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Learning Network

connecting people, organisations, software agents and learning resources to establish the emergence of effective lifelong learning

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Abstract

This article argues that the provision of lifelong learning opportunities needs to be based on well-thought-through integrated models. These models should merge pedagogical, organisational and technological perspectives and meet requirements for the provision of lifelong learning opportunities. This article also claims that these requirements cannot be met by existing educational models and tools. The Learning Networks model is offered as an alternative, feasible model for ICT-network supported lifelong learning. A Learning Network is defined as an ensemble of actors, institutions and learning resources which are mutually connected through and supported by information and communication technologies in such a way that the network self-organises and thus gives rise to effective lifelong learning.

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Introduction

The large-scale availability of ICT-networks not only blurs the traditional boundaries between institutions for higher distance education and regular higher education by expanding the time, pace and space independent educational offer of the latter. It also holds the promise of changing educational offerings that both kinds of institutions can make in the context of lifelong learning. It is expected that, in the long run, lifelong learning supported by e-learning methods and environments will be a major offering of these institutes. It should then cater for the needs and demands of industry and society in general in co-operation with various types of organisations (i.e. governmental as well as commercial organisations). New learning and ICT technologies will support the seamless and ubiquitous access to these facilities at work, at home, and in schools and universities.

One of the major questions for the coming years is how the potential of ICT networks for lifelong learning can be identified and realised. A problem in answering this question is that the relation between the e-learning and the lifelong learning domain is quite young and immature. Technical, pedagogical and social developments are rapid and continuous. Although first implementations of e-learning instruments that intend to promote and support lifelong learning opportunities are already in place, there is in general a lack of theories and models supporting these implementations.

In this article we will first identify current problems and views in the field of ICT-supported lifelong learning. From this we derive a set of requirements for lifelong learning models. Then we introduce the Learning Networks model as a feasible construct to meet these requirements. We describe the features of this model. Finally, we discuss to which extent the model meets the identified requirements for lifelong learning.

Problems, views and requirements for lifelong learning

The idea of lifelong learning dates back to the 1920s (Smith, 1996; Jarvis, 1987; Cross-Durrant, 1987; Brookfield, 1987), although then it was named lifelong education and mainly related to adult education. Its main proponents are UK and US educational philosophers, Basil Yeaxlee (UK), Edward Lindeman (US) and John Dewey (US). They felt that education was not to be regarded as a luxury for few and as something that only spanned a short period in life, but as a permanent national necessity and inseparable aspect of citizenship (Smith, 1996/2001).

The idea has been revived several times in history, but circumstances in society (e.g. high unemployment rates in the 1930s, the oil crisis in the 1970s) and lack of power of intergovernmental organisations (Field, 2001) prevented its widespread development and implementation.

Only since the 1990s, the idea of lifelong learning has become translated in national and international policy, and acquired support from organisations with executive power. Policy generally focused on improving the efficiency of use and the transfer of information and knowledge within society, with the aim of improving the economical situation and competitiveness of nations or regions. In this scenario the individual citizen has an important role to play. All individuals should actively participate and bear responsibility for the development of society. By improving their own abilities they would indirectly support society as a whole. Low threshold, accessible learning opportunities should be provided to individuals to allow them to act as a 'motor of the knowledge society' and to develop abilities during their lifespan. Thus, learning is not restricted to formal, organised governmental educational settings over a relative short period of time, but has become any individual citizen's own lifetime responsibility. Learning opportunities should be available for everyone, no matter what age, background or disabilities. According to Aspin & Chapman (2000) 'lifelong learning' should aim for:

- economic progress and development

- personal development and fulfillment

- social inclusiveness and democratic (justice & equity) understanding and activity.

Lifelong learning has been put high on the political agenda. This has resulted in a flurry of policy documents on lifelong learning (Cheallaigh, 2000; EC, 2001; The Council for Museums, Archives and Libraries; CEDEFOP & Eurydice, 2001) and about as many definitions of the concept (Aspin & Chapman, 2000; Field, 2001; Griffin, 1999). In this paper, we consider the following ingredients to be key:

- a belief in the <u>value of learning in all phases</u> of life

- a variety of <u>internally and externally motivated needs</u>

- a variety of <u>motives and perspectives</u> (related to personal, civic, social and/or employment-related activities a person can employ)

- the <u>aim of improving</u> knowledge, skills and competence

- a wide spectrum of <u>learning 'events'/learning activities</u>

Agreeing on what we mean by lifelong learning is one thing, agreeing on its implementation quite another. In a UNESCO report on lifelong learning Faure (1972) stated: 'if we want to implement the idea of lifelong learning it will require a complete overhaul of our way of thinking about education, a new programme of action and it would act as a master concept for all educational planning, policy making and practice'.

In our view, the provision of lifelong learning opportunities forces us to take the following requirements into account (partly derived from CEDEFOP & Eurydice, 2001):

Insert table 1 about here

Although the requirements are diverse they may be summarised as <u>put the learner centre stage in the learning process</u>.

What models of learning could meet the aforementioned criteria, could indeed put the learner centre stage? Clearly, our current models cannot, as they tend to revolve around the curriculum and the course. Current models are embedded in institutions which were predicated upon entirely different assumptions. Curricula were designed from the perspective of a knowledge domain and an expert, the teacher. The student is a rather passive knowledge consumer, not an active knowledge worker. These assumptions are even built into the architecture of school buildings: classes with one central focus, the teacher in front of a class (frontal instruction). In particular, current models have difficulty to meet the requirements of low access, personalisation, and customisation and accreditation of acquired competencies. 'Regular' educational institutions have restricted access, aim their education at the average student and only credit specific diplomas.

 Edwards (2002) suggests an alternative model. His reflexivity theory presupposes a more active learner, who not only reacts to changes in the environment, but also actively participates and (re)-constructs the environment. This would be acquired through reflexivity: 'through self and social questioning an individual is able to adapt and change the (direct) contexts of his/her life'. Edwards (2002) claims that learning models that include open, dialogic inquiry in social networks would promote the use and development of reflexive practices. Since practices are constituted *organisationally*, the roles in use may form part of permeable rather than a differentiated social system, rules may reinforce opportunity rather than boundary, and participation may be valued above hierarchy of authority. This suggests that the conditions for reflexive agency are created by flexibly structured social networks, which allow actors to perform and position themselves in exchangeable roles and settings, in what Law and Hetherington (2001) refer to as 'knowing locations', that is, being at the right place in a network of materially heterogeneous elements.

In summary, in order for lifelong learning to become a viable form of education new models of education are needed that minimally meet the following requirements:

- open access, to avoid exclusion of learners on the wrong grounds

-   personalisation and customisation, to cater for everybody's specific needs

-   accreditation of acquired competences, to avoid any waste of time

-   improved effectiveness, to increase quality without increasing teacher workload (Thurmond, Wambach, 2004; Downes, 1998)

-   improved efficiency, to increase quality without increasing institutional costs for maintenance, planning, control and quality (Sloep, 2004; Sheppard, 1999; Downes, 2000).

Towards an integrated model: Learning Networks

In an attempt to meet the requirements discussed above, we have developed an integrated model on lifelong learning, called 'the Learning Network ' model. We define a Learning Network as:

An ensemble of actors, institutions and learning resources which are mutually connected through and supported by information and communication technologies in such a way that the network self-organises and thus gives rise to effective lifelong learning.

It should be noted that we use the term 'Learning Network' in a stipulative way. There are a number of other ways in which it may be used, each with a somewhat different meaning. Harasim, Hiltz, Teles & Turoff (1995) define Learning Networks as 'groups of people who use CMC [computer-mediated-communication] networks to learn together, at the time, place, or pace that best suits them and is appropriate to the task'. Networked learning is another case in point. It focuses on the experiences of students and teachers with the use of computers in learning (CSALT, 2001). Both conceptions bear similarity to the one espoused here, particularly in that each involves the use of networked computers to support learning. However, there are also significant differences. The most important one is that the model proposed here combines organisational, educational and technological perspectives whereas the others have an educational focus only. In our view, ignoring the non-educatonial aspects leads to too weak a conception of a learning

network, one which is unable to meet the requirements discussed above. In the sections to come we will attempt to justify this view.

Theoretical foundations of Learning Networks

Organisational perspective

One of the main ideas underlying the Learning Network model is 'emergence' (Johnson, 2001; Gordon, 1999; Ison, 2000; Waldrop, 1992). Emergence occurs when an interacting system of actors and resources self-organizes to form more intelligent, more adaptive, higher-level behaviour. This is reflected in the organisation that arises, which puts constraints on the social interactions of the actors and resources (Figure 1). The emergent behaviours of a system evolve over longer periods of time (Gordon, 1999).

Insert Figure 1 about here

The idea of self-organisation within Learning Networks provides a new means of organising learning. Studies in other domains show that inductively created organisations can be at least as effective and efficient as top-down designed ones (Dorigo, 1999; Bonabeau, E., Dorigo, M., Theraulaz, G., 1999). Learning may be organised or patterned in an inductive way. The autonomy of the learner is taken as the starting point, rather than as an element in a design based on particular instructional principles. Quite on purpose, a Learning Network offers learners the same opportunities to act as teachers and other staff members in regular, less learner centred educational approaches. Thus, learners can create their own learning activities, can build their own learning plans, can share their learning activities and their learning plans with peers and institutions. Through the users' learning behaviour, inductively learning 'principles' emerge and each learner will select opportunities that best meet his needs.

- Exactly what types of emergent behaviours occur in a Learning Network, by what rules they are governed, what their efficiency and economy is, and how they can be influenced, are empirical questions in need of investigation. They can only be investigated by setting up learning networks that foster emergence. For self-

organization to occur in a network (see for example Johnson, 2001), the actors have to have a high level of interactivity, feedback about the performance of similar others (so-called 'neighbours') in the network and feedback about the emergent properties of the whole system (e.g. policies and performance).

Educational perspective

An educational analysis of e-learning systems results in the following process model for ICT-based education (Koper, 2003, 2004):

Insert Figure 2 about here.

In this system three core processes and two data stores are distinguished:

1. The <u>development process</u>, which creates and adapts learning resources

2. The <u>repository</u>, which imports and exports learning resources from other systems.

3. The <u>learning process</u> in which the actual learning and teaching occurs. It uses existing learning resources by retrieving them from the repository and supports the development process by creating and storing new learning resources.

4. The <u>dossier</u> stores the properties of individual users, groups and roles. It can import/export properties from outside and thus supports current and future learning processes.

5. The <u>assessment process</u> is initiated by the learning subsystem before learning, during learning and after learning and retrieves properties in or from the dossier.

In traditional educational systems there are fixed roles and routines in the system. First learning content is created, then courses are designed, delivered and, finally, evaluated. Participation of learners in content creation or course design is limited; the development of content is primarily a responsibility of providers.

In a Learning Network, however, these fixed, planned processes are not the only means of building knowledge: learners can create their own learning resources, that subsequently can be used by other learners. All the approaches and roles can be mixed and the resulting learning resources are all part of the Learning Network. This demands that all the production subsystems are under the (partial) control of the learner. More to the point, in a learning network there will be only one actor. This actor adopts different roles; learner, teacher, developer. The actor may continually switch roles, although in most cases, any particular actor will have a dominant role. The network, however, is designed to allow any actor to adopt multiple roles, as the next section will show in more detail.

Technological perspective

Technology is seen as an enabler, setting the stage for emergence to occur. Electronic networks and software agents are elements in the model and aim to give people the possibility to interact in large groups (Retallick, Cocklin & Coombe, 1999; Ison, 2000, Peters, 1999) and to make interaction patterns visible to actors (Gamma *et al*, 1995; Fowler, 1997; Larman, 2002). In this way, feedback, meta-information is provided and behaviour is influenced (Liber, Olivier & Britain, 2000; Barkai, 2002).

A framework for a Learning Network

Integrating the organisational, educational, and technological perspectives yields a Learning Network sufficiently powerful to meet our requirements. This will be illustrated, first, by discussing the fuctions users of the Learning Network may perform, subsequently, by reviewing the Network's logical structure.

Use case diagram of a Learning Network

Figure 3 provides an elaboration, in UML (OMG; Booch, Jacobson & Rumbaugh, 1999), of the Learning Network use case. It specifies the different functions that different actors can perform in a Learning Network.

Insert Figure 3 about here.

Note that there is one actor only, the lifelong learner with several specialised roles. Lifelong learners have varying levels of expertise and can perform teaching as well as learning activities. Specialised lifelong learners may be present in the Learning Network, for example persons who focus on teaching. However, in a Learning Network the teachers are also viewed as lifelong learners, be it at another level of expertise. Furthermore, a lifelong learner actor can be an individual person or a group of persons. The group can be formal (e.g. a department) or informal. Learners can be persons or groups at home (e.g. citizens, families), in work situations (e.g. workers, companies) or in educational settings (e.g. students, universities).

Lifelong learners can perform a variety of functions, such as 'perform a learning activity', 'create/read/update a learning activity', 'select an activity' or 'rate the quality of an activity'. Software agents can support the lifelong learners. A key notion in a Learning Network is that learners can perform all functions, including those that traditionally are the responsibility of teachers only. There are no central control actors, as discussed above, the control is expected to emerge, given a set of agreed upon policies.

Similarly, there is no central quality control. Although, the network is likely to contain a varied quality of learning activities, feedback mechanisms (like reviews and ratings) will ensure that on the average a satisfactory quality level will be maintained. Thus, factors like development costs, frequency of use, incentives, price, and satisfaction may be dynamically balanced. Again this is an emergent behaviour.

Formal structure of a Learning Network

In this section the formal structure of a Learning Network is discussed. A Learning Network may be represented as a graph in some domain, with *Units of Learning* as its nodes. The learning activities, learning objects, learning resources, support activities, and all the connected metadata can be packaged to form an integrated Unit of Learning. A Unit of Learning is a construct that is formally described by the IMS Learning Design specification (IMSLD, 2002). A Unit of Learning in a Learning Network can be of any size:

very small, representing only a single learning activity or quite large, for example a course of 400 hours of study. Smaller Units of Learning allow for more flexibility in adapting to specific learner needs. The smallest Unit of Learning contains exactly one learning activity with a connected learning environment.

Some of the metadata of a Unit of Learning are dynamically updated according to certain characteristics of use, for example frequency of use, user ratings, and average completion time. An important feature of any Unit of Learning is the set of rules that govern the lifetime of the activity it contains, specifically its extinction ('fading out') and maintenance ('staying alive') behaviour.

Actors travel in a Learning Network and thus leave tracks (Figure 4). Formally, a *track* is a totally ordered subset of the set of all nodes. Informally, it is the collection of nodes an actor has completed, one after another. A track thus is an empirical concept, it reflects an actor's actual behaviour. A designer may also prescribe (or suggest) a particular sequence of nodes. This we will call a *route* (Figure 4). Like a track, it is a totally ordered subset of nodes, unlike a track it is a prescriptive concept.

Insert Figure 4 about here.

The concept of a track may be expanded, once we take the behaviour of multiple learners into account. If one superimposes tracks, one may label all the edges (i.e. connections) between the nodes with the frequency of their usage. Per pair of nodes, two frequencies will be available, the frequency from A_n to A_m, and from A_m to A_n. Typically, one frequency is much higher than the other. A subset of nodes and their frequency labelled edges is called a *learning road* (Figure 5*)*. It is a statistical concept that reflects the generalised behaviour of many actors. Learning roads, particularly the ones with consistently high frequencies and the ones with consistently low frequencies, are interesting as they suggest collections of learning objects to adopt or avoid. The notion of a learning road may be further refined by taking into account the kinds of learners that have left particular tracks behind. Matching their profile to that of a prospective learner

and generating a learning road for that profile specifically, will provide a prospective learner with highly valuable information. Such profile specific learning roads, may be viewed as a *road map*, an inductively obtained "prescription". Roadmaps are thus an alternative to the prescribed routes described earlier (Koper & Sloep, 2003).

Insert Figure 5 about here.

Another concept of importance is the learner's *position* in the Learning Network (see Figure 6, the set $\{a_4, a_8, a_{10}\}$). The *position* is defined as the set of Units of Learning that have been completed in the Learning Network. Furthermore we identify the notion of a *target* in the Learning Network. A target is any set of Units of Learning that is not yet completed and the actor seeks to complete. A target is always connected to a certain level of competency or expertise in the domain (e.g. in Figure 6 the set $\{a_1, …, a_8\}$). A target may include one or more formal assessments (i.e. a specific kind of Unit of Learning, or integrated in one or more Units of Learning) to certify a competency.

Insert Figure 6 about here.

The difference between the set of target nodes and the set of position nodes, defines the set of Units of Learning that a learner yet has to complete (i.e. a to-do list, for example in Figure 6 the set $\{a_1, a_2, a_3, a_5, a_6, a_7\}$). Given the to-do list a learning route can be established, by prescribing the order in which the Units of Learning are taken (e.g. first a_1 and a_2, than a_5, etc.). This decision can be based on the tracks of successful, similar others in the Learning Network. If so, it becomes a road map. Of course, a learner may also follow a more exploratory course. In the end this will also create a track that can be shared with others.

Conclusion

Through principles of self-organisation, the characteristics and activities of the actors in the network, and the availability of an ICT-supported network with special features (e.g. provision of metadata and feedback on the behaviour of fellow actors in the network) the Learning Network model described here has the potential to meet the requirements that were identified as necessary for the support of lifelong learning. The requirement of <u>low threshold access</u> is met through the support of ICT and the openness of the network (i.e. no entry restrictions); <u>personalisation</u> is met by letting each actor choose the most suitable route; <u>accreditation of formerly acquired competences</u> is met by determining the position of an actor in a learning domain and defining and accrediting the acquired target nodes. The Learning Network model makes it feasible to automate parts of the teaching-learning process and to achieve a form of self-organised learning. By sharing the production of learning activities in the network, it allows the realisation of cost-effective lifelong learning and of mass customisation of learning content and contexts. It also fosters implementation of new instructional design models, the reuse and sharing of learning resources, and the realisation of completely novel learning opportunities (e.g. just-in-time as opposed to just-in-case learning opportunities). Most importantly, it places the learners at the centre of all activities, providing them the opportunity to organise and control their own learning.

Further work on the Learning Networks model should address the question of how one may foster the emergence of such networks, perhaps even create them. More specifically, research should result in:

- a better understanding of learning phenomena in networks such that educational institutions may create multi-leveled collaboration and ICT-networks that offer support in a planned rather than haphazard way

- a better insight into how to set up and manage the collaborative development of learning resources and content in the eLearning field (via, for example, consortia of digital universities, public-private sector partnerships, libraries, partnerships between traditional and open university systems, international collaborations, relations with publishers)

- a better approach to and instrumentation of the learner positioning and assessment aspect of lifelong learning; without this, the Learning Networks model cannot function properly, as learners should be able to enter or leave a Learning Network as they like while still obtaining generally accepted credits for their activities.

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Requirement	Description of requirement
access	Learners should have low profile access to learning opportunities: open, without restrictions/entry requirements, anyplace, anytime, for all/anyone/all-inclusive
means/facilities	Learners should have readily/low-profile available means/facilities (instruments, technologies, organisations) to access learning opportunities.
learning activities	Learners should be able to engage in learning activities.
personalisation	The type of learning activity, the way it is delivered and the sequence of opportunities should fit the personal experiences, needs and interests of the learner(s) (individual/group).
accreditation of experience	Accreditation of experience is not only limited to public governmental education. All learning experiences (formal, non-formal and informal) should be accredited.
guidance	Learners should be guided in defining their personal learning experiences by learning assistance services (e.g. in definition of learning needs, use of ICT, mental coaching)
information	Learners should be able to select their personal learning activities from a variety of learning opportunities, which are described and offered by various organisations. Technology/information relevant to these opportunities should be provided and the marketplace should offer varied possibilities (e.g. resources created/exchange by means of partnerships, coordination and cooperation between all kind of individuals and groups, like enterprises and governmental

	organizations, communities, clubs).
Learner as regulator	Learning activities should be shaped and organised according to the wishes of the learner, who self-directs and regulates the learning experience continuously. This requires a demand-driven approach of a learning organisation.

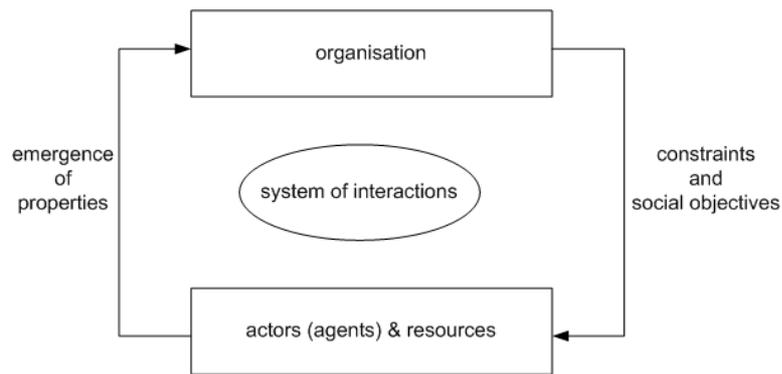Table 1: requirements for lifelong learning opportunities
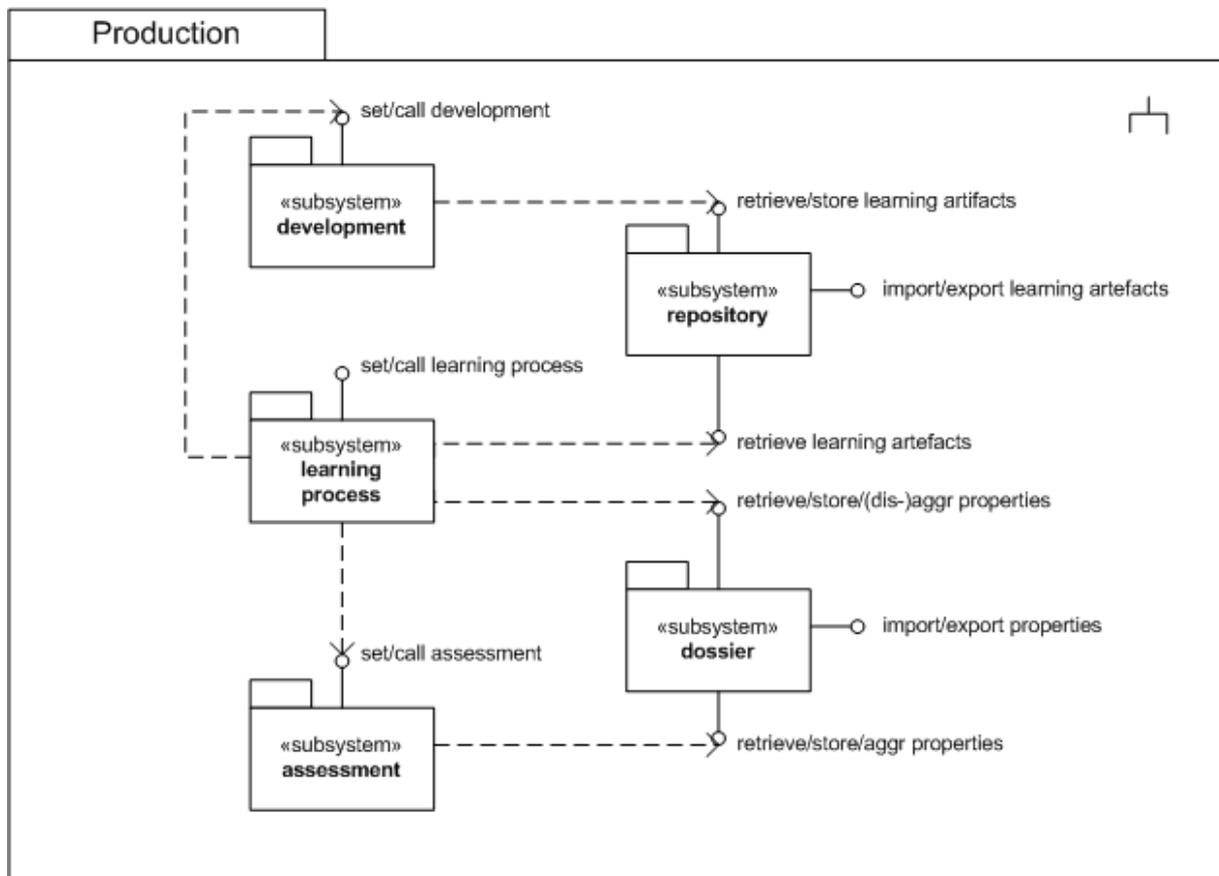
Figure 1: Self-organising system
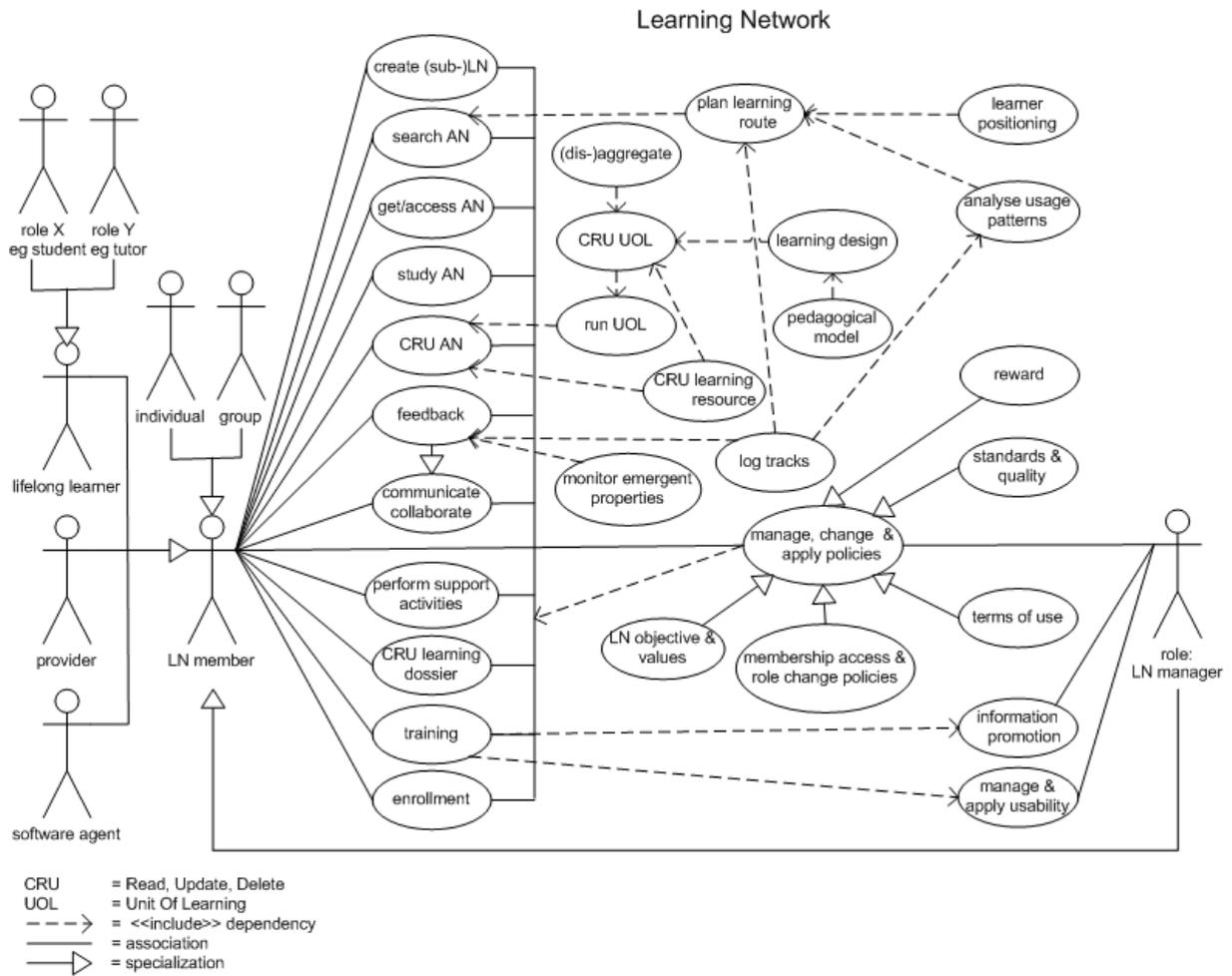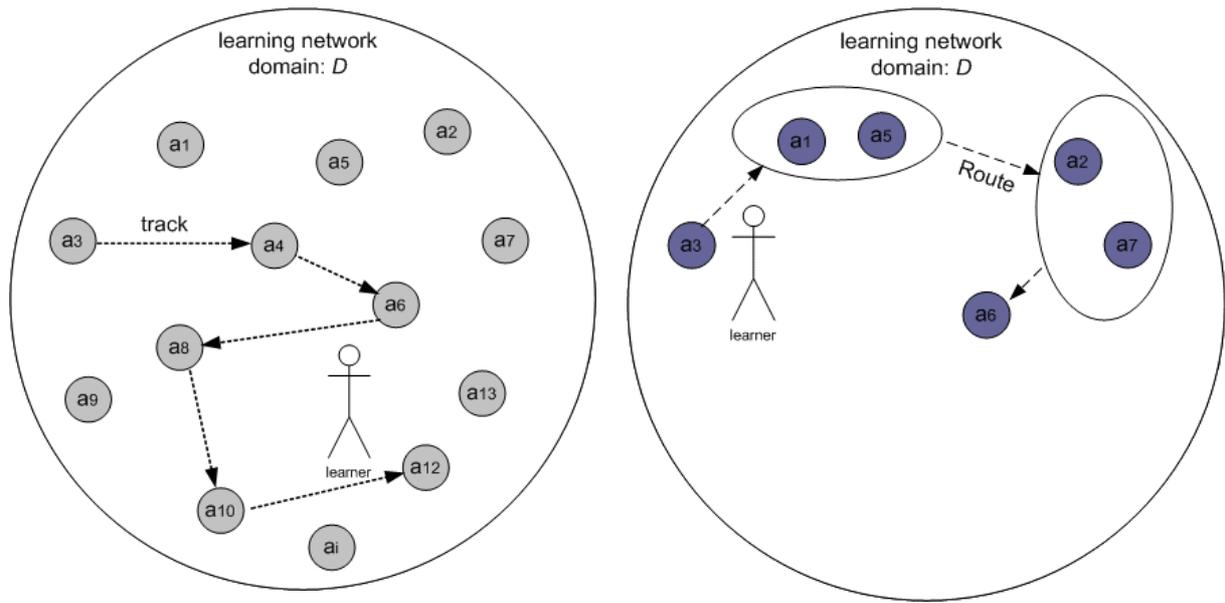
Figure 2: The subsystems of the production system.

Figure 3: Use case model for Learning Networks

(a) track   *(b) route*

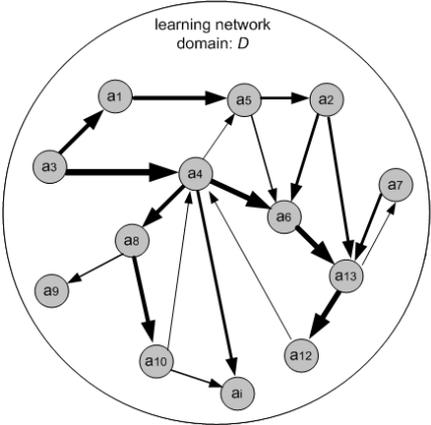Figure 4: tracks (a) and routes (b) in a Learning Network

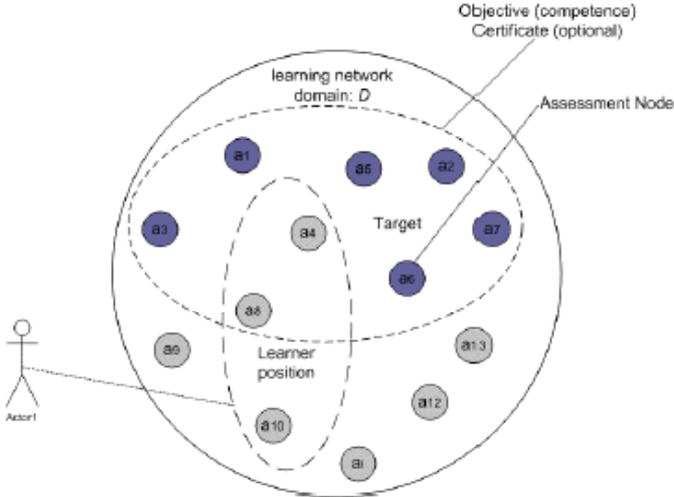Figure 5: a learning road map (line thickness reflects frequency).

Figure 6. Illustration of the concepts position and target