European Lifelong Learning Networks

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KEYWORDS

ABSTRACT

The provision of lifelong learning is a major new direction for higher education catering for the demands of industry and society as expressed in the EU Lisbon Agenda. ICT networks can in principle support the seamless, ubiquitous access to lifelong learning facilities at home, at work, in schools and universities. However, this implies the development of new ways of organizing the delivery of learning facilities that goes beyond the current course, programme and institute-centric models. This paper analyses the requirements for the development of a learner-centred, learner-controlled approach for distributed lifelong learning in Europe. The challenges for European institutes for Higher Education to implement the requirements for lifelong learning are explored and in the conclusion some actions are discussed.

INTRODUCTION

The need for better provision for lifelong learning in society is broadly recognised and is expressed in national and international policy documents (e.g. the EU Memorandum on Lifelong Learning 2000).
The concept of lifelong learning refers to the activities people perform throughout their life to improve their knowledge, skills and competence in a particular field, given some personal, societal or employment related motives (Aspin and Chapman 2000; Field 2001; Griffin 1999).
To achieve these aims of lifelong learning, educational institutions and other organizations must offer facilities that meet the needs of learners at various levels of competence throughout their lives. People must be able to use lifelong learning facilities to upgrade their knowledge, skills and competence in a discipline as required. They can also contribute to the facilities by sharing knowledge and supporting other learners. Lifelong learners are not merely the consumers of learning content, but can also be the producers of learning content that is of use for other learners (Fischer and Ostwald 2002).
The use of ICT networks is crucial for the realization of the lifelong learning agenda, especially the establishment of so-called *Learning Networks for Lifelong Learning* (Koper et al. 2003, 2004, 2005). A Learning Network for Lifelong Learning (LN) is a network of distributed persons and organizations who create, share, support and study learning resources ('units of learning') in a specific knowledge domain. These networks support the seamless, ubiquitous access to learning facilities at work, at home and in schools and universities.
The requirements placed on learning technologies to support lifelong learning differ considerably from those placed on technologies to support particular fragments of a learning lifetime. The time scales involved in lifelong learning, together with its multi-institutional and episodic nature are not reflected in today's mainstream learning technologies and their associated architectures.
In this paper the requirements for LNs are explored and the challenges for institutes for Higher Education when meeting these requirements are discussed.

The analysis will be presented from three integrated perspectives: pedagogical, organizational and technical (Koper 2004).

PEDAGOGICAL ASPECTS

A learning network (LN) is a network of persons who create/perform, share, support and study learning activities and units of learning to develop their competence in a particular discipline. A LN contains two types of nodes: 1) the persons, that establish the *user community* of the LN and 2) the *learning activities* within the LN. The learning activities are the facilities in the network that the members can use to learn. It includes formal and informal learning resources, courses, lessons, assessments, etc.
The core questions to be answered when searching for the pedagogical requirements for LNs are: a) how can we facilitate the development of effective user communities directed at development, use and reuse of learning resources, and b) how can we facilitate the development, use and reuse of effective units of learning within the context of such user communities?

User Communities
Shaffer and Anundsen (1993) define 'community' as a dynamic whole that emerges when: a group of people share common practice; are interdependent; make decisions jointly; identify with something larger than the sum of their individual relationships; and make long-term commitments to well-being (their own, one another's and the group's). Communities tend to be self-governed, self-organized and decentralized. Common goals and values and communal relationships are important moderators in forming communities. Communities have their own identity, which can change and evolve.
A specific type of community is the 'learning community'. Wilson and Ryder (1998) characterize 'learning communities' as follows: they have distributed control; there is commitment to the generation and sharing of new knowledge; learning activities are flexible and negotiated; community members are autonomous; there is a high level of dialogue, interaction and collaboration; and there is a shared goal, problem or project creating a common focus and incentives to work together.
We prefer to use the word 'community' in a more general sense, to include learning communities, but also communities of developers, institutions and practitioners (e.g. teachers).
Within the context of lifelong learning it is necessary to have an enduring membership of communities in one or more fields of knowledge. Competence in a field evolves over a lifetime. An important requirement for lifelong learning is that the learning results are stored in a portable, standard way, for example in a *portfolio*. These learning results can be used to position a person in the network; and to provide a classification of the expertise of a person in the field.
As seen from a lifelong learning perspective, a teacher is not a separate person, but *a role* that any lifelong learner can take depending on his/her (relative) expertise. Anyone can start in a community as a novice and evolve into an expert. During his/her lifetime the person stays a member and is responsible for sharing knowledge and experience as required. The knowledge and support services in the community and the members' knowledge also evolve. In a permanent community, the community itself gets a structure and culture independent of the participants. The idea of a *lasting, evolving community* of users is a key requirement to establish LNs.
Lifelong learners must have easy, ubiquitous access to a LN, which should not be location or technology dependent. It should be *accessible from anywhere by standard means of communication*. In order to sustain it, it must support, among other things, *interoperability specifications and standards* that have been adopted, defined and agreed upon within the community.

Formal and Informal Learning Activities
Members of a LN should be able to select and/or execute the learning activities they want or need in order to attain certain expertise or competencies, given their pre-knowledge. There are different types of learning activities, but a major distinction can be made between spontaneous, informal learning activities and preplanned formal learning activities.
Informal learning activities are the learning activities that are not preplanned by others, but are executed using the resources in the LN. The performance of informal learning activities can leave new resources in the LN (the onces created by the learner) and the tracks of the learner, performing activity after activity can be shared with others.
Educational institutes offer programmes and courses that are preplanned (so-called 'units of learning', UOLs). UOLs are developed and used in LNs and serve various functions depending on the design (for example the introduction to a knowledge domain; acquisition of a skill; or assessment of acquired knowledge).
A UOL typically contains a *learning design* and *learning resources*. The learning design specifies the workflow in the teaching-learning process (Koper 2001; Koper and Manderveld 2004; Koper and Van Es 2004) and can be expressed in an interoperable way using the IMS Learning Design specification (LD 2003). The same learning design can be used with different resources and vice versa.

In order to develop effective UOLs, the learning design of the UOL should be based on an appropriate *pedagogical model*. A pedagogical model prescribes an effective teaching-learning process for a class of learners to achieve a class of learning objectives in a class of situations. Examples of pedagogical models are mastery learning, problem-based learning, active learning, or in fact any teacher's notion and intuitions about good teaching and learning practice. There is a wide range of pedagogical models practiced and described in the literature. Some are better suited to specific disciplines, target groups, settings or learning objectives. However, there are no fixed rules for deciding which model is the best in what situation (Reigeluth, 1999). At a high level of analysis, Merrill (2003) summarizes current pedagogical models as follows: '… the most effective learning products or environments are those that are problem-centred and involve the student in four distinct phases of learning: (1) activation of prior experience, (2) demonstration of skill, (3) application of skill and (4) integration of these skills into real-world activities'. He further summarizes the underlying 'first principles of instruction' by stating that learning is promoted when: learners are engaged in solving real world problems; existing knowledge is activated as the foundation for new knowledge; new knowledge is demonstrated to the learner; new knowledge is applied by the learner; and new knowledge is integrated into the learner's world.

Merrill's analysis and the instructional design approaches he studied focus on a single learner in a problem situation. In LNs this has to be extended using the notions of communities, or more general of social-constructivism (Duffy and Cunningham 1996; Retallick et al. 1999; Hooff et al. 2003). One of the notions in social-constructivism is that knowledge is not absolute, but is relative to the interpretation and beliefs within communities of practice. This social notion of knowledge implies that facts, events, data and information can only be interpreted and acted upon when the social context is represented in the learning situation (Lave and Wenger 1991).

Bransford et al. (2000) summarize this broader perspective on teaching and learning, stating that effective education should be: learner-centred, taking the preconceptions of learners into account; knowledge-centred, paying attention to the subject matter and what competence or mastery appear to be; (formative) assessment-centred, providing feedback; and community-centerd, taking care of the application context in the real world, sharing knowledge and developing values.

ORGANIZATIONAL ASPECTS

How can we organize a LN? As we have said, user communities tend to be self-organized. One reason is that the management of a large distributed network can be very complex. Different perspectives and powers have to be balanced carefully. A decentralized management approach such as self-organization is desirable. This is especially true when the network contains different individuals and organizations from different European countries.

Another reason for introducing self-organization in LNs is to increase the efficiency of the learning support structure in LNs. Active learners in a LN 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, whose workload will then increase considerably. The assumption is that the application of self-organization can be a foundation for the establishment of efficient systems with a minimum of planning and control, while maintaining maximum flexibility to adapt to learners' needs. This will reduce overhead costs for maintenance, planning, control and quality. This assumption is based on research into self-organization theory (Varela et al. 1991; Maturana and Varela 1992), which is grounded in complexity theory (Waldrop 1992; Kauffman 1995) and studies the characteristics of the social organization of communities that 'emerge' from the interactions of lower level actors. It deals with the way macro-phenomena occur as emergent behaviours from the activities of the subsystems at the micro-level (Prietula et al. 1998, p.14).

Using this perspective, the organization of lifelong learning 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.

The management and application of policies in a LN is termed 'sociability' (Preece 2000, p. 26-17). 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 (p. 95-96) 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 LN in terms of: objectives and

values; terms of use; membership/role policies; standards and quality policies; and reward policies.
An important factor in establishing self-organization is the creation of first-order and second-order feedback mechanisms. First-order means that people in the community know what their counterparts are doing or have done regarding the learning activities in the network. This provides information for navigation and behavioural models within the community. Second-order refers to feedback about the emergent properties in the system: what is the performance of the community at large, and how is it organized (Gilbert 1995)? For instance, there is no centralized quality control in the LN. It is expected that the network will uphold a range of quality levels, but that the feedback mechanisms (e.g. reviews and ratings) will ensure that on average satisfactory quality is maintained. Thus, factors such as development costs, frequency of use, incentives, price and satisfaction may be dynamically balanced.
Most effective self-organization systems in nature (e.g. ant colonies) depend on some specialization of roles that perform tasks simultaneously. However, this role-specialization is functional. Individuals can change roles when the demand for a certain activity increases (Bonabeau et al 1999).
The activities of persons in a LN are influenced by the reward system established in it (e.g. personal need, reputation, money). A theory about reward is elaborated in social exchange theory (Thibaut and Kelly 1959; Constant et al. 1994). The reward system is typically implemented in the policies of a LN.
A final note about self-organisation. Sometimes it is confused with chaos, anarchy or disorganization. However, self-organisation is also intended to lead to a *well-organised* structure. The only different is that there is no central agency that imposes the structures, but that democratically established policies are governing the interactions and constraints.

TECHNICAL ASPECTS

How can we support the actors in the network to perform their tasks as efficiently as possible? Furthermore, how can we establish an interoperable network with distributed lifelong learners, distributed support organizations and a variety of different learning activities? The first question is related to usability and software agents; the second to interoperability specifications and standards.

Usability and Software Agents
a LN's usage may be hindered if it is too complex, is unpredictable or contains errors. These factors are addressed in 'usability'. A LN is usable when it supports rapid learning, high skill retention, low error rates and high productivity. It is consistent, controllable and predictable, making it pleasant and effective to use (Preece 2000, p. 26-27). The problem with usability is that it competes with the flexibility and complexity of a system. More flexible systems have more options that tend to overload the cognitive system when not properly designed (Paas and Firssova, 2004). Measures such as adaptable interfaces, help systems and training facilities can be used to increase the usability of the LN, but also can software agents help users perform their tasks more easily and efficiently. Software agents can be used to automate tasks normally performed by people to support users in doing certain tasks more effectively or efficiently. Software agents are computational systems that inhabit a complex, dynamic environment, can sense and act autonomously in this environment, and in doing so achieve a set of goals or tasks they are designed for (Jennings 1998). There are two approaches to implementing software agents: the single (complex, intelligent) approach; and the multi-agent approach (multiple agents, low intelligence, simple). These can be considered as two different paradigms. Multi-agent systems are loosely coupled networks of entities that have the following characteristics: each agent has incomplete capabilities to solve a problem alone; there is no global system control; data is decentralized; and computation is asynchronous. According to Ferber (1999), these systems have skills in social organization, cooperation, coordination, negotiation and communication. The principles of self-organization are applied in software in these multi-agent systems.
The quality of the tasks performed by software agents is dependent on the technical advancement of these agents and the state-of-the-art in the field. Some possibilities are: agents help users search for information using semantic web principles (Berners-Lee et al. 2001); agents help answer e-mails with certain common characteristics; or agents help organize and plan the activities in a LN.

Interoperability specifications
In order to establish a network of interacting entities in a technical sense, it is necessary for the entities to use the same underlying standards to support connectivity and exchange. For example, Internet protocols enable the connectivity of millions of computers around the world to establish a network. The entities in a LN also need to be standardized, at least within the community, if they are to connect. A *learning resource* or *service* offered or created in location Y, using infrastructure X, should be usable in location Z, using infrastructure W.

Standards can be defined solely within a community or LN. However, it is good practice to use existing open standards and specifications wherever possible. Several open interoperability specifications have been developed. At the technical level they are defined for instance by the W3C (HTML, XML, OWL, WSDL, etc.). The educatianal specifications are defined by IMS (imsglobal.org), IEEE (ltsc.ieee.org) and AICC (aicc.org).
Various standards have to be agreed upon, and customized (creating application profiles) to establish LNs. Webservices have to be defined. The portable coding of the learning resources or knowledge must be specified (e.g. XHTML for non-binary resources). Metadata standards such as LOM (2003), Dublin Core (2003) or RDF (2003) can be used to describe the learning resources. The IMS Question and Test Interoperability Specification (QTI 2003) can be used for testing. In a LN specific sets of specifications and standards application profiles have to be developed, agreed upon and supported. A critical specification for LNs is IMS Learning Design (LD 2003). LD supports the interoperable specification of simple and advanced learning designs that are needed to support the full scale of pedagogical approaches that are needed to support lifelong learning. Among other things it provides a framework for including learning activities, support activities, assessment and learning or knowledge resources (e.g. the once that are modeled according in SCORM).

REQUIREMENTS SUMMARIZED

In the analysis section, several statements about LNs were formulated that can be summarized into general requirements for LNs (see Table 1).

Table 1: Sixteen Requirements to establish Learning Networks for Lifelong Learning (LNs)

	General Requirements
G1	The objective of any LN is to offer long lasting, evolving facilities for the members to improve and share their expertise and build the competencies needed in a disciplinary field.
G2	The LN should offer facilities for members to create, search, get access and study LNs, learning activities, units of learning and learning resources as a means of building expertise and competence.
G3	The LN should facilitate a high level of dialog, interaction and collaboration among the members.
	Pedagogical Requirements
P1	The LN should offer informal learning activities and UOLs for different levels of expertise to serve a heterogeneous membership.
P2	The LN should offer facilities to search for learning activities and UOLs that match the members needs. Furthermore, LNs should support flexible learning routes (positioning, logging of tracks of others and usage patterns).
P3	The LN should offer learning activities and UOLs in which learning designs are based on the pedagogical models that are selected as suitable for the discipline, the membership, the technologies used, and the learning objectives (e.g. problem-based and learner-centred, formative assessment, knowledge and community-centred).
P4	The LN should support guidance/scaffolding, or more generally: support activities.
P5	The LN should have facilities to assign its members to specialized roles according to certain role policies. Roles are not fixed. Role change policies must be available
	Organisational Requirements
O1	The LN should be governed by community policies that reflect the common goals and values of the membership. Instruments must be available to manage, change and apply the different policies (LN objectives and values, terms of use, standards and quality, reward system, membership policies).
O2	The LN should support distributed control where appropriate. The LN managers are LN members with specific assigned management tasks (according to the change policies).
O3	The LN should provide first order and second order feedback to all members to support the optimization of organization and quality according to self-organization principles.
O4	An explicit exchange reward system which is consistent with self-organization principles should be available in the LN.
	Technical Requirements
T1	The LN should provide distributed, ubiquitous access.
T2	The LN should have facilities to provide automated support (software agents) for some members' tasks to make performance more efficient.
T3	The LN should use community standards for interoperability (e.g. units of learning, learner dossiers, learning/knowledge services and resources) and provides facilities to discuss and change these.
T4	The LN should find the right balance between usability for the participants and flexibility/complexity (information/training facilities, adaptable user-interfaces, error free technology).

CHALLENGES FOR HIGHER EDUCATION

As anyone who is involved in higher education can see immediately, these requirements constitute an enormous challenge for institutes for higher education. In this small paper we will not sum up all the challenges systematically, that is part of the discussion in the meetings and should be studied carefully in the future. However some of the major challenges are the following:
In order to support lifelong learning, a first action is that European institutes should set up serious collaborations with other national and international institutes to establish learning networks for lifelong learning. These collaborations must balance competition and co-operation at the right level. Currently, most institutes are still islands that have very weak collaboration ties with other institutes. In the consortia they have to agree upon interoperability mechanisms (standards, specifications, application profiles, services, ePortfolio's, etc.). Even for rather small consortia of up to ten universities this is proven to be a hard job. Consortia have to agree upon common output standards for competences and adapt their assessment systems and educational system accordingly. This can also be done at a European level, but the danger is that the complexity is so high that it never occurs. Furthermore their management style should allow some sort of openness and self-organization in the collaboration as have been argued above. Currently most institutes have a rather centralized management structure that makes it hard to collaborate with in open, user centred networks. Another challenge is the change of the pedagogical models that are required to support lifelong learning. Specifically the acknowledgement of competencies that are required informally or elsewhere are a problem. How can we access the competences of persons in an institution independent way? How can we provide enough variation in pedagogical approaches to fit a wide variety of user needs, knowledge and situational circumstances? From the pedagogical perspective maybe the biggest challenge would be to seriously implement a learner-centred approach. This mechanism has been talked about for decades, but have never really been supported.

CONCLUSION

In this paper the requirements for the development of a learner-centred, learner-controlled approach for distributed lifelong learning in Europe are analysed and presented. Meeting these requirements constitutes an enormous challenge for the European institutes for Higher Education at the pedagogical, organizational and technological level. This will take years of planned actions and further RTD on these three levels to really support the Lisbon ambition in education. In our work at the Open University of the Netherlands, we are developing and testing approaches to tackle these different demands. For papers about architectures, technologies and experiments with LNs the reader is advised to look at the papers and software provided in: http://dspace.ou.nl and news provided at http://learningnetworks.org.

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ROB KOPER is professor and director of learning technologies research and development at the Open University of the Netherlands, where he leads a team of around 30 researchers. He has (and had) numerous roles in management and advisory boards, among others: the National Assessment Agency, the Digital University Consortium, the local government and standardisation & specification bodies like IMS and CEN/ISSS.

He publishes regularly in journals,like: *British Journal of Educational Technology (recently edited a special issue on Technology and Lifelong Learning), Educational Technology & Society, Computers in Human Behavior, Int. J. Learning Technology, Journal of Computer Assisted Learning, Int. J. of Continuing Engineering Education, Journal of Interactive Media in Education, Research in Learning Technology, Journal of Artificial Societies and Social Simulation*.

Recent co-edited books are: *Integrated eLearning*, 2004. London: RoutledgeFalmer; and *Learning Design: modelling network-based education and training*, 2005. Heidelberg: Springer. Furthermore he wrote chapters about Learning Technologies and Learning Objects in a variety of books. See http:dspace.ou.nl for an overview of current publications and specifications & tools developed.

Among other things, he was responsible for the development of Educational Modelling Language (EML), currently known as the IMS Learning Design specification (www.imsglobal.org) and he directed several large scale innovation projects. Furthermore, he leads or participates in a variety of EU-funded R&D projects, served in a variety of conference programme committees, SIGS, editorial boards, and was responsible for the organization of a large number of conferences, seminars, workshops in the field.

His current research focuses on self-organized distributed networks for lifelong learning, including:
* Instruments for creating, using and sharing digital learning objects and courses ('units of learning')
* Intelligent software agents to support teaching and learning.
* Instruments for navigation in learning networks.
* Language technology for assessing competency development
* Models and simulations of (part of) the teaching and learning process.
* Architectures, tools, standards, infrastructures for lifelong learning.