning resources will be made available via self-directed learning. The individual learner thus has the choice of which offering fits best his personal preferences and work related needs. We refer to this variety of possible learning resources as the AD-HOC Spectrum (see Figure 2). It bridges the gap between continuously searching the company's intranet and formal courses.

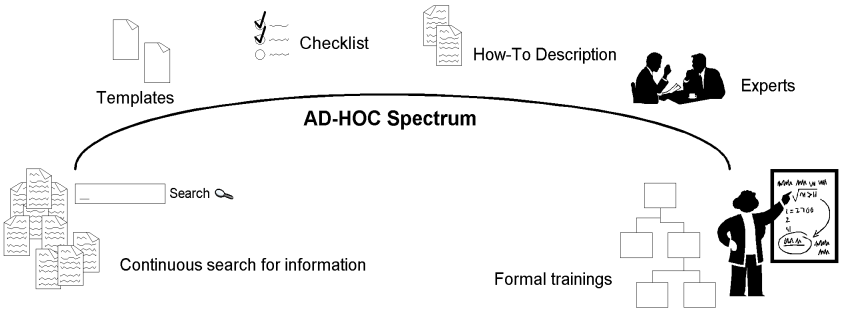

Fig. 2. The AD-HOC Spectrum

Many short task-oriented unconscious learning experiences and few long general conscious learning episodes represent the two extremes of the AD-HOC Spectrum. Between those extremes, AD-HOC offers the learners (workers) a variety of different resources relevant for their specific work tasks. These resources range from example documents and templates, checklists, how-to descriptions, guidelines, contacts to dedicated experts, etc.

3 Competency Development and Workplace Learning

It is generally agreed that learning at the workplace can take different forms. As we have discussed in the previous section, one can differentiate between short-term performance support that would involve learning simple procedures or problem solving strategies, and long-term people development (e.g. [11], [12]). In this paper we look at the latter kind of these learning activities, namely at how employees develop competencies that enable them to perform competently in a broad range of situations.

Up to this point, the use of information technology at the workplace has been primarily concerned with providing performance support, and many knowledge management applications give account of this focus. Learning, however, does also involve permanent changes in the underlying cognitive structures[12]. If we intent to consider a more holistic idea of learning at the workplace, it would therefore be

essential to look at human competencies, how they are developed in the workplace and how they are used to produce performance.

We define competencies as personal characteristics (knowledge, skills, abilities) of employees which are relatively stable across different situations (see also [13]). Competencies can be described in terms of distinguishable elements of underlying capacities or potentials which allow job incumbents to act competently in certain situations [14]. Employees dynamically combine these elements according to the requirements of the situation in a self-organising process [15].

Traditionally, competency-based training was targeted at specific behaviors that constitute superior performance. Recently it has been argued that instead of a set of behaviors, competencies should be understood as a set of attributes that allow for superior performance, and that development should be targeted at the underlying competencies rather than at the behavioral level [11]. In accordance with this view, competency development aims to extend the capacity of a person to act competently in a number of situations by helping this person acquire additional competencies applicable for performance in several tasks.

Our view of competency development is such that people acquire new competencies predominantly in interaction with real job situations and tasks (see [14]). New competencies are being developed when a person enters a new situation or task in which action is not predetermined. Reflecting on the outcomes or receiving feedback from a more experienced person helps in this development. This view is in accordance with a large body of research showing the importance of informal learning as opposed to formal training when it comes to learning at the workplace [16].

Baitsch [12] and Conlon [17] have discussed a whole variety of methods that can be used for informal learning, including mentoring, coaching, networking, modeling, effective leadership and interactions in a team environment. Employees consider alternative ways to think and behave, and reflect on processes to assess learning experience outcomes.

How such development can be integrated into workplace learning scenarios is the central concern. In recent times, methods derived from competency-based human resource management (also termed “competency or skills management”) have been suggested to improve both knowledge management (KM) and eLearning. Within these methods, competencies of individual employees are being described and rated in order to improve accessibility of these assets or to develop them further.

In KM, competencies have been used to create yellow pages or expert searches (see [18], [19]) in order to leverage “tacit knowledge”. Others have suggested that competencies be defined as a means to derive goals for strategic knowledge development [20]. In eLearning, comparing profiles of required competencies for different jobs to profiles of available competencies of individual employees has been utilized in an attempt to assign eLearning courses to employees who need them [21]. Some authors see competencies as a way to closer relate KM and eLearning activities in companies (e.g. [22]).

In this paper we argue that KM and eLearning initiatives aimed at developing competencies of the workforce by employing competency management methods may be improved in two ways: (1) By providing a closer connection between competencies on the one hand and tasks or performance outcomes on the other, and

(2) by seeing competency development as an individually controlled learning process rather than a centrally managed development initiative.

Issue (1) will be addressed by a framework which establishes a competency-performance connection (see section 4). We present results of a case study in a research institute of 30 members, in the following referred to as *Research Ltd.*, where the framework was applied. Issue (2) will be addressed by two scenarios that show how our framework can be applied within an informal workplace learning approach (see section 5). The scenarios emphasize self directed learning from a knowledge repository (rather than the utilization of static courseware) and feedback mechanisms in a coaching process (rather than off the job training).

4 A Competence Performance Approach

Any model for describing competencies should therefore aim to offer a tight integration between competencies and task performance. Using Korossy's competence-performance conception (see [23]), we have developed a framework that achieves this integration. By relating competency descriptions to descriptions of task in which the competencies are being used (*task competency matrix*), we derive a structure on the set of competencies and on the set of tasks (*competence performance structure*).

Table 1 gives an extract from a *task competency matrix* for *Research Ltd*. In this case, the competencies (A-G in the rows) denote typical competencies that deal with different issues of communication. The tasks (the numbers in the columns) denote several documents actually produced by employees working in projects, for example a project requirements document or a management summary. Each document represents a specific task in the project management process that encompasses all actions necessary for producing it.

The document competency matrix was derived by asking project managers, which competencies (knowledge and skills) they had used when producing the documents. Competencies were both general (e.g. communicating in a team setting or with partner companies) and domain specific (e.g. knowledge of streaming technologies). While the first are used for coaching purposes, the latter ones may be used in the context of self-directed learning from a knowledge repository (see next section).

Table 1. Extract from a task-competency matrix for *Research Ltd*

		Project Documents									
Competencies		10	11	12	13	14	17	24	26	33	41
A	Communication about client requirements		x	x	x		x	x	x		x
B	Discussing ideas on an informal level		x				x	x	x		x
C	Understanding goals of others	x	x				x				x
D	Discussing a common practice in a team		x	x	x	x	x		x		x
E	Employing effective interview techniques						x				
F	Presenting and selling own ideas		x				x	x		x	x
G	Defining goals and persuading others		x	x		x	x			x	x

Figure 3 shows the *competence performance structure* that can be derived from the matrix. The boxes in the figure represent *competence states*, which are characterized

by a specific combination of competencies (A-G). States are connected by lines denoting a subset relation. Below the competencies, numbers of documents are given that can be created in the state (documents are only listed in the minimal state). For example, in the state {A, D, G} the documents 12, 13 and 14 can be created. The method for deriving a competence performance structures is described in [13].

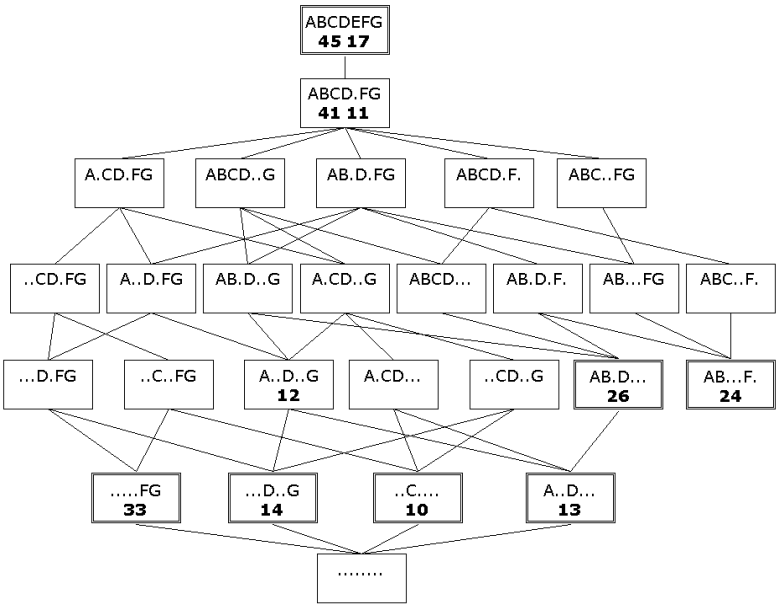

Fig. 3. Structure for competencies A-G and documents corresponding to the states (see [13])

Competence performance structures are based on dependencies that exist both within the set of documents and the set of competencies. Within the competence performance framework, these dependencies can be interpreted as learning prerequisites which can be used for diagnosing learning needs. For example, Figure 3 suggests that there exists a dependency between documents 12 and 13 in that document 12 requires the same competencies as document 13 (A and D) plus one additional one (G). The diagnosis of learning needs happens through an assessment of the performance outcomes (documents in this case). So from good and poor performance in any of these performances, missing competencies can be derived. As competencies are directly connected to performance outcomes, this diagnosis may happen within the usual work processes.

5 Supporting Informal Workplace Learning

Competence performance structures as described in the previous chapter can be the basis for a more effective support of technology enhanced learning interventions at the workplace. They provide the basis for dynamically modeling learning goals and

prerequisites, and in conjunction with an AD HOC environment can be used for supporting workplace learning. As competency development is inherently an individual learning activity, we focus on two scenarios that illustrate their use in informal workplace learning.

5.1 Scenario A: Enhancing Supervisor-Employee Learning Interaction

At *Research Ltd.,* project managers are required to write a management summary at the end of each project (as part of a defined project-close-out process). In this management summary the goals of the project, the approach taken, the results achieved and the value generated are stated within a few pages. However, many project managers have difficulties taking a step back from the specific project problems and technical details to give a clear, abstract description of what was achieved. Since the management summary is published on the website of *Research Ltd.* and serves as a communication device to the management, its quality is of high importance. Thus, steps have to be taken to ensure the quality of the documents and to improve the capability of the project managers.

Imagine now that one project manager recently has completed a project. Using the AD-HOC environment which guides him through the project-close-out process he finishes writing his management summary. Within the environment, a workflow is initiated in which the supervisor reviews the document and provides feedback about its suitability (differentiated task rating). The management summary is part of a *competence performance structure,* and so are other documents the project manager has previously created and which have been reviewed. Based on this information the environment determines the likely competence state the employee is in and identifies competencies the employee is likely lacking.

In this case the environment finds out that the project manager in the past had low ratings in the competencies “problem abstraction” and “structured writing” which are essential for writing a management summary. The environment displays these findings to the supervisor thereby supporting the supervisor in his role as a learning coach by helping him assess strengths and weaknesses of the project manager. In this case, the project manager has made considerable improvements in “problem abstraction” but still has some deficiencies in “structured writing”. Since the development of this competency is best done by providing feedback and discussing the paper together the supervisor meets with the project manager and coaches him.

This scenario illustrates the connection between the competencies “problem abstraction” and “structured writing” and the task of management summary writing. With a competence performance structure that models the relation of competencies and tasks, it becomes possible to integrate learning in the working process. From the quality of the management summary, the system suggests that the project manager should focus on the development of these specific competencies. Since these competencies are also crucial for other tasks (e.g. writing of user requirement definition) improving them will help to improve overall performance. The scenario also underlines the trend to perform competency development within the business unit as opposed to relying on centrally controlled human resource activities.

5.2 Scenario B: Using a Document Repository for Self-organized Learning

Searching the company's document repository for documents that have been produced in previous projects and finding pointers to the people that have produced them is a different form of informal learning that takes place at knowledge intensive workplaces. The problem is that the document repository is usually not structured according to learning requirements. Again, we suggest that competence performance structures may offer such structuring that is based on learning prerequisites among the documents that have been created.

Fig. 4 shows part of the structure that was created from the data provided by the employees. The part that is shown in the figure focuses on a subset of knowledge used in e-Learning projects (domain specific competencies). The structure was visualized using Formal Concept Analysis [24], which creates concepts (the nodes in the graph) that consist of subsets of objects (documents) and subsets of attributes (competencies). Two documents (5 and 7) can be seen in the structure. The other descriptions denote competencies. All competencies used for producing a specific document can be found by following all paths upwards in the graph.

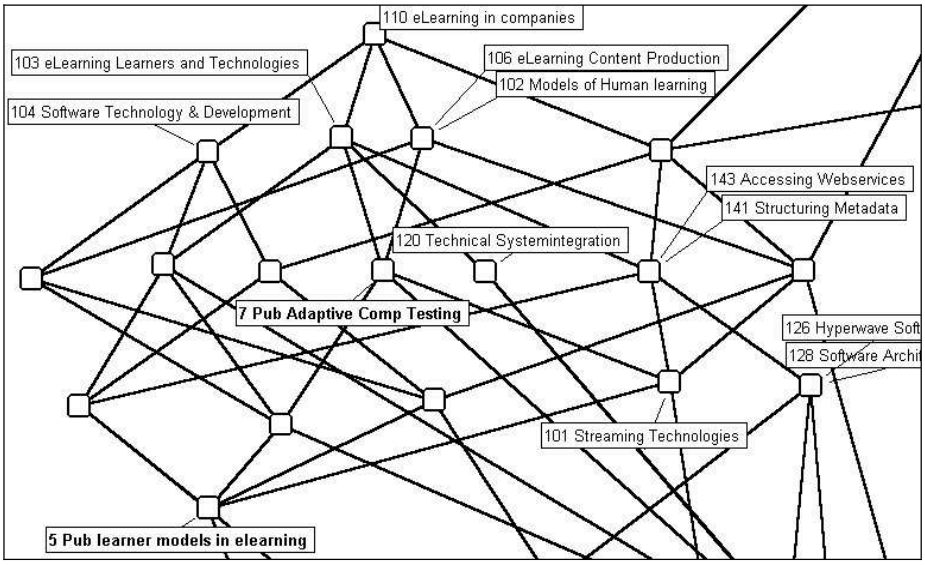

Fig. 4. Formal Context of the documents (5 and 7) and domain specific competencies (101-143) needed for producing them

From the graph, relationships between competencies are readily apparent. For example, we find technological knowledge ("Accessing Webservices", "Structuring Metadata" and "Streaming Technologies") closely related as these were evidently applied in similar contexts. Also, the two documents are related, as document 7

(a publication on adaptive competence testing) used a subset of competencies that was used for document 5 (a publication on learner models). When supporting a self-directed search in the document repository, these relationships can be exploited: For the author of document 7 who is searching for information on technologies used in e-Learning, document 5 might be a valuable learning resource.

This scenario shows that knowing which competencies are available improves self-organized learning by offering documents and information applicable to the user in question. In this case, the environment can take on the role of the "coach" in the sense that for the initial building of the competency "technologies in eLearning" available documents are provided. Initially, no human coach is needed but can later be accessed through the environment as well.

6 Conclusion

We have shown how competence performance structures that establish a connection between tasks and competencies can support informal workplace learning. Two scenarios illustrate possible areas of application. Both utilize a structure of competencies that models the learning prerequisites within the set of competencies and the relationships to the tasks in which they are applied. This provides support in competency assessment and coaching and enhances access to resources in a document repository for learning purposes.

The view of competency development advocated in this work is in sharp contrast to simply teaching certain behaviors or providing employees with rules that describe performance in a specific task (for example a "how-to description" for writing a management summary). Instead, competencies also encompass attitudes and the way employees conceive of the work [25] (e.g. writing from the viewpoint of a potential customer) and high-level skills (e.g. abstraction from specific cases) that is commonly acquired by experience in working on many different tasks. We do not imply that all learning in organizations should conform to this pattern. In fact, training behaviors or providing performance support should be sufficient in many cases. Whenever tasks change quickly and employees have to dynamically adapt to new situations frequently, a competency-based approach should be favorable since it emphasizes more broadly applicable skills. In our view, support for this kind of competency development has been scarcely addressed so far.

Another advantage of using competence performance structures when modeling competencies is that they offer substantial potential for automating the process of competency profiling. Because the structures integrate competencies with the tasks performed in an organization, profiling can be done within the usual work processes. Additionally, the prerequisites in the structures reduce the amount of information that has to be provided manually. If the AD-HOC environment utilizes a document management system, a workflow may be introduced in which only little information (i.e. document-competency ratings) have to be provided in order to place a certain document into the structure, and to make it accessible for technologically enhanced learning purposes.

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