Ten-Competence

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Chapter XI

Ten-Competence:

Lifelong Competence Development and Learning

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Abstract

In most solutions for supporting learning today, one single approach is leading the selection, installation, and usage of information technology (IT)-based tools. Either content-based approaches lead to the creation of a content-based infrastructure with course management systems and content repositories, or a collaboration background leads to the usage of virtual classrooms and collaborative learning environments. The TEN-Competence project aims forward for integration of the different tools, perspectives, and learning environments in a common open source infrastructure based on today's standards on the level of knowledge resources, learning activities, competence development programs, and learning networks. TEN-Competence will integrate tools in a service-oriented architecture (SOA) and evaluate the approach in a variety of pilot applications for lifelong competence development.

Introduction

In the last seven years, a variety of tools and learning environments have been created and installed in schools, universities, and cooperates supporting learning. Mostly those tools have been created around learning content and collaborative learning activities like virtual classrooms. In the last two years, the terms competence, competency, skills, and knowledge have seen a renaissance, and the e-learning communities are becoming aware of the importance of competences and competence models as the driver for life-long learning. Competences enable users to work in their job; they enable students to learn and achieve the curriculum goals.

Competences can be defined in a manifold of ways. There have been functional, cognitive, behaviorist, and many other approaches (for a nice overview and integration, see Cheetham & Chivers, 2005). The TEN-Competence consortium interprets competence as all the factors for an actor to perform in an ecological niche. Performance includes the specific context that is necessary for the interpretation of competence. Off-course competences include competencies and knowledge that are necessary to put the competence into performance. An example could be running a small bakery shop with all the necessary skills and knowledge ranging from the recipes and skills for baking bread to the selling and booking in the shop. Besides the specific knowledge, competencies, and skills, the context in the ecological niche has an important impact, and to enable people to act in an ecological niche effectively, meta competences are necessary. To develop competences over time, including the changes of the ecological niche, meta cognitive processes and reflection also play an important role (Schön, 1983).

Competency models in the upper sense as models of interrelated competencies already play an important role in today's educational systems. In school curricula, competences build the basic structure to connect the different school levels and class curricula as well as their content. In organizations, competence-based assessments build the basis for controlling and steering services in the human resources (HR) departments, like staffing, career planning, and personalized training. Often the personalized selection of contents is mentioned these days as one main application for competence-based education. Nevertheless, daily practice in organizations often shows a focus on learning tools on different levels that are rarely integrated and perceived from a life-long competence development perspective. Often learning is driven by contents, so the main tools in organizations focus on the management, creation, sharing, and use of content. Discussions are focused on reusability of "learning objects," and cheap and rapid production of contents for targeted training rarely learning contents from those systems are reused and integrated on the level of learning activities. The developments regarding learning activities and units of learning have gained much visibility through the IMS Learning Design Specification (Koper & Tattersall, 2005) developed at OUNL and have opened a path for a standardized way of describing and sharing learning processes and a new focus on pedagogical and social issues in learning. Furthermore, the social aspects of learning like communities of practice, social exchange of learning resources, or informal learning aspects have gained more and more importance in the last years. Learning in this sense is no longer perceived as a mere business process that can be administered and handled in ERP systems but as an individual process that needs resources, process structures, competence development programs, an enabling social environment, and active people to take place.

Ten-Competence is a European Integrated Project set up with the target to integrate different levels and approaches of learning content tools, learning activity tools, competence development programs, and learning networks in a common open source infrastructure to enable and foster lifelong competence development and learning. The main objectives are:

1.   To research and develop innovative methods and technologies for the creation, storage, use, and exchange of **knowledge resources** related to lifelong competence development.

2.   To research and develop innovative, standards-based methods and tools for the creation, storage, use, and exchange of formal and informal **learning activities and units of learning**. This includes tools for the assessment of the learning process and learning outcomes.

3.   To research and develop innovative methods and technologies for the creation, storage, use, and exchange of formal and informal **competence development** programs (including the assessment of previously required competence levels, navigation support, and the sharing of successful formal and informal learning tracks).

4.   To research and develop models, methods and technologies for the creation, storage, use, and exchange of **networks of competence development programs** from different sources around Europe to support lifelong competence development.

This chapter will give an introduction to the problems and shortcomings of today's support for lifelong competence development and highlight two main issues. After that, two main approaches for solving those problems will be introduced. First, the approach for the integration of different levels of granularity will be described and important links between content, competences, learning activities, and communities will be highlighted. Second, the aspects of "social software" in TEN-Competence and its foundation in social exchange theory (Thibaut, 1959) and self-organization theory (Varela, Thompson, & Rosch, 1991) will be described, and first approaches are sketched.

Background: Today's Challenges and Research Issues

The central need addressed by TEN-Competence is to provide ubiquitous and lifelong adapted access to facilities that support the creation, storage, use, and exchange of formal and informal knowledge and learning resources. To this end:

TEN-Competence supports individuals, groups and organizations in Europe in lifelong competence development by establishing the most appropriate technical and organizational infrastructure, using open-source, standards-based, sustainable and innovative technology.

Seven major problems underlay the present lack of such an infrastructure. The solutions to these problems form the core requirement for the development of the TEN-Competence infrastructure.

1. *The pedagogical models that are applied in training, schools, and universities do not meet the demands and possibilities of lifelong competence development and the new learning technologies that are available.*

    The provision of such new, promising, innovative pedagogical approaches for lifelong competence development will be supported by the TEN-Competence infrastructure. The new models will integrate individual learning, collaborative learning, organizational learning, and knowledge management. They will not simply mimic the face-to-face approaches (e.g., virtual classrooms) and will be usable for informal, self-directed learning in companies or at home. Furthermore, the approaches will take into account that it is not only humans who can store and apply knowledge but that technological artifacts (e.g., intelligent agents, ambient technologies) can also support humans in their tasks.

2. *For individuals, groups, and organizations in Europe, it is still hard to get an overview of all the possible formal and informal knowledge resources, units of learning, programs, and learning networks that are available and to identify the most appropriate for their needs.*

    To this end, TEN-Competence will provide tools to support individuals, groups, and organizations in Europe to find the best solution for their formal or informal learning problem. The tools will connect existing repositories with learning and knowledge resources, and address present technological, organizational, practical, language, IPR, and business model problems. Furthermore, the tools will provide sufficient support for users in finding the best solution to their learning needs, given their prior knowledge, preferences, and situational circumstances.

3. *The pro-active sharing of knowledge and learning resources is a major problem. For a variety of reasons, people are not able to (or do not want to) share their knowledge and other resources.*

    To this end, TEN-Competence will provide policies and software agents that support the pro-active sharing of knowledge and learning resources. The application of the principles of social exchange theory to the sharing of knowledge objects & learning objects will result in policies and tools in conjunction with the development of new business models that suit the needs of the different service providers within the field.

4. *For an organization in Europe, it is still hard to assess the competencies of applicants, employees, and learners who have studied and worked in a variety of settings.*

    To this end, TEN-Competence will provide models and software tools to assess the competencies of individuals, groups, and organizations in an exchangeable way. An interoperable mechanism to express and exchange learners' competencies will be developed, especially for informally acquired knowledge and competencies. Core aspects of such a mechanism are methods and technologies for interoperable person

and group portfolios and personal development plans, as well as interoperable competence definitions.

5.   *The availability of support is crucial for effective task performance. Current e-learning and knowledge management environments provide too little effective support to the users in their various tasks.*

To this end, TEN-Competence will provide software for the effective and efficient support of users who create, store, use, and exchange knowledge resources, learning activities, units of learning, competence development programs, and networks for lifelong competence development. The software will support both a) learners and knowledge users involved in learning or applying a new skill or complex knowledge, and b) experts, trainers, and teachers who provide learning support services in order to increase their bandwidth.

6.   *Centralized models for the management of a network do not work in Europe because a). the market is not homogenous, being strongly competitive and culturally diverse; b) individuals and organizations who collaborate in lifelong learning infrastructure want to maintain their autonomy and control as much as possible.*

To this end, TEN-Competence will provide models and software solutions to establish a decentralized, self-organized, and empowered management model when using the TEN-Competence infrastructure. The decentralized, self-organized, and empowered management model in the network for lifelong competence development will be based on principles of self-organization and social exchange theory.

7.   *Although the three areas of knowledge management, human resource management, and e-learning share many common themes (e.g., the need for a holistic view of individuals' formally and informally developed competencies, the benefits to be gained from social approaches to competence development), there has been little unifying work that integrates models and tools for competence development during learning and working and across a lifetime.*

To this end, TEN-Competence will integrate isolated tools that are available in the fields of knowledge management, human resources management, and e-learning. The integrated tools will be flexible, support a range of pedagogies, incorporate the more innovative aspects of the Web, be open standards-compliant, and plug-and-play.

The TEN-Competence Approach

In the following section, we will describe some of the steps toward a unifying infrastructure and the integration of different levels. The main challenges are the ***integration of different levels*** of knowledge resource, learning activities, competence development, and learning networks. Raising the awareness and enabling a ***lifelong learning*** perspective and the integration of formal programmes with social software, ***informal learning and community building*** in learning networks.
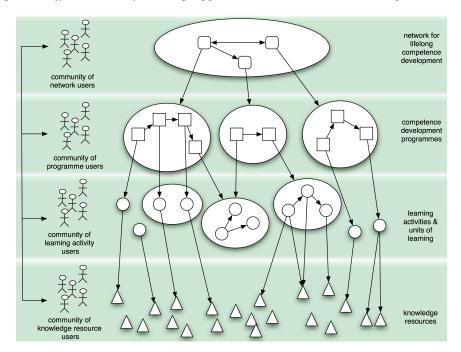
Figure 1. Different levels of learning support and their relation in TEN-competence

Integrating Different Levels of Learning Support

TEN-Competence is designed to solve the problems of lifelong competence development described by providing advanced infrastructure that integrates the different models and tools in the field of knowledge resource sharing, learning activities, competence development programs and lifelong learning networks. It selected the concept of "competence development" as its core, because it unifies all the approaches. In human resource management, knowledge management, training, and regular education the concept is used increasingly. An overview of the different levels of tools and communities can be seen in Figure 1. The relations between the different layers are explained in the following section.

Knowledge resources are basically the containers that store the explicit knowledge for sharing purposes. Examples are learning objects, articles, books, software programs, informal messages, etc. On the level of knowledge resources, the project will integrate with other initiatives in the knowledge resource sharing and management area to circumvent cold-start problems, using open standards (Advanced Distributed Learning, 2004; IMS Global Learning Consortium, 2004a) and protocols for federated search and access (GLOBE, 2005; Prolearn, 2005). The project develops models and methods to stimulate and organise pro-active creation, storage, search, retrieval, packaging, and quality rating of knowledge resources. Beside current ongoing efforts to manage and share knowledge resources (Littlejohn, 2005),

the project especially also looks at the social aspects in the sense of social exchange theory and using a set of rating and recommending mechanisms allowing users of knowledge resources to provide feedback on their quality for the competence development network. Based on this, we also perceive a set of reward mechanisms and customized community policies as essential. These mechanisms will be customizable to stimulate the following of policies for specific domains (i.e., in areas with significant knowledge resource coverage, the policies might encourage re-use whereas in areas needing investment, the policies would encourage new resource development).

Recent research in technology-enhanced learning has been dominated by *learning objects*, and the shrink-wrapping of content for delivery in different contexts is becoming mainstream e-learning practice. However, there is a growing feeling that while reusable learning objects are valuable, they do not lead to learning, education, and training as such. A counter approach builds pedagogical processes on top of the learning and knowledge objects. This new learning activities-based approach does not oppose the learning objects approach but integrates it with a higher-level layer.

Learning activities in this sense are the designed or performed activities of a person that are directed at the attainment of a (explicit or implicit) learning objective. Designed learning activities are called "units of learning" (UoLs), such as courses, workshops, lessons, and so forth. A unit of learning adds a "learning design" to the knowledge resources; they add pedagogical aids like study tasks, tutoring, mentoring, monitoring communication services, feedback, formative, and summative assessments. TEN-Competence work in this area will integrate and extend several existing initiatives around Europe to ensure that the benefits of the learning activities approach are apparent and its adoption is eased. Fundamentally, the project will ensure that the focus of technology-enhanced learning falls upon innovative approaches to competence development (e.g., learning in communities) rather than underlying technological infrastructure (Koper & Tattersall, 2005).

On the one hand, a TEN-Competence extension is necessary that links learning activities and knowledge resource sharing by integrating the creation of learning designs and the access to shared repositories. On the other hand, learning activities have defined learning objectives that can be linked and classified according to standardized ontology-based competence descriptions. The UNFOLD (UNFOLD, 2004) project has already grown an active community for using and developing IMS Learning Design which the project will build on. TEN-Competence will create a series of components that are easy-to-use, standards-based and open source, enabling users to create, store, use, support and exchange learning activities and units of learning. Furthermore, the extension of existing assessment standards like IMS-QTI (IMS Global Learning Consortium, 2004c) and competence assessment models will be integrated with learning designs to steer the individual learning process and the dynamic selection of knowledge resources based on competences profiles and individual preferences considering learning paths.

Competence development programs crucially depend on a number of services and components. First, the competence records of learners cannot be treated as clean slates. As they possess prior competencies at certain levels, this requires a *positioning service*. Second, the learner's personal competence development plan needs to be translated into program-bound learning activities, identifying those that are relevant to the plan and those that are not (*learning path service*). It is likely that several routes lead to the competence development goal as specified in the personal development plan. Therefore, third, a *navigation service*

(Janssen et al., in press; Tattersall et al., 2005) is required that provides the learner with a personalized recommendation for a route. Personalized recommendations in the research on adaptive hypermedia systems is often based on individual user models, but more and more social navigation support mechanisms become prominent and commercially successful. Fourth, while carrying out a learning activity, the learner is likely to need human help at some point. In this case a *learner support service* will find related peers and tutors. Finally, a learner who has acted upon the recommendations of the allotment and navigation services, who with the help of tutor or peer support has achieved the goals specified in his or her personal development plan, in the end will want to know at what level of competence he or she performs. A *performance assessment service* (posterior assessment) should spring into action to accomplish this and close the cycle to a new turn around to the next competence target profile.

Competence development programs are formal or informal collections of learning activities and units of learning that are used to build competence in a certain discipline or job. Depending on the competencies to be built, these programs can be small or quite extensive (e.g., a master's program). In addition to formal programs offered by institutions, it is also possible to store and share learning routes and paths that are the result of exploratory behavior and exchange them among the users. In order for competencies to be used effectively, Europe clearly needs to go beyond the current syntactic approach, providing not only a systemic but especially a "meaningful" semantic way to contextualize and match competence data and related learning material for individuals and teams alike. For networks to meaningfully use competence data, a "dual articulation" model is proposed.

A reusable competence definition captures "the part of competence information that may be reused for more than one person in one or more contexts and possibly with different metrics" into simple and existing standard formats such as IEEE RCD (IEEE, 2004), IMS RDCEO (IMS Global Learning Consortium, 2004d), or HR-XML (HR-XML Consortium, 2006). This "context neutral" information can be published in public competence registers. To describe a learner's existing competence repertoire (accredited or non-accredited), a common language needs to be used. This language should help, for any specific competence, to establish at what level a learner possesses the competence in question, whether a learner strives to acquire it, and whether a particular competence program caters to its acquisition. Research needs to be done into the questions of how semantic Web tools may be used. Last but not least, the competencies that users have to acquire for different jobs and tasks change all the time. It is essential that these competencies are monitored in the field and that a mapping mechanism is available to map older definitions of competences to the changed new ones.

Networks for lifelong competence development are defined as collections of programs. Networks can be defined within a single country or institute (e.g., all the programs offered by a university or training company) or across countries and institutes. Networks are, however, defined in one (larger) domain of knowledge like economy, digital media, management, music, and so forth. In this activity, TEN-Competence develops tools to support the interoperability of formal and informal competence development programs from different providers and from different countries.

Lifelong Competence Development:
Today's Missing Links

Competence development is a hot topic in different research communities, and different motivations have been important to discuss the topic. In e-learning, often an individual perspective is taken on competencies, skills, and knowledge of the individual. In the area of knowledge management organizational backgrounds, return on investment (ROI) analysis and controlling issues were the main motivation to discuss about organizational competence development and strategic competence management. Specific requirements that come from the field of lifelong learning are often not sufficiently reflected in today's approaches:

- In lifelong learning, the learner is put centre-stage, meaning that the learner is self-directed and can perform different formal and informal learning activities in different contexts at the same time. For instance, on the same day, a person can have a job-related training course at work, learn a new language after work from a teacher in the neighborhood, read texts and search the Internet for information, and do a master's degree in psychology at a university in the evening.

- In lifelong learning, participants in any given domain of knowledge have different levels of competence, varying from novices to top experts, from practitioners to re-searchers and developers. Taking the long-term perspective, the learners will come from a variety of different backgrounds and have different knowledge.

- To support lifelong learning adequately, it is necessary to maintain a record of an individual's growth in competency in a persistent and standard way to ensure that learners can search for new learning facilities that fit and extend their current knowl-edge. Current developments of standards in the area of e-portfolio reflect this need (IMS Global Learning Consortium, 2004b).

All three requirements put the learner and an informal and formal competence model at the centre of learning processes. In this sense, learners need competence as the enabling factor for performing tasks in everyday life (Cheetham & Chivers, 2005).

E-learning platforms have been installed in a large number of schools, universities, and companies, but there are at least *three important factors* that are driving the need for a new generation of learning technologies that are not taken into account in the first generation described above:

1. New Internet technologies can support *completely different kinds of learning* than was possible only a decade ago. Ubiquitous access to information spaces and phenomena like podcasting, blogging, or wikis are just some examples.

2. Our current knowledge-based society demands a different attitude toward learning and the provision of learning: *learning is no longer tied to the school and university context but is lifelong, more integrated into work and other life contexts, and combines different formal and informal learning activities*

3. The introduction of social-constructivist principles of learning has brought about *fundamental changes in the way learning and teaching is conceived*. Examples of these new social approaches are collaborative learning, the use of learning communities, use of authentic tasks, scaffolding principles, social tools (friend of a friend, social presence, wikis, syndicated blogs), legitimate, supported peripheral participation in real practice, and new assessment methods (competency-based assessment, peer assessment, collaborative rating techniques, 360 degrees feedback, etc.) based on the principle that assessment should be authentic and integrated into the learning process. These new approaches focus more on the process of learning (the learning activities) than on the content.

Those factors stress the need for an integration of formalized and structured learning support based on pedagogical models with the collaborative and socially driven approaches for supporting informal learning.

Developing competences is taken as a unifying concept between formal and informal learning processes in TEN-Competence. As can be seen in Figure 1, the competence layer builds the link between formalized learning processes and knowledge resources and the learning networks in which mainly informal and social processes for competence development play an important role. TEN-Competence is designed to solve the problems of lifelong competence development described above by providing an advanced infrastructure that integrates the different models and tools in the field of knowledge resource sharing, learning activities, competence development programs, and lifelong learning networks.

The main aims of the infrastructure are that it solves the problems with lifelong learning mentioned above, and that it is sustainable, widely accessible (free of charge), and user-friendly. We envisage that such an integrated infrastructure can provide a tremendous push toward further European integration and collaboration and the support for the European knowledge society. It can be used at all levels of learning: primary education, secondary education, higher education, continuing education and training, company training, job accreditation, adult education, workshops, conferences, and all kinds of informal learning. The broad scope of the platform is needed to attain the right critical mass to support lifelong learning in Europe. In the current approach, the project analyses the requirements for such a platform from different perspectives. First, the needs of users in special domains are analyzed for first pilot applications in which focused aspects of the whole infrastructure will be evaluated. Second, future scenarios and use cases are developed to identify the gaps between today's practice and the actual future need for lifelong learning. Third, existing open source tools on the different levels described above are analyzed and a common infrastructure is defined with interfaces that allow the technical integration; those will include:

1. An *extension of IMS QTI (IMS Global Learning Consortium, 2005)*, integrating new assessment methods suitable for lifelong competence development.

2. A *learning path specification* to describe the structure of programs (curricula, training programs, personal development programs, etc.) in an interoperable way.

3. A *learning services connector specification* that enables the runtime connection between communication and collaborative services (forums, chats, shared whiteboard, etc.) to learning design engines.

Building Learning Networks

As described above, TEN-Competence will deliver an integrated technical framework for enabling lifelong learning; nevertheless core questions for working communities and learning networks have often been identified in the social aspects of "how to get technology in use and how to create a stimulating environment that challenges and fosters the growth of a learning network." TEN-Competence in this sense focuses on questions of :

- How can a distributed network of actors and artifacts be created that optimizes the emergence of effective, efficient, and attractive lifelong learning in its participants and the network as a whole?
- What principles, theories, models, methods, rules and technologies govern such a network?
- What are the benefits and its restrictions?
- What is the critical size in terms of actors/agents and artifacts for emergence to become possible?
- What are reasonable relationships between learning networks?

In the following we will focus on two important backgrounds we consider essential for answering those questions, that is, social exchange theory and self-organization theory.

Social Exchange Theory

A main critical point in building software that is used and communities that become active learning networks is the engagement in the sense of active participation and contribution of the individual. The individual satisfaction and perception of effectiveness in that sense is closely related to the commitment of the individual to contribute and actively participate.

Social exchange theory provides a theoretical framework with guidelines to increase active participation and decrease lurking. This theory (Constant, Kiesler, & Sproull 1994; Thibaut, 1959), derived from economics' rational choice theory, suggests that there is a relationship between a person's effect (satisfaction with a relationship) and his commitment to that relationship, that is, his willingness to contribute and share knowledge. Social exchange theory argues that individuals evaluate alternative courses of action so that they get the best value at lowest cost from any transaction completed. Hall (2001) suggests four main reasons that could underlie the motivation and commitment of community members to share knowledge:

1. Personal need, or anticipated reciprocity: Learner has a pre-existing expectation that he will receive actionable and useful information in return.

2.   Reputation: Learner feels he can improve his visibility and influence to others in the community, for example, leading to more work or status in the future.

3.   Altruism, or the perception of efficacy of the community in sharing knowledge as a "public good," especially when contributions are seen as important, relevant, and related to outcomes.

4.   (Tangible) reward: Learners negotiate to get some kind of more tangible asset (financial reward, bond, etc.) in return.

Likewise, other authors make distinctions between individual (personal need, reputation, reward) and interpersonal factors (altruism) (Deci & Ryan, 1985), hard (e.g., access) and soft (e.g., satisfaction) rewards (Hall, 2001), quantitative and qualitative gain, or intrinsic and extrinsic factors (Hemetsberger & Christian, 2004). Many researchers warn us against introducing (more tangible) extrinsic rewards as incentives, since they might destroy the "public good" factor. When knowledge is considered a public good (McLure-Wasko & Faraj, 2000), knowledge exchange is motivated by moral obligation and community interest (altruism) rather than by narrow self-interest (personal need, reputation). A public good is a commodity that can be provided only if group members contribute something toward its provision; however, all persons may use it (Komorita & Parks, 1995). Greater self-interest reduces knowledge sharing (Constant et al., 1994), and people are less likely to use collaborative technologies to share information perceived to be owned by the organization (Jarvenpaa & Staples, 2000). Introducing tangible rewards in return for the provision of public goods promotes self-interested behavior, reduces intrinsic motivation, and destroys the public good. The danger is that individuals may appear to be contributing something, but what is not contributed is more significant. This would appear to be more significant when reward mechanisms are in operation (Von Krogh, 1998). Incentives for knowledge sharing should match the spirit of what is to be achieved (Sawyer, Eschenfelder, & Hexkman, 2000)

Besides intrinsic and extrinsic factors that motivate individual community members to share knowledge, Hemetsberger (2003) identified other key elements of exchange processes and relations in a community:

1.   **Common goals and values.** Communities gather around a common interest, a passion (Kozinets, 1999). Values are important moderators for solidarity in relationships (Anderson, Challagalla, & McFarland, 1999).

2.   **Communal relationships.** On a micro level, intimate communal ties can be distinguished (Rheingold, 2000). On a meso level, there can be a web of personal relationships in cyberspace or trusting relationships between two or more partners (Grönroos, 1999).

All these elements of social exchange play a complex and often intertwined role in communities. The right combination of those elements can constitute a powerful mechanism for a self-sustaining system for the exchange and reuse of learning objects. All of them define the willingness (motivation) of the members to exchange information and support in a community.

Self-Organization Theory

The management of a large distributed network such as that proposed here can be very complex, and consequently a decentralized management approach making use of self-organization is desirable. Another reason for introducing self-organization in lifelong competence development networks is to increase the efficiency of the support structure in the networks. Active learners produce work such as written contributions to discussions and research reports. These have to be read, reacted to, or reviewed. In a traditional setting, there is a danger that these tasks will be assigned solely to the teacher, trainer, or expert, whose workload will then increase considerably. The assumption of TEN-Competence is that the application of self-organization theory can be a foundation for the establishment of efficient systems with a minimum of planning and control, while maintaining maximum flexibility to adapt to the users' needs. This will reduce overhead costs for maintenance, planning, control, and quality. This assumption is based on research into self-organization theory (Maturana & Varela, 1992; Varela, Thompson, & Rosch, 1991), which is grounded in complexity theory (Waldrop, 1992) and studies the characteristics of the social organization of communities that "emerge" from the interactions of lower level users.

The management and application of policies in a network or community is termed "sociability" (Preece, 2000). Sociability governs social interaction in a community. It cannot be controlled directly, but can be supported by carefully communicating the purpose and policies of the community. Preece (2000) identifies several policies in a community: joining or leaving requirements; by-laws; codes of practice for communication; rules for moderation; issues of privacy and trust; practices for distinguishing professionally contributed information; rules for copyright; and democracy and free speech in the community. We identify the policies in networks in terms of: objectives and values; terms of use; membership/role policies; standards and quality policies; and reward policies.

Using this perspective, the organization of lifelong competence development networks can be realized by installing technical facilities that enable distributed interactions among participants directed at a common purpose (e.g., competence development in a disciplinary field), governed by policies that stimulate participants to learn, share knowledge and support each other.

Building Learning Networks in TEN-Competence

TEN-Competence explores different approaches to stimulate and integrate formal and informal learning processes:

- Develop and test methods and tools to set up a *competency observatory* to monitor and capture the competencies that have to be acquired in different professional and academic fields. Allowing the learner to locate him/herself and other stakeholders to contribute learning services.

- Develop and test components to provide an integral overview of all the possible formal and informal programs that are available for the users to develop their competencies. This requires a consistent *mapping of contents, competences, and learning objectives* integrated with approaches from the semantic Web and competence ontologies.

- Develop and test models and *software agents to stimulate the pro-active sharing* of programs and the underlying learning activities and resources among users. Develop and test policies and software agents to stimulate the pro-active sharing of learning and knowledge resources among users. The software agents must be compliant with the technical standards and architectural constraints. The task will identify services and policies that foster social exchange in networks for lifelong competence development. It will identify reward mechanisms, member participation, terms of use, quality standards, and procedures, including their ontological requirements. It will describe and prepare experimental test beds to test the effects of policies and social exchange services on sharing behavior amongst members and the management of the network.

- Develop and test models and tools to manage the network whilst maintaining a maximum of autonomy and control of participants. *Self-control of participants in learning networks* is essential also in the sense of active participation and the perception of self-efficiency.

Recent experimentation in learning networks has shown that incentive mechanisms like the adaptive introduction of extra (bonus) material based on contributions can increase both active and passive participation in learning networks (Hummel Burgos, Tattersall, Brouns, Kurvers, & Koper, 2005). Beside the individual activity, adaptive rewarding mechanisms could also take into account the current needs of the community (which contributions are currently needed, i.e., new items, rating of items, Cheng & Vassileva, 2005) and the style and quality of individual contributions in the past, that is, fewer high-quality contributions or more lower-quality contributions in a shorter time.

We perceive adaptivity and personalization as key issues for implementing mechanisms to foster and increase activities in lifelong learning networks. Currently, an integrated approach that allows rewarding and incentive mechanisms on different levels of sharing and exchange (knowledge resources, learning activities, competence development programs) is researched in the TEN-Competence project. The activities in this sense will identify from a perspective of self-organization theory the policies that are known, on an empirical basis, to be associated with successful communities. These include reward mechanisms, member participation, terms of use, quality standards and procedures, social exchange, management, and policy change in communities in order to identify policies and policy changes. The participants will be provided with recommendations and specifications of the appropriate policies for the implementation of competence development networks. Empirical tests of the effects of introducing these policies to a network will be carried out using field experiments and possibly simulations, and the results validated in field trials.

TEN-Competence will pilot applications in different domains also to develop sustainable and validated approaches that hold in different application areas with different policies and support for lifelong learning.

Currently four basic pilots are foreseen in the project, which will be extended with pilots from associated partners. The four pilots are: training for digital movie production, training for continuous education of health workers, Unesco-IHE–Institute for Water Education, and The Antwerp Lifelong Learning City.

Based on the integration of current learning support tools, the pilots will identify domain-specific customizations necessary and the validity of the general domain model developed in TEN-Competence.

Conclusion and Outlook

The central need addressed by TEN-Competence is to provide ubiquitous and lifelong adapted access to facilities that support the creation, storage, use, and exchange of formal and informal knowledge and learning resources. The project started in December 2005 and will run for four years, where within the first 18 month already pilots are set up and evaluation of the core elements and methods described above will be done.

The integration of the different layers of granularity is an essential need to work toward a holistic view on lifelong learning. The usage of knowledge resources and their integration in pedagogically structured learning activities has already been demonstrated in recent research projects.

The integration of competence development programs and learning activities is mostly solved proprietarily in different solutions but rarely standardized descriptions for competence models are used to build and exchange those models from a lifelong learner perspective. Furthermore, the integration of learning networks or communities of practice are mostly implemented separately from content-driven e-learning solutions and do not allow for the integration of formal and informal learning activities. By combining the described layers in TEN-Competence, we therefore foresee giving the learner a new perspective on learning and competence development by reusing and integrating existing technologies and solutions in an open source lifelong learning infrastructure.

To this end, TEN-Competence (http://www.tencompetence.org) will support individuals, groups, and organizations in Europe in lifelong competence development by establishing the most appropriate technical and organizational infrastructure, using open-source, standards-based, sustainable, and innovative technology.

Additionally, questions of combining informal, non-formal, and formal learning processes, and the different perspectives become an essential issue in today's computer based learning support. Therefore, TEN-Competence is exploring mechanisms for supporting users in positioning and navigation in learning networks on the one hand but also provides approaches to stimulate active participation of different stakeholders in learning networks.

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