Revising the framework of knowledge ecologies: how activity patterns define learning spaces?

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Abstract
This chapter describes the web of social software tools with its inhabitants as an evolving and ecological environment, discussing and elaborating the Connectivist framework coined by George Siemens in his book Knowing Knowledge. This new perspective to ecological learning in social software environments resides on the ideas of Gibson's and his followers approach to ecological psychology, the rising theory of embodied simulation and Lotman's theory of cultural semiosis. In the empirical part of the paper, we focus on the methods of investigating how social software systems become accommodated with their users forming learning spaces. Analysis discusses such ecologically defined spaces for individual and collaborative learning.

Keywords: knowledge ecology, learning niche, affordances, personal learning environment

Introduction

Recently, the widespread public use of social software in Web has triggered for the need to theoretically ground the learning phenomena in this new environment using the ecological view. Favouring the biological human-centred understanding of information systems, Davenport and Prusack (1997, p. 11) primarily used the information ecology as a metaphorical term to capture holistic and human-centred management of information. Next, the knowledge ecology and knowledge ecosystem terms were coined, which started to mark the rapidly developing area that binds knowledge creation and utilization with the social and management aspects in human networks (Pór & Malloy, 2000; Pór & Spivak, 2000). The Web visionaries like John Seeley Brown (1999; 2002), and George Siemens (2005; 2006) related knowledge ecology and knowledge ecosystem terms with weaving information and artefacts, meanings and knowledge, networks and connections. G. Siemens published a book "Knowing Knowledge" (2006), which received wide public recognition in social Web communities. He suggested Connectivism as the learning theory for new Digital Age. While the book captures a new knowledge ecology vision, it has yet several limitations, which will be discussed in this chapter.

G. Siemens formulated that Connectivism is the assertion that learning is primarily a network-forming process (Siemens, 2006, p. 15). He relies on the ideas of Downes (2005) who wrote that: *A property of one entity must lead to or become a property of another entity in order for them to be considered connected; the knowledge that results from such connections is connective knowledge. The act of learning is one of creating an external network of nodes – where we connect and form information and knowledge sources* (Siemens, 2006, p. 29). Connectivism focuses on the knowledge, situated externally from people in the web. Several authors address this knowledge using different terms eg. cultural knowledge (Heft, 2001); semiotic niche (Hoffmeyer, 1995) or cognitive niche (Magnani, 2008; Magnani & Bardone, 2008). These terms will be elaborated in the further parts of the paper.

G. Siemens (2005; 2006) assumes that creating meanings and relations publicly in social software environments would aid through connective processes the formation of new knowledge ecologies and learning cultures. In the Connectivism framework Siemens takes an approach that is strongly tilted towards knowledge, meanings, communities and networks and their spaces – knowledge ecosystems. However, the Connectivism framework is inconsistent

in elaborating the ecological role of tools, activities, and communities in the formation and evolvement of knowledge ecologies. Siemens writes: *The pipe is more important than the content in the pipe. 'Know where' and 'know who' are more important today that 'knowing what' and 'how'* (Siemens, 2006, p. 32). In this chapter we attempt to argue against this metaphoric claim. We suggest that the use of static 'pipe' metaphor, and diminishing the role of activities, the 'knowing how' part, may theoretically lead to losing the ecological nature of knowledge ecologies framework.

Studies of communities and networks assume that these are formations of people (Lin, Sundaram, Li, Tatemura & Cheng, 2006; Kumar, Novak & Tompkins, 2006) or their artifacts in the Web (Klamma, Spaniol, Cao & Jarke, 2006). What yet is missing is seeing Web 2.0 as a united ecological system with its inhabitants. The interrelations between communities, the environment and the culture left there by people - the traces of meanings (Llor`a, Imafuji, Welge, & Goldberg, 2006; Magnani, 2008) and the traces of activities - are important in the ecological framework. Similar tiltedness towards artifacts and meanings appears in the development of most of the social software tools. In social software systems we can find several possibilities of organising and filtering content by socially defined meanings, however, to see what activities take place in the communities that use these systems is often possible only if participating in the communities. We assume in this chapter that the ecological formation of common places, where communities and networks exist and take action, needs to be integrated into the theoretical explanations about connectivist learning in these systems.

The remaining chapter is organized in the following order. We introduce the enlarged ecological framework of learning in social software systems. The ecological learning framework is illustrated in the case study from formal higher education. This study is discussing the methodologies of detecting ecological learning spaces of the communities that use social software. The analytical part demonstrates learning spaces of individual and collaborative learners who use social software at the course. The analysis focuses on the importance of activity-related aspects in the ecological model. We provide answers to the two research questions:

What characterizes the learning spaces of individual and collaborative learners who use social software at the formal higher education course?

Which differences in the learning culture with social software do the learning spaces of individual and collaborative learners reveal?

Knowledge ecosystems in the Connectivism framework: flowing knowledge in the connected pipes

Siemens (2006) wrote in his book *Knowing Knowledge* that Connectivism is a staged view of how individuals encounter and explore knowledge in a networked/ecological manner. The central concepts Siemens discusses are: knowledge, learning, spaces, networks and knowledge ecosystems. He illustrated his framework with the following metaphor: *The pipe is more important than the content in the pipe. 'Know where' and 'know who' are more important today that 'knowing what' and 'how'* (p. 32). Subsequently we introduce his position in concerns of these terms, asking also some questions, which reveal the areas where Connectivism framework must be elaborated. The answers to these questions will be further discussed in the next chapters.

Knowledge: *Knowledge rests in networks. Knowledge may reside in non-human appliances, and learning is enabled/facilitated by technology (p. 31). The act of knowing is offloaded onto the network itself – to a connected network of specialists. The network (or*

web) of connections is the structure, which holds the knowledge of individuals in a holistic manner (p. 33). Content is imbued with new meaning when situated in network (or is more accurate to say that the network acquires new meaning when new content is added?) (p. 43).

Learning: *Learning is a network formation process of connecting specialized nodes or information sources (p. 31). The elements that create understanding are scattered across many structures and spaces. We 'know' when we seek and pull elements together – when we create a meaning-laden view of an entity (p. 45).*

Q: How technology enables/facilitates ecologies?
Q: How network holds knowledge and acquires new meanings?

Spaces: *We create spaces where we can dialogue about and enact knowledge (p. 4). Ecologies and networks provide the solution to needed structures and spaces to house and facilitate knowledge flow (p. 86). Understanding knowledge in a particular era is important in ensuring that we have aligned our spaces and structures with the nature of knowledge (p. 10). Spaces are themselves agents for change. Changed spaces will change practice (p. 87).*

Q: How spaces enable enacting knowledge?
Q: Can we separate the knowledge flow from the structures and spaces – networks and ecologies – where knowledge flows?

Networks: *Our mind is a network… and ecology. It adapts to the environment (p. 27). The network is a structure that individuals create on their own (p. 132). Content is imbued with new meaning when situated in network (or is more accurate to say that the network acquires new meaning when new content is added?) (p. 43). Better quality of networks and connections result in better quality knowledge sharing (p. 20). Networks occur within ecologies. Ecology is a living organism. It influences the formation of the network itself. The health of each personal learning network is influenced by the suitability of the ecology in which the learner exists (p. 92).*

Q: What are networks: Personal learning environments (PLEs)? Connections between artifacts a person creates? Connections between people a person interacts with?

Ecology: *Ecologies and networks provide the solution to needed structures and spaces to house and facilitate knowledge flow (p. 86). Ecology is a knowledge-sharing environment (p. 87). The ecology fosters connections to original and knowledge sources, allowing for currency. The ecology fosters rich interaction between disparate fields of knowledge, allowing growth and adaptation of ideas and concepts. Each participant in the ecology pursues his/her own objectives, but within the organized domain of knowledge of a particular field (p. 117). Ecologies permit diverse, multi-faceted concepts… and meanings to emerge based on how items are organized or self-organize (p. 87). The creation of the ecology permits a broad-scale implementation of differing knowledge and learning experiences, permitting employees to achieve knowledge-based needs in a multi-faceted manner, multiple ways, and through multiple devices (p. 132). Ecologies are nurtured and fostered…instead of constructed, organized and mandated (p. 90). Ecologies are capable of rapid growth, adapting to new competition, differing perspectives, and enabling innovative concepts and ideas to gain traction (p. 87). Ecology is a living organism (p. 92). Ecologies are: loose, free, dynamic, adaptable, messy, and chaotic (p. 90). The ecology influences the formation of the network itself. The health of each personal learning network is influenced by the suitability of*

the ecology in which the learner exists (p. 92).

Q: How does the ecology influence personal networks?

Siemens (2006, p. 87) also discusses the characteristics of ecologies that promote knowledge sharing. He emphasizes the freedom of choice to use different systems and tools that meet the needs of each person, and which they perceive easy to use. This suggests owning a personal learning environment (PLE), the autonomously combined various tools, material- and human resources for facilitating person's cognitive learning activities, which are accommodated to certain person's needs and may be interconnected with other persons' PLEs (Attwell, 2007; Underwood & Banyard, 2008). Secondly, the variety of systems and tools that individuals use is considered important. This may increase the possibility of making connections between people and between artifacts across the various borders. The personal choice in making connections is of importance to hold motivation and inquiry spirit. Because knowledge is supposed to be situated in networks and connections, the deep and trusting connections between individuals, who uptake knowledge from the ecologies, and tolerance among these individuals must be achieved. Thirdly, the consistency of participating in certain practices with knowledge is suggested, which may increase the probability that patterns will emerge within ecologies, and that persons will notice them.

Siemens (2006, p. 45) explains the functioning of knowledge networks as follows: *Individuals are active in the learning ecology/space in terms of* ***consuming or acquiring new resources and tools****. The learner begins to actively contribute to the network/ecology essentially, becoming a visible node. Time in the network has resulted in the learner developing an* ***increased sense of what is happening*** *in the network/ecology as a whole. She/he will become more adept at* ***recognizing new patterns or changing winds of information of knowledge****. Individuals are capable of understanding* ***what do the emerging patterns mean****. The learner is also* ***focused on active reflection of the shape of the ecology itself****. The learner may engage in* ***attempts to transform the ecology beyond his/her own network****.*

In the practical implementation of Connectivism ideas into learning Siemens (2006, p. 140) suggests three key aspects of ecologies – they must be *holistic*, *adaptive* and *result-focused*. These concepts may also serve as the starting-points into taking the fresh look at the knowledge ecologies.

Siemens suggests that holistic ecologies represent the situation diversely, allowing multiple perspectives and views. We can further argue that holistic view means that we may find several subspaces in the ecologies, which differ from each other by perspectives. Ecologies are formed of many individuals who try to realize their personal objectives, often individually and without being consciously involved into group actions. The view at the ecology level permits to see these individuals forming various communities who share similar views or act in a certain way without even knowing each other or forming networks. However, the *communities inhabit sub-spaces in the ecology*, which are evolving, and dynamically changing. Across the vaguely defined borders of community sub-spaces, knowledge can be interpreted and translated, creating new knowledge. The abstract sub-space concept, which we formulize as a *learning niche for certain community*, is central in the revisions of Connectivism framework. A learning niche is a community-specific activity- and meaning sub-space for learning in the larger learning space of the knowledge ecology or knowledge ecosystem.

Secondly, Siemens suggests that ecologies must be adaptive and able to adjust and

change as the environment changes. These characteristics are elaborated further in the next subchapter, introducing the ecological idea of *affordances that define niches*. Affordances denote the relations between particular aspects of the situations and people planning or taking action. If the persons are linked to their existing habits, activities, processes and tools, like Siemens suggests, any change in their objectives and preferences would cause the changes in the whole environment, in these communities. People, activities, and tools what they find to fulfill their objectives are ecologically interrelated. People rely on the cultural behaviors that take place in certain social environments – eg. 'tagging of personal meanings' or 'reflecting in public spaces' etc. Thus, community activities influence, which perspectives of meanings, actions and tool functionalities and objectives would be actual for the learners. Everything what people do in Web remains as the *feedback into the systems.* It is interpreted as an *ecological knowledge,* influencing not only this community, but also potentially other communities. Ecological knowledge is everything what people do in Web, eg. the content and meanings, the process traces from actions taken with certain tools with certain artifacts with certain people that remains to the Web and can be used as a feedback for communities or as a cultural knowledge embedded to Web systems.

Thirdly, Siemens emphasizes the intended targets and desired outcomes that the ecologies might have. This view would obtain a new meaning if we stop seeing the formation of ecologies as the systems purposefully designed by groups, but as *emergent and evolving activity systems*. The mutual interrelations between individuals, their objectives, and what they see and use in the surrounding system, when constructing knowledge, are triggered ecologically. The ecological knowledge is always being formed and always influencing what is being formed, and how it is being formed. This *ecological knowledge is not only content* and meanings left into the Web systems, but also the *process traces from actions* taken with certain tools with certain artifacts, with certain people. Thus, the communities always shape their spaces and these spaces shape the communities.

Enactment when learning in knowledge ecosystems: communities construct niches

In the previous discussion several questions where addressed when analyzing the Connectivism framework. These questions revealed that there are unclear aspects, suggesting the necessity to take a more in-depth look into the knowledge ecologies. We have reorganised the order of these questions to frame our argumentation about the nature of knowledge, networks, knowledge ecologies and their interrelations.

Q: What are networks: Personal learning environments (PLEs)? Connections between artifacts a person creates? Connections between people a person interacts with?

Q: How network holds knowledge and acquires new meanings?

Q: Can we separate the knowledge flow from the structures and spaces (networks and ecologies) where knowledge flows?

Q: How technology enables/facilitates knowledge ecologies?

Q: How spaces enable enacting knowledge?

Q: How does the ecology influence personal networks?

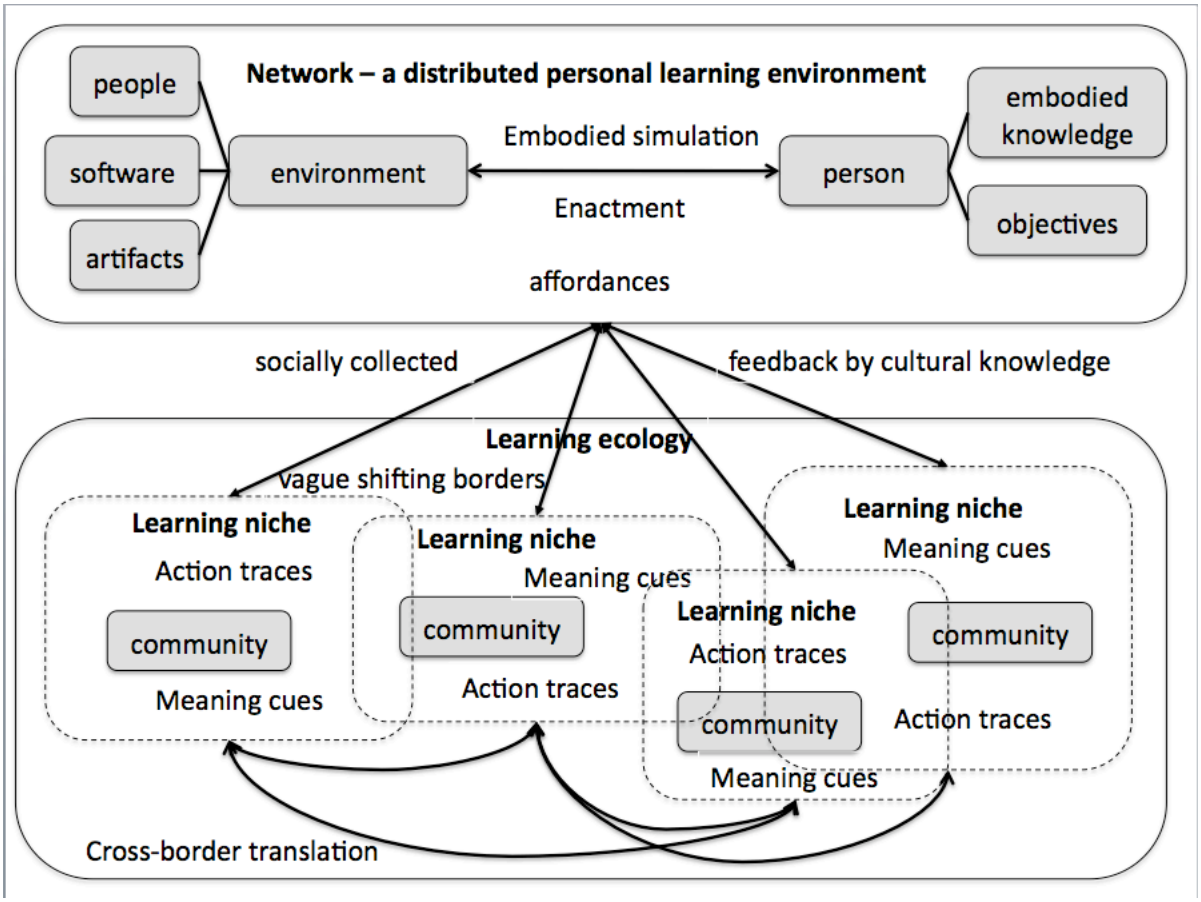

Figure 1. Components in the learning ecology framework

To answer these questions we introduce some more concepts to the ecological learning framework: *niches* as abstract community spaces, *affordances* that define niches, ecological knowledge as the *feedback* that communities create, *enactment* and *embodied simulation* as the possible processes that cause ecology formation. Siemens (2005, 2006) has built his Connectivist framework on the ecological understanding. However, deepening of the ecological approach enables to see activities in the more central position in the knowledge ecologies. We aim to elaborate the knowledge ecosystem idea, strengthening the role of activities and introducing the theoretical framework how activities are related to the knowledge ecosystems. Figure 1 illustrates the components of our knowledge ecologies framework.

Network-knowledge interrelations

Q 1: What are networks: Personal learning environments (PLEs)? Connections between artifacts a person creates? Connections between people a person interacts with?

We do not want to criticise the main idea expressed by Siemens (2006) in Knowing Knowledge, declaring that knowledge rests and changes in the networks that connect people and their artifacts. Asking, what these networks are, we want to emphasise *the role of tools and activities as an ecologically entwined parts of the network.* We emphasise that knowledge, is more than information and meanings – *knowledge has an activity- and tool-related dimension.* Personal learning environments (PLEs) that people construct and use in their daily activities are not merely the mediators, 'the inactive pipes' that enable knowledge

flow. PLEs are dynamically evolving activity systems in which the personal objectives and human and material resources are integrated in the course of action.
We want to emphasize the *distributed nature of what we define as PLEs*. Here, we do not mean only that each PLE may be constructed of many separate tools forming a distributed system. PLE is also distributed ecologically, integrating our minds with the elements of the environment. Zhang and Patel (2006) suggested that people perform the distributed cognition evoking simultaneously affordances, the allowable actions specified by the environment coupled with the properties of the organisms, in the form of distributed representations extended across external (the environment) and internal (the organism) representations. Hommel (2003), has written that action control to all behavioral acts is ecologically delegated to the environment - when planning actions in terms of anticipated goals, the sensory-motor assemblies needed to reach the goal are simultaneously selectively activated in the environment, and bind together into a coherent whole that serves as an action-plan, facilitating the execution of the goal-directed actions through the interaction between the environment and its embodied sensory-motor activations. In the frames of ecologically defined learning systems, we can assume that our embodied sensory-motor knowledge of previous meaningful actions and its environmental correlates that we find around us form one emergent distributed system. In the course of learning our PLE is always in change. We actualize certain dimensions from the environment around us integrating it to the action-plans, and simultaneously the environment extends certain dimensions to us changing and shaping our intentions. Deliberately, we do not talk of the environment as merely of tools and systems. Environment involves all kind of resources in PLEs – people, artifacts, software systems and services. Thus, *the network in the ecological framework may be interpreted as a cognitively distributed system continuously constructed of our minds and the environment components*.

Q 2: How network holds knowledge and acquires new meanings?

Applying the previous interpretation of networks in ecological framework we can assume that knowledge that the networks hold is pattern-like, cognitively distributed between the environment and person(s), and dynamically emergent in activities. Two perspectives are important about the nature of knowledge – knowledge is always developed within the distributed systems personally and culturally. These personal and cultural ways to create knowledge are interrelated.

Varela, Thompson & Rosch (1991, p. 149) wrote that knowledge is the result of ongoing interpretation that emerges from our capacities of understanding. These capacities are rooted in the structures of our biological embodiment but are lived and experienced within a domain of consensual action and cultural history. They coined the term *embodied action* to transmit the idea that cognition depends upon the kinds of experience that come from having a body with various sensory-motor capacities, and second that these individual sensory-motor capacities are themselves embedded in a more encompassing biological, psychological, and cultural context. The authors assumed that sensory and motor processes, perception and action are fundamentally inseparable in lived cognition (p. 172-173). Using the term *enaction* they focused on two points: 1) perception consists of perceptually guided action, and 2) cognitive structures emerge from recurrent sensory-motor patterns that enable action to be perceptually guided (Varela et al., 1991, p. 173).

Bereiter (2002, p. 57) framed and answered the question about the nature of knowledge as follows: *Where is knowledge if it isn't contained in individual minds? The kind of answer coming from activity and situated cognition theorists runs along the following lines: Knowledge is not lodged in any physical or metaphysical organ. Rather knowledge inheres in*

social practices and in the tools and artifacts used in those practices. Knowledge is regarded as distributed. This does not mean merely that it is spread around, a bit here and a bit there… knowledge does not consist of little bits…all the knowledge is in the relationships – relationships among the people engaged in an activity, the tools they use, and the material conditions of the environment in which action takes place. Yet, Varela et al. (1991) and Bereiter (2002) do not offer explanations of how network holds knowledge and how this knowledge can change.

Recently researchers have come up to the idea how this distributed knowledge emerges as a result of *embodied simulation*. Discoveries in cognitive and neuroscience about the functioning of mirror-neuron systems (Gallese et al., 1996), claim, that cognition is embodied through grounding knowledge directly in sensory-motor experiences without the mediation of symbolic representations (Pecher & Zwaan, 2005). Research indicates that from observation of others and the environment (Rizzolatti et al., 2001), from listening narratives (Rizzolatti & Arbib, 1998; Iaccoboni, 2005) or from reading narratives (Scorolli & Borghi, 2007) and looking everyday images of objects or works of art (Gallese & Freedberg, 2007) we perceptually activate certain multi-modal action-potentialites of embodied symbols that directly mediate our purposeful and goal-directed actions (see Gallese & Lakoff, 2005). These findings suggest an additional way of how distributed cognition works without representational processes suggested by Zhang and Patel (2006). When acting in social learning environments not only the meanings are newly created from found information, but also the action-related cues are picked up from different narratives and from the whole systems, and they are integrated into our action plans. These findings indicate, that besides possibilities of organizing meanings with various ways in social learning environments, much more attention needs to be put on these *action-related cues individuals and communities interact within the environment.* Knowledge is always in change because of personal nature of embodied simulation processes and the influence or *feedback* that people make with their actions, action- and meaning traces, and their specific way of activation of PLEs from the environment.

Q 3: Can we separate the knowledge flow from the structures and spaces (networks and ecologies) where knowledge flows?

In the revised ecological framework knowledge and networks are integrated. Our ecological learning framework binds together three assumptions: i) network may be interpreted as a cognitively distributed system continuously constructed of our minds and the environment components in the course of action; ii) knowledge is pattern-like, distributed between the environment and people, and is dynamically emergent in activities, iii) knowledge emerges as a result of embodied simulation, when people perceptually activate certain multi-modal action-potentialites from the environment that mediate their purposeful and goal-directed actions, and leave action- and meaning traces as a feedback to the environment.

Network-ecosystem interrelations

Q: How technology enables/facilitates knowledge ecologies?

The concept of ecology plays an important part in the Connectivism framework of learning. However, Siemens (2006) is not very precise in explaining how ecologies and networks influence each other. In our main amendments to Connectivism we try to elaborate the emergent nature of ecologies with bottom-up social definition of learning niches, discuss

what is the role of using software systems in these ecologies, and describe how feedback through ecological knowledge connects ecologies and networks.

Ecologies are formed as a result of many individuals taking actions. Thus, people with various perspectives are simultaneously at present in these ecologies and influencing them. Many abstract sub-spaces can be formed within ecologies. Such sub-spaces emerge when parts of the environment are embodied and used similar way by many people. They are more general than networks of one individual – they come to existence and can be identified only if many individuals actualize similar personal learning environments (PLEs) for the same purposes with certain frequency at the certain period of time. These groups of individuals have something in common in their identity. Hoffmeyer (1995) coined the *semiotic niche* term to signify the semiotic spaces that are actualized by certain organisms in species' specific semiotic processes when interacting with their environment. Magnani (2008), and Magnani and Bardone (2008) use the term *cognitive niche* to mark the distributed space that people create by interrelating individual cognition and the environment through the continuous interplay through abductive processes in which they alter and modify the environment. In the knowledge ecologies we can use the learning niche term that marks the cognitive niches that are related to learning-related activities. Learning communities inhabit *learning niches – the abstract sub-spaces for learning in the space of knowledge ecosystem*.

Hutchinson (1957) defined niche as a region (n-dimensional hypervolume) in a multi-dimensional space of environmental factors that affect the welfare of a species. Niches have been conceptualized as the collections of environmental gradients with certain ecological amplitude, where the ecological optimum marks the gradient peaks where the organisms are most abundant. The welfare of species can be determined by meaning-creation and action-taking possibilities in the environment. For example Hoffmeyer (1998) coined the term semiotic fitness to describe the relation how organisms contribute to the emergence of semiotic niches. Semiotic fitness measures the semiotic competence or success of natural systems in managing the genotype-environtype translation processes. The optimization of semiotic fitness results in the continuing growth in the depth of interpretative patterns accessible to life. In the gradient concept structural ecosystem properties are comprehended as concentration gradients in space and time (Müller, 1998). Any niche gradient is a peak of the fitness landscape of one environmental characteristic (Wright, 1931), which can be visualized in two-dimensional space as a graph with certain skew and width, determining the ecological amplitude. The shape of the fitness graph for certain characteristic can be plotted through the abundance of certain specimen benefitting of this characteristic. All niche gradients are situated and establish a multi-dimensional hyper-room, which axes are different environmental parameters.

The formation of learning niches for specific learning-related activities happens through the social definition of several factors that influence learning. It is assumed that any learning niche in social systems is determined as a set of characteristics that people perceive and actualize as useful for their activities and wellbeing individually or in groups. The meaning- and action-relevant information should be considered important in niche formation. Each niche gradient defines one dimension of the learning space. Hutchinson (1957) made difference of fundamental and realized niche – the former exist as the complex of all necessary environmental characteristics for certain species, the latter is formed under the pressure of all the currently available environmental characteristics in the competitive conditions with other species. On our learning ecology framework, the fundamental cognitive learning niche term applies for all the possibly usable software tools and services, artifacts and people, while the realized niches form under the constrained conditions of resource availability.

What is the mechanism how niches appear? Previously we have described the distributed

cognition (see Zhang & Patel, 2006; Magnani, 2008; Magnani & Bardone, 2008) and embodied simulation (see Gallese et al., 1996; Pecher & Zwaan, 2005; Gallese & Lakoff, 2005) as the candidates of ecological emergence of knowledge in systems from individual activities in interrelation to the ecosystem knowledge. Both approaches may be related with the *affordance* concept from ecological psychology. This concept we use in our elaborated framework to describe the different dimensions people actualize in the course of action with the environment.

Gibson (1979) originally defined affordances as opportunities for action for an observer, provided by an environment. The mainstream view on affordances in educational technology settings considers them as objective properties of the tools, which are perceptible in the context of certain activities. Thus, it is commonly suggested that tools have concrete technological affordances for certain performances that can be brought into a learner's perception with specific instructions (Norman, 1988; Gaver, 1996). This use of the concept tends to ignore its relativistic nature and observer-dependence, and seems to imply that affordances should be located in the environment or specific artifacts or tools.
The interactional affordance concept that supports the embodied simulation mechanisms appears in a number of studies. Chemero (2003), a researcher from the school of Gibsonian ecological psychology, has suggested that affordances are rather the relations between particular aspects of the animal and the situations. Chemero wrote that affordances are features of whole situations (meaning the actors are part of this situation). Gaver (1996) emphasized that affordances emerge in human action and interaction and, thus, go beyond mere perception. Michaels (2003) claimed that perceiving affordances is more than perceiving relations, but it brings attention to the action-guiding information and sets up action systems to act. Magnani and Bardone (2008) also stress that human and non-human animals can "modify" or "create" affordances by manipulating their cognitive niches.

Barab and Roth (2006) have noted that connecting learners to ecological networks, where they can learn through engaged participation, activates the affordance networks. Affordance networks, in contrast to the perceptual affordances described by Gibson, are extended in both time and space and can include sets of perceptual and cognitive affordances that collectively come to form the network for particular goal sets. According to Barab and Roth (2006) affordance networks are not entirely delimited by their material, social, or cultural structure, although one may have elements of all of these; instead, they are functionally bound in terms of the facts, concepts, tools, methods, practices, commitments, and even people that can be enlisted toward the satisfaction of a particular goal. In this way, affordance networks are dynamic socio-cultural configurations that take on particular shape as a result of material, social, political, economic, cultural, historical, and even personal factors but always in relation to particular functions. Barab and Roth (2006) assumed that affordance networks are not read onto the world, but instead continually "transact" (are coupled) with the world as part of a perception-action cycle in which each new action potentially expands or contracts one's affordance network.

Affordances emerge and potentially become observable in actions what people undertake to realize their goals. Actions of other people in the environment or traces of their action serve as the triggers of new action plans. Vyas and Dix (2007) distinguished 3 levels of affordances: personal, organization/community, and culture level, which differ also on the level of how rapidly they can change. They claim that affordances of different levels influence each other. For example affordances one person can perceive may depend on the affordances the community perceives or culture uses as norms. Heft (2001) wrote that: "*we engage a meaningful environment of affordances and refashion some aspects of them… These latter constructed embodiments of what is known – which include tools, artifacts, representations, social patterns of actions, and institutions – can be called ecological*

knowledge. Ecological knowledge through its various structural, material culture, human setting manifestations becomes an integral social and cultural part of 'the environment', with these social and cultural affordances constituting effective, largely material, forms of knowledge with their own functional significance, cultural transmission, and adaptation implications." Heft's interpretation enables to view both the information from the artifacts but also the traces of action in social software systems as important components that define knowledge ecologies.

We can conclude that in our elaborated framework of ecological learning *we support the idea that affordances are the perceived possibilities for both thinking and doing, what learners evoke and signify during their actual interaction with an artifact or tool and with each other.* People determine the personal learning affordances within their PLEs. Hence, the learning affordance descriptions involve the learning action verbs, people who are involved in action, and mediators of actions (various tools, services and artifacts). Any individual conceptualizes learning affordances personally, but the range of similar learning affordance conceptualizations may be clustered into more general affordance groups eg. 'pulling social awareness information' or 'searching artifacts by social filtering' etc. These *affordance clusters may be interpreted and used as the abstract learning niche gradients.* The affordances as niche gradients are socially developed.

Using the affordance conception for defining learning space dimensions for the communities, we can bring the emergent ecological properties from the individual network level to the new structural level that is niches in the ecologies. *Ecologies integrate many niches of different communities.* The awareness of different niches is obtained by tracing the meaning-spaces and activity patterns of other people twined between the distributed real and virtual places they inhabit. If the dimensions of learning niches become unfolded, they become usable for our own self-directed learning. Two aspects here are important. The meaning centred aspect suggests to use distributed PLEs to be aware of more communities and their *meaning niches*, and to create conditions for transferring information from one conceptual dimension to another. This precondition for cross-border meaning-building activities has been focused both in cultural semiotics (Lotman, 1990; Hoffmayer, 1995) as well as in the theory of Connectivism. Second aspect is finding people to learn together with. To be involved in the similar activities, similar *action niches* need to be used for interaction. *Learning affordances enable to characterize these action niches.*

Q: How spaces enable enacting knowledge?
Q: How does the ecology influence personal networks?

Previously we have defined the various sub-spaces in the Connectivism framework as learning niches. Here we assume that *niches enable to enact knowledge and influence personal networks because of ecological inheritance left as feedback to the social software systems*. We suggest that this *ecological inheritance is the particular set of affordances and meanings left into the systems by various communities in the form of meaning- and action-relevant cues.*

Hoffmeyer (1995) assumes that in the semiotic communication through their semiotic places the organisms' have capacity for anticipation, and the possibility of foreseeing actual events and protecting oneself against them or otherwise deriving advantage from them. A recent literature in evolutionary theory provides the idea of niche construction (Odling-Smee et al., 2003) as an ecological factor that enables organisms to contribute for and benefit from environmental information. It is argued, the organism has a profound effect on the very environment as a feedback loop. Organisms have influence on their environment, and the affected environment can have a reciprocal effect on other organisms of this species or on

other species, creating an environment different from what it would have been before it was modified. This niche construction challenges the convention of a distinct separation between organism and its environment. The niche-construction perspective stresses two legacies that organisms inherit from their ancestors, genes and a modified environment with its associated selection pressures. The authors assume that the feedback must persist for long enough, and with enough local consistency, to be able to have an evolutionary effect. They introduce the term *ecological inheritance.* Ecological inheritance is a modified environment influenced by organisms, their ancestors or other organism communities what has evolutionary effect and selection pressure to organisms. Genetic inheritance depends on the capacity of reproducing parent organisms to pass on replicas of their genes to their offspring. Ecological inheritance, however, does not depend on the presence of any environmental replicators, but merely on the persistence, between generations, of whatever physical changes are caused by ancestral organisms in the local selective environments of their descendants. If organisms evolve in response to selection pressures modified by themselves and their ancestors, there is feedback in the system.

Magnani (2008), and Magnani and Bardone (2008) note that human and non-human animals "modify" or "create" affordances by manipulating their cognitive niches. This manipulation in social software systems takes place in the form of creating PLEs as cognitive personal learning environments constructed of various personally activated tools and system functions, networks of people and artifacts and interaction patterns, and interacting with PLEs in various knowledge building communities. In accordance with the ecological inheritance ideas, social software systems demonstrate similar interdependency between user-generated environmental influence and the development of user culture. The activities in social systems make them into the arenas of 'produsage' where learners' production and consumption cannot be separated from the surrounding environment (Bruns, 2008). The concept of 'produsage' as a term highlights the idea of embodied action, suggesting that within the communities, which engage in the collaborative creation and extension of information and knowledge, the role of consumer and even that of end user have long disappeared, and the distinctions between producers and users of content have faded into comparative insignificance. People actively participating in social web culture and technological systems form an ecological system.

It is generally accepted that learning, and tools used by certain culture from one side, and individuals of this culture and their learning and tool-using habits from another side, are influencing and shaping each other mutually (see Vygotsky, 1978). By definition, the more social software tools are used, the better they become adjusted to the cultural habits of their users. The more user-defined interrelations between the meanings exist and can be activated by social-software, the better the systems get for social retrieval of information. The more users' activities in social environments are externally marked by the users, for example with machine-readable formats describing people, the links between them, and the things they create and do, the better the access to the activity-related information and people becomes. The positive side effect of it is also, that the systems obtain new qualities for monitoring and getting awareness, that would open the gateway to the otherwise non-traceble communities in which the members are not personally related into social networks through shared activities. They may or may not have an awareness of each other, but they share similar meanings or perform same type of activities.

Access to such people in new environments is potentially opening a multi-dimensional place where individuals can learn from each other or where shared group activities can be initiated for learning purposes. The more people get involved into the similar activities, while evoking for themselves certain functions the social tools offer, the stronger the pressure gets of developing the systems towards facilitating this activity, and the more this activity

becomes part of the learning culture in this environment. This presumes the ecological relationships between people and their objectives for action in certain learning environments, and the personally differentiated perception of meanings and tools in their surrounding environments. Such relations would alltogether dynamically shape the social software environments as places for learning.

An interesting aspect about ecological knowledge is its influence to the subsequent members of the community or other communities. Niches and their communities have interdependence and they cannot exist without each other. Besides this, some communities benefit from the niches of other communities, but these may not be existential for their wellbeing. Vandermeer (2008) explains that if organisms construct their environments, there must be ecological consequences in addition to the evolutionary ones. He distinguishes between obligate and facultative organisms and niches, formulating assumptions how these organisms are influenced by niche construction: a) In an obligate constructive niche the organism dies in the absence of niche construction; b) In a facultative constructive niche the organism survives even in the absence of niche construction, nevertheless will benefit further from the construction, c) A facultative organism survives even in a non-constructive niche, but benefits further from the construction, and d) An obligate organism does not survive unless a constructed niche becomes available.

These assumptions can be transferred to the social web environments. For example: a) Wikis and microblogging environments can be considered obligate constructive niches, where single person without the community has very little benefit of the system; while b) Blogs or social bookmarking systems may be seen as facultative constructive niches, in which keeping individual diary or collecting bookmarks gives some additional value even without the community; c) A facultative user of web systems will not rely on its' activities on the niche construction of the other users; but d) An obligate web user has constructed its personal learning environment of community tools and services eg. of 'pulling feeds', and cannot function effectively without this niche construction.

How ecologies enable learning and knowledge?

In this subchapter we try to elaborate some ideas how learning happens within ecologies. We can view niches as semiotic formations. Deeley (1990) defines semiosis as a process of applying signs to understand some phenomena, reasoning from sign to sign, and intervention of new signs to make sense of some new experiences. Processes of operating within the same or between different sign systems are characteristic to learning new things. The simplified way of interpreting semiotic processes is by claiming that there is a complete mutual translability between signs from different systems and all the information can be transformed from one system to another without any loss until new understanding of the phenomenon under investigation has reached learners' minds. As an improvement, Eco (2000) suggested that semiotic processes are more complex. He interpreted signs as not fixed semiotic entities but rather the meeting ground for independent elements coming from different planes and meeting on the basis of coding correlation.

Using semiotic model in knowldge ecology framework we rely heavily on the model created by Lotman (1990) of the semiosphere to explain cultural semiosis. His model depicts semiosis as a knowledge creation between cultural spaces on the basis of meanings. Similarly, Hoffmayer (1995, 1998) has proposed that semiotically determined niches are places where semiotic processes take place, and survival through semiosis implies a dynamic creativity. Lotman (1990) defined the conception of the semiosphere as a living space of dialogical events, in which the production of consciousness and meaning can only take place through contact with an 'Other'. He explained that during semiotic processes people always

focus on those aspects of the sign systems, which are important to them. They systematize their perceptions into structured descriptions of the system, by this distinguishing also the elements that are perceived as belonging to out-of-system area or to other systems for them. Thus, a dynamic binary structure is formed in their minds that Lotman described as the semiosphere. Binary parts of semiotic spaces – common and align contexts – are connected by translation. Lotman (1990) assumed that separate sign systems do not have mutual semantic correspondence. He wrote that any cultural semiosphere and its text-generating mechanisms depend on otherness and its semiotic input in order to forge appropriate conditions for semiotic enrichment and change. He assumed that the dynamic reconstruction of context, the alteration of meanings, and the construction of new information happen only in the communication between differences when the lack of fit between cultural 'languages' creates the conditions for translation. According to his theory, fixed elementary semiotic systems are abstractions. Instead, *semiosphere should be regarded as an initial unit where semiotic processes take place between inconsistent semiotic spaces that people create in their minds*.

Stecconi (2004) suggested that during semiosis the translator relies on his notion of similarity to find and generate intuitively equivalent relations between sign systems, using abduction to make certain elements of these systems that may not have similar meanings equivalent. By this, the dynamics of semiotic structures emerge from the involvement of the out-of-system elements to the system and the upstage of the system elements to the regions with less systematic nature.

Learning ecologies are similar to the semiosphere model. Niches support the formation of binary structures, the places where learners must apply different rule-systems and languages, and can yield knowledge or find new ways how to yield knowledge. Niches enable to translate between common and align contexts not only meaning-based, but also the affordances of different niches may be integrated temporarily into ones personal learning environment for performing certain actions. Magnani (2008) and Magnani and Bardone (2008) assume that affordances are the important determinants of cognitive niches created by humans. Thus we can consider that similarly to meaning-creation and semiosis also the action-related information is re-interpreted and translated in niches, creating new possibilities for enactment. Magnani and Bardone (2008) write that finding and constructing affordances refers to a (semiotic) inferential activity: we come up with affordance insofar as an object exhibits those signs from which we infer a possible way to interact with it and to perform suitable actions. This inferential process relies on various cognitive endowments, both instinctual and learnt, and occurs in the eco-cognitive interaction between environment and organisms.

The formation of the dynamic ecology for the learners depends on whether their personal learning environment evokes certain affordances from different niches enabling their interrelations with various communities, and if learners perceive and start using the interrelated binary structures manifested by these emerging affordances. For example Pata & Fiedler (2009) describe that learners perceive different affordances of the group environment while composing a shared learning environment from PLEs, and grounding of affordances as a necessary procedure. Secondly, integrating one new tool may restructure the whole set of affordances people perceive in concerns of other software in their PLE. The software use at different, non-familiar communities may in some cases attribute totally new affordances to the software that differ from the previous cultural use of this software. One example of how this translation of affordances has appeared may be taken from microblogging environments (Mackie, 2007).

The case study from formal higher education

We illustrate the enlarged ecological framework of learning in social software systems with the case study from formal higher education conducted in Tallinn University.

In this study we demonstrate the methods of detecting ecological learning spaces of the communities that use social software. The results part demonstrates learning spaces of individual and collaborative learners who use social software, answering two research questions: What characterizes the learning spaces of individual and collaborative learners who use social software at the formal higher education course? Which differences in the learning culture with social software do the learning spaces of individual and collaborative learners reveal? We discuss the results in the frames of using ecological framework.

Methods

Sample

The participants of the study were master students of Tallinn University, mainly from Institute of Informatics who participated in the course „Learning with social media". The two groups of students were involved in the development of the course design in two separate studies. In the first study, held in spring 2007, 25 second-year master students participated at the course. In the fall 2007, 28 first year master students participated at the course. The master students of the Tallinn University, Institute of Informatics originated from heterogeneous backgrounds – there were practicing schoolteachers of different subjects or informatics, educational technologists of different governmental and military institutions or private enterprisers. Thus, they all had needs for different competences and their contact with social media had been quite minimal so far. Due to the authentic settings of the study, convenient sampling was used. Thus the conclusions from this research must be regarded in the particular contextual setting. Two facilitators of the course were involved in research.

Course settings

The first year the course was run aiming to develop primarily the learners' competencies of using Web 2.0 environments for planning learning landscapes and activity patterns, both for personal and collaborative use (see Väljataga, Pata, Tammets, in press). At the second year the structure of the course was changed, the new focus was on developing self-directed learning competences through individual and collaborative activities with Web 2.0 software (see Tammets, Väljataga & Pata, 2008). This meant mainly that the task of self-reflection on personal learning contracts in weblog was part of the learning tasks in addition to the previous tasks that were used at the first year of the course.

The general planning of the course was the following. Together with facilitators, the distributed learning environment of the course was created, which was used and developed during the course. Every student individually developed his or her personal distributed learning environment (see Figure 2) and described and tested it in action. In order to perform collaborative learning tasks, learners had to combine their personal learning environments, to conduct collaborative activities.

Course had three face-to-face contact days, meantime learners were asked to do independent work, either individually or in groups. At contact days, facilitators gave theoretical lectures and modeled practical competences of using different social media tools and services for educational purposes. At the same time learners were expected to get practical experiences with different social media tools in order to plan their individual and

collaborative learning environments and activities with those tools.

The distributed web-based learning environment of the course was conducted dynamically under learners' eyes with their active participation. Creating such joint learning environment together with learners, improved the learners' competencies of conceptualizing the affordances of the learning space similarly as the facilitator, and enabled the facilitator to make corrections in the learning environment in accordance with the learners' perception of affordances. Students could see, that their role was equal to the facilitator, and monitor how each member was contributing to the development of the distributed learning environment of the course.

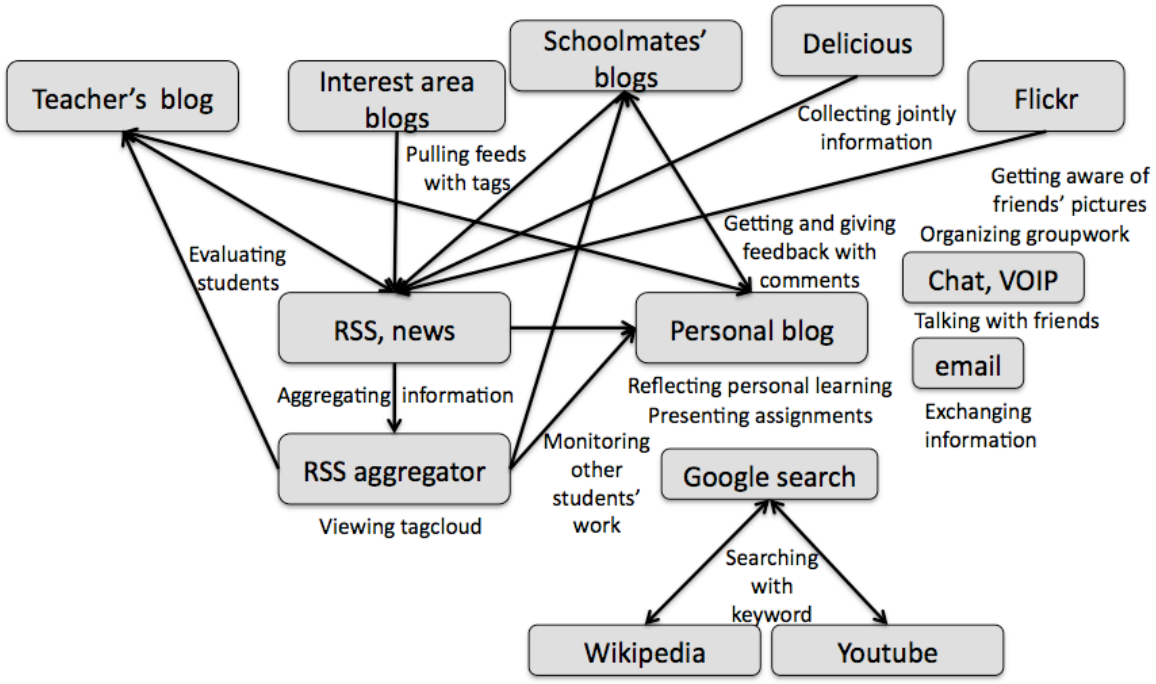

Figure 2. Personal learning environment scheme of one student

The central feedback and learning material service of the course was a blog at Wordpress.com provider, which was maintained by two facilitators. The primary function of the blog was organizing learning materials and assignments, it also served as the feedback channel between learners and facilitators. The second part of web-based distributed learning course environment was the social bookmarking service Delicious (http://delicious.com/mii7008), where facilitators collected bookmarks of the materials related to the course. The Slideshare.net tool and Splashcast were used to present slideshows, which were also embedded to learning materials at the course blog. The third central tool of the course was a shared aggregator in Pageflakes.com provider (http://www.pageflakes.com/kpata/12983138). This aggregator enabled to integrate different distributed course tools, using feed and mashup technologies. The course aggregator collected into the shared place the feeds from course weblog and learners' weblogs enabling the monitoring between learners themselves and between facilitators and learners (Väljataga, Pata & Tammets, 2008). The tagcloud feed from the course bookmarks and the mashed feed from social bookmarks accounts were pulled to the aggregator.

The students' distributed learning environments consisted of weblog, social bookmarking service and Slideshare accounts, web-based office software, wiki, instant messaging services, and aggregators. Individual weblog was a compulsory tool for each student. Using Delicious for bookmarking was required. The rest of the tools were not

optional. Some students used very actively wiki, some web-based office service, Flickr and Youtube social repositories. That kind of usage of tools and services supported personalized mediation of self-directed learning. Every learner made the choice of most suitable tools for her/him. Learners had chance to decide what is useful for them and they used only those tools, but not the services, that teacher has thought might be the most suitable. The shared learning environments of the groups were developed as part of the course assignments. In general individual weblogs, collaborative writing/drawing environments like wiki, google.docs, Vyew.com or bubble.us, and instant messaging services like Gabbly.com, MSN and Skype.com were used, but the landscapes differed from each other. The case, where learners teamed up themselves, then selected tools what they need in order to complete assignments gave them competence, how to plan the group work, select the tools, which are suitable to everyone, how to organize the communication between team members and how to divide the responsibility. In other words, the assignment developed their competencies, which are required in their professional life.

Data collection and analysis

Learners were expected to draw visual schemas of individual and collaborative learning environments and activity diagrams, write an essay, and fill in a questionnaire as assignments. Schemas of personal and shared distributed learning environments and activity diagrams were collected from learners‘ blogs. Essays and schemes from learners‘ blogs were used as research instruments in the design-based research process. In that kind of authentic settings it was important to use those data gathering instruments in order to get the ideas of learners‘ ideas and perceptions of learning affordances without intervention. Thus, the same data-collection instruments served as a natural part of learners‘ assignments supporting their competence development.

For the data analysis the visual and narrative data collected from the course was used. The students composed personal learning environments from Web 2.0 tools and described these composing learning landscape schemes. They also draw activity patterns to describe activities at their personal learning landscapes. Several of the landscape and activity pattern descriptions were composed for collaborative groups. Each figure was accompanied by narrative descriptions mentioning several learning affordances in relation with the tools the student(s) used for activities and for constructing distributed learning landscapes.

For the study two researchers analyzed from schemata and narratives, what kind of tools consisted learners‘ distributed learning environments, and what kind of tools they used for planning individual activities. It was investigated, what kind of tools were perceived useful for individual and collaborative learning. It was studied, which learning affordances the students perceived in relation to every tool in their learning environment in individual and collaborative cases. Each affordance was listed only once in relation to mentioning it with the certain tool. The differences between two researchers’ categorization were resolved after comparison and discussions.

The analysis of 63 activity- and learning landscape descriptions was conducted. From the figures and from the narratives the learning affordances were collected and categorized. The categorization scheme separated each affordance according to its belonging to individual or collaborative learning activity. The relationship of the learning affordance with the tool(s) was categorized using binary system. The main tool categories were: blog, wiki, chat tools (MSN, Skype, Gabbly), email, search engines, RSS aggregator, social bookmarking tools, forums, co-writing tools (eg. Zoho or Google Documents), co-drawing tools (eg. Vyew, Gliffy), and social repositories of Flickr and Youtube. These were selected because these tools were mostly in use by the students during the course and they also appeared at their

schemes frequently. These data reflect specifically the learning affordance perception of the students of the course (beginner users of Web 2.0 tools), and cannot be broadened to the perception of learning affordances of the active Web 2.0 users in various settings.

Analytically, conducting ANOVA, Cross tabulation, and Chi square analysis with SPSS 16.0 were used as methods to show if there was a difference in the distribution of learning affordances at individual and collaborative cases. The learning affordances were categorized into specific types representing similar affordances: assembling, managing, creating, reading, presenting, changing and adding, collaborating and communicating, sharing, exchanging, searching, filtering and mashing, collecting, storing, tagging, reflecting and argumenting, monitoring, giving tasks and supporting, asking and giving-getting feedback, and evaluating. These types were deduced from the main verbs the students tended to use in their learning affordance descriptions. Cross tabulation was performed to demonstrate learning niches. The frequency of learning affordance categories was found for each tool both in case of individual and collaborative activities. Each learning affordance e.g. searching was considered as a variable defining the niche. Niches have been defined as the collections of environmental gradients with certain ecological amplitude, where the ecological optimum marks the gradient peaks where the organisms are most abundant. In all activity/landscape descriptions the optimum for certain learning affordance category was calculated dividing the frequency of this affordance per certain tool to the total frequency of certain learning affordance category for all tools. The results were plotted on the maps with MS Excel.

Results

What characterizes the learning spaces of individual and collaborative learners who use social software at the formal higher education course?

Table 1. ANOVA analysis of the distribution of learning affordances between tools at individual and collaborative learning situation descriptions.

Tools	Activity	N	df	Mean square	F	Sig
blog	I	151	1	0.001	0.001	0.99
	C	143		0.247		
wiki	I	18	1	0.076	1.29	0.25
	C	24		0.059		
chat	I	27	1	0.285	3.20	0.07
	C	39		0.089		
bookmarks	I	49	1	0.001	0.002	0.96
	C	46		0.123		
aggregator	I	61	1	0.165	1.05	0.30
	C	68		0.156		
email	I	21	1	0.015	0.24	0.61
	C	23		0.062		
search engine	I	33	1	0.084	1.06	0.30
	C	24		0.078		
co-writing	I	30	1	0.047	0.63	0.42
	C	23		0.073		
forum	I	10	1	0.003	0.13	0.71
	C	8		0.026		
co-drawing	I	11	1	0.033	0.88	0.34
	C	15		0.038		
flickr	I	14	1	0.008	0.22	0.63
	C	11		0.036		
youtube	I	24	1	0.099	1.70	0.19
	C	17		0.058		

**p<0.001 *p<0.01 I – Individual activity C – Collaborative activity

Table 1 presents the results of ANOVA analysis demonstrating that there were no significant differences between the frequency of tool use in case of how students planned their individual and collaborative diagrams of activities and learning landscapes (see Table 1). The number of affordances, mentioned in case of the tools in individual and collaborative settings did not differ. Thus, viewing only the tool use is not distinguishing two types of activities.

Table 2. ANOVA analysis of the distribution of learning affordance types in individual and collaborative descriptions.

Affordance types	Description	N	df	Means square	F	Sig
assembling	I	41	2	0.203	1.629	0.19
	C	55		0.124		
managing	I	10	2	0.013	0.440	0.64
	C	9		0.029		
creating	I	41	2	0.152	1.613	0.20
	C	27		0.094		
reading	I	14	2	0.027	0.797	0.45
	C	9		0.033		
presenting	I	34	2	0.048	0.468	0.62
	C	41		0.103		
changing and adding	I	20	2	0.051	0.909	0.40
	C	18		0.057		
collaborating and communicating	I	34	2	1.391	10.594	0.001**
	C	73		0.131		
sharing	I	10	2	0.180	3.536	0.03
	C	25		0.051		
exchanging	I	5	2	0.010	0.521	0.59
	C	8		0.019		
searching	I	29	2	0.054	0.714	0.49
	C	26		0.076		
filtering and mashing	I	42	2	0.186	1.932	0.14
	C	30		0.096		
collecting	I	14	2	0.021	0.593	0.55
	C	10		0.035		
storing	I	21	2	0.055	1.104	0.33
	C	14		0.050		
tagging	I	19	2	0.156	4.545	0.01*
	C	5		0.034		
argumenting and reflecting	I	30	2	0.132	1.666	0.19
	C	25		0.079		
monitoring	I	11	2	0.069	1.502	0.22
	C	20		0.046		
give tasks supporting	I	24	2	0.266	2.951	0.053
	C	42		0.090		
asking giving and getting feedback	I	36	2	0.186	2.305	0.10
	C	21		0.081		
evaluating	I	12	2	0.082	1.903	0.15
	C	16		0.043		

**p<0.001 *p<0.01 I – Individual description C – Collaborative description

Next, it was investigated, if learners perceive the learning affordances of individual and collaborative activities differently. ANOVA (see Table 2) and Chi Square analysis indicated that differencies between individual and collaborative descriptions were significant for

collaborating and communicating (χ^2=2.062, df=2, p<0.001), sharing (χ^2=7.028, df=2, p=0.030) and tagging (χ^2=9.008, df=2, p=0.01) affordances. Collaborative activity niche involved significantly more affordances of 'collaborating and communicating', and 'sharing', while 'tagging' was the only specific affordance type descriptor, distinguishing the individual activity niches. Affordances of 'giving tasks and supporting' were more frequent in case of collaborative activity niches.

Comparison of the differencies of individual and collaborative activities in Table 1 and 2 enabled to assume that two distinct learning niches were found comparing the means of affordance use, but not on the basis of tool usage differences.

Which differences in the learning culture with social software do the learning spaces of individual and collaborative learners reveal?

Figure 3 demonstrates the learning niches of individual and collaborative activities, calculated on the basis of Cross-tabulation of affordances with tools. The figure shows the map of isoclines indicating the gradient of each affordance type in case of using particular set of tools. This map-like niche landscape shows the areas where certain affordances were perceived in relation with using specific social software tools. It was found that collaborative activity niche was different from the individual activity niche by the following characteristics:

Blog (eg. Wordpress, Blogger) had similar affordances in individual and collaborative learning activities eg. assembling, managing, presenting, reading, changing and adding, collaborating and communicating, storing, reflecting and argumenting, monitoring, asking and getting feedback and giving tasks, and supporting and evaluating. The exception in this pattern was the fact that in the collaborative activity niche blog was seen useful for the tagging, filtering and mashing, and collecting information.

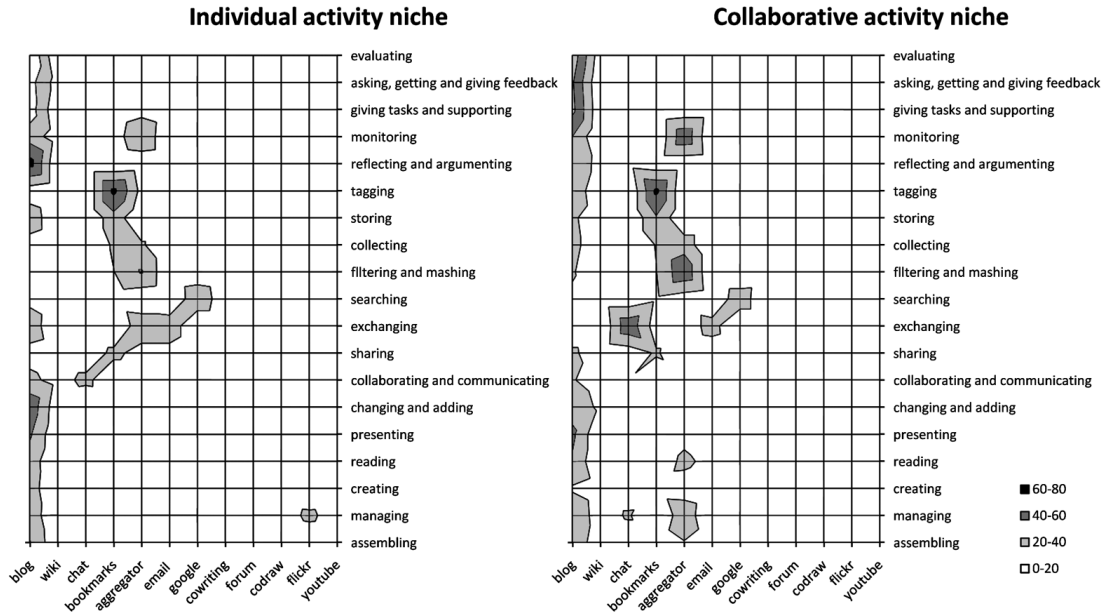

Figure 3. Niche maps for individual and collaborative activities (the importance of certain tool type among other tools in evoking some specific affordance is presented as isoclines using the scale between 0-100 %).

Wiki (eg. PBWiki, Wikispaces) was used seldom at the course, thus, wiki-related affordances do not show up on individual and collaborative niches. These students had no experience with using a wiki tool.

Chat tools (eg. MSN, Gabbly, Skype) were perceived useful for managing and exchanging in collaborative activity niche, while in individual activity niche chat was attributed the affordance of collaborating and communicating. This indicates that in the collaborative setting the need for managing the learning-related issues is a necessary part of learning culture and this socially defined need would activate the perception of this type of affordances in relation to chat tool.

Social bookmarking tool (eg. Delicious) was perceived obtaining the filtering and collecting, sharing and searching affordances in both individual and collaborative activity niches. It was supposed that students of the course did not learn to use the whole range of social bookmarking functionalities, thus affordances that indicate group use activities like collaborating, changing and adding, and exchanging were not part of collaborative activity patterns and landscapes.

The affordances of filtering and collecting and monitoring with the aggregator (eg. Netvibes) were common to both niches. Aggregator was seen useful for managing, assembling and reading in the collaborative activity niche, while in the individual activity niche it obtained also the role of sharing and exchanging. These results were unexpected and indicate that there is a certain other-directed aim in individual activities with social media. Learning from the others seems to be already part of the individual learning culture. The attribution of managing affordances to the aggregator in collaborative settings indicates that groups perceive the need to organize their learning with PLEs, assembling them with the aggregators.

Email was perceived useful of sharing and exchanging in the individual activity niche, while in the collaborative niche only the exchanging affordance remained important. Thus it is possible to assume, that students perceived some difference between these seemingly close types of affordances.

The search engines (eg. Google) had the same role of searching in both individual and collaborative activity niches. Other tools for co-drawing (whiteboard tools), co-writing (eg. Google.docs), and social repositories (eg. Flickr, Youtube) were mentioned with lower frequency, and therefore they did not appear at the maps of the individual and collaborative learning niches.

Presenting the differences of individual and collaborative activities according to the tool-use, affordance selection and niche theory we could demonstrate that the last method was most effective in revealing considerable differences between two types of activities from the learners' perspective.

Discussion

In this paper we have proposed a framework explaining the bottom-up social determination of learning niches within the knowledge ecologies using the affordances as niche gradients. In the limited space of this chapter we do not provide evidence to all elements of this framework. The empirical case demonstrates the formation of two partially overlapping niches for individual and collaborative activities using the dataset collected from the course of self-directed learning with social media.

We have analysed the students' understanding of their activity-patterns within social software environments using three different methods: comparing the frequence of mentioning certain tools, comparing the frequence of mentioning certain affordance dimensions, and plotting the affordances as niche gradients on tool landscape. Three general findings were: i)

The frequency of use of social software was not different in individual and collaborative activities. ii) The frequency of use of some affordance dimensions was different in individual and collaborative activities, but many affordances appeared with similar frequency in both activities. iii) The comparison of individual and collaborative niche landscapes demonstrated that these niches differed on the basis of niche gradients – some tools appeared to be more frequently selected compared with other tools in relation to certain affordances.

The following assumptions could be made:

i) When learning with social software people use same tools for individual and collaborative activities. The tools in personal learning environments are switched to the distributed learning environments for collaboration and vice versa, collaborative tools are used for organising individual learning. Thus, merely the tool use frequency would not distinguish the learning cultures related to individual or collaborative assignments.

ii) However, students evoked different learning affordances in relation to these tools in the individual and collaborative settings. This suggests that different objectives of individual and collaborative assignments might actualize different sets of affordances within learning ecologies. There seems to be an overlap of what types of affordances would be actualized in indvidual and collaborative learning activities with social software. We can assume that same types of affordances are in general useful nevertheless if learning at individual or collaborative settings with social software. This indicates also, that the paradigm of learning with social media is other-directed and entails various aspects of benefitting from the ideas of others‘, and sharing knowledge with other people both in individual and collaborative learning modes.

iii) The activity setting (individual or collaborative) has influence on how learners would activate certain sets of affordances in relation to certain social software. It suggests that different objectives might enable learners to actualize and integrate into their action plans different action perspectives rising from the use of the learning environment. This supports the idea that affordances are by nature emergent aspects in the learning situations.

Currently, there are few sufficient automatic ways of collecting learners‘ action relevant information when people use social software. The user modelling approaches are only appearing at the frontlines of scientific conferences and yet the meaning-based user-modelling techniques prevail (eg. using personal information and tags) (see Carmagnola, Cena & Gena, 2008). However, if action-relevant information was available for individuals and communities, it would enable to predict and control the learning niches dynamically in the course of action. Secondly, the niche visualization and exploration aspects are important if people want to use niches more effectively in the learning design. In this paper we have used a simple method of plotting the niche gradients in two-dimensional space. The affordance data were collected in the active design sessions where learners had to visualize their learning landscapes and activity patterns. For learners this activity proved to be a useful method for gaining control of their learning, yet, a lot of manual work was needed to demonstrate the niches. Thus, better tools are needed that enable to collect this learning landscape and activity pattern information from learners‘ personal learning environments or from group environments. One tool prototype for determining the learning affordances in respect to social software tools has been developed to plan the affordances and explore the niches (Väljataga, Pata, Laanpere & Kaipainen, 2007). Another interesting approach has been taken in a new type of mashup tool Mupple prototype for constructing PLEs, which enables users to collect their activity-related data in the phase of planning (Mödritscher, Wild & Sigurdarson, 2008). It is predicted that in the forthcoming years the tracing of activity-patterns in social software environments will undergo a rapid development and it would gain an equal position in the theoretical and practical solutions that support learning in social communities.

Conclusions

In this paper we have demonstrated that niche conception might add the missing link between knowledge network and knowledge ecology levels in the Connectivist framework. Data from the empirical case study indicated that exploration of learning niches might give useful information for evaluating learners' perspectives to certain learning approaches. Accordingly, the niche monitoring and evaluation can be used in planning and facilitating learning and the community identity formation according to the ecological principles.

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